Wireless Communications and Mobile Computing

Artificial Intelligence Applications in Mobile Virtual Reality Technology 2022

Lead Guest Editor: Balakrishnan Nagaraj
Guest Editors: Raffaele Mascella

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Retraction

Retracted: Numerical Simulation and Optimization Control of Precious Metal Jewelry Process Based on VR Virtual Technology

Wireless Communications and Mobile Computing

Received 28 November 2023; Accepted 28 November 2023; Published 29 November 2023

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[1] L. Li, "Numerical Simulation and Optimization Control of Precious Metal Jewelry Process Based on VR Virtual Technology," *Wireless Communications and Mobile Computing*, vol. 2022, Article ID 8723282, 7 pages, 2022.

Hindawi
Wireless Communications and Mobile Computing
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Retraction

Retracted: Robot Structural Optimization Based on Computer Intelligent Image

Wireless Communications and Mobile Computing

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[1] J. Zhao, "Robot Structural Optimization Based on Computer Intelligent Image," *Wireless Communications and Mobile Computing*, vol. 2022, Article ID 3328986, 6 pages, 2022.

Hindawi
Wireless Communications and Mobile Computing
Volume 2023, Article ID 9804762, 1 page
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Retraction

Retracted: Interactive Clothing Optimization Design Model Based on 3D Printing

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[1] Y. Sun, "Interactive Clothing Optimization Design Model Based on 3D Printing," *Wireless Communications and Mobile Computing*, vol. 2023, Article ID 1319959, 8 pages, 2023.

Hindawi
Wireless Communications and Mobile Computing
Volume 2023, Article ID 9839786, 1 page
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WILEY | Hindawi

Retraction

Retracted: Integrated Development of Smart City Tourism and Cultural and Creative Industries Based on Internet of Things

Wireless Communications and Mobile Computing

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[1] S. Liu, "Integrated Development of Smart City Tourism and Cultural and Creative Industries Based on Internet of Things," *Wireless Communications and Mobile Computing*, vol. 2022, Article ID 8669570, 8 pages, 2022.

Hindawi
Wireless Communications and Mobile Computing
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Retraction

Retracted: Application of Data Mining Model in Smart Chemistry Education

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[1] S. Fei, "Application of Data Mining Model in Smart Chemistry Education," *Wireless Communications and Mobile Computing*, vol. 2022, Article ID 2506565, 6 pages, 2022.

Hindawi
Wireless Communications and Mobile Computing
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Retraction

Retracted: Laboratory Virtualization Management Based on Deep Integration of Cloud Desktop

Wireless Communications and Mobile Computing

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[1] Y. Liu, S. Duan, and B. Wang, "Laboratory Virtualization Management Based on Deep Integration of Cloud Desktop," *Wireless Communications and Mobile Computing*, vol. 2022, Article ID 4487023, 7 pages, 2022.

Hindawi
Wireless Communications and Mobile Computing
Volume 2023, Article ID 9863504, 1 page
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Retracted: Application of Virtual Reality Technology in Teaching and Training System of Processing Industrial Robot

Wireless Communications and Mobile Computing

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[1] Q. Chen, "Application of Virtual Reality Technology in Teaching and Training System of Processing Industrial Robot," *Wireless Communications and Mobile Computing*, vol. 2022, Article ID 3415660, 8 pages, 2022.

Hindawi
Wireless Communications and Mobile Computing
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Retraction

Retracted: Commodity Information Collection and System Construction of e-Commerce Platform Based on Network Data

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References

[1] M. Qi, "Commodity Information Collection and System Construction of e-Commerce Platform Based on Network Data," *Wireless Communications and Mobile Computing*, vol. 2022, Article ID 1359374, 8 pages, 2022.

Hindawi
Wireless Communications and Mobile Computing
Volume 2023, Article ID 9873746, 1 page
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Retraction

Retracted: Three-Dimensional Simulation Garden Landscape Design Method Based on Virtual Simulation Technology

Wireless Communications and Mobile Computing

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[1] S. Chen and X. Wang, "Three-Dimensional Simulation Garden Landscape Design Method Based on Virtual Simulation Technology," *Wireless Communications and Mobile Computing*, vol. 2022, Article ID 4804256, 7 pages, 2022.

Hindawi
Wireless Communications and Mobile Computing
Volume 2023, Article ID 9873156, 1 page
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Retraction

Retracted: Research on Machine Learning Algorithm for Internet of Things Information Security Management System Research and Implementation

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[1] W. Jiang, "Research on Machine Learning Algorithm for Internet of Things Information Security Management System Research and Implementation," *Wireless Communications and Mobile Computing*, vol. 2022, Article ID 8933468, 6 pages, 2022.

Hindawi
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Retraction

Retracted: Data Mining Technology for Agricultural Equipment Machinery and Information Network Data Resources

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References

[1] Z. Fan, N. Zhang, X. Zhang, D. Wang, and G. Wu, "Data Mining Technology for Agricultural Equipment Machinery and Information Network Data Resources," *Wireless Communications and Mobile Computing*, vol. 2022, Article ID 3899618, 8 pages, 2022.

Hindawi
Wireless Communications and Mobile Computing
Volume 2023, Article ID 9869173, 1 page
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Retraction

Retracted: Open Sharing Management of Artificial Intelligence Laboratory Based on Deep Fusion of Big Data

Wireless Communications and Mobile Computing

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[1] C. Liang, "Open Sharing Management of Artificial Intelligence Laboratory Based on Deep Fusion of Big Data," *Wireless Communications and Mobile Computing*, vol. 2022, Article ID 6509356, 7 pages, 2022.

Hindawi
Wireless Communications and Mobile Computing
Volume 2023, Article ID 9862426, 1 page
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Retraction

Retracted: Research on Information Retrieval Effectiveness of University Scientific Researchers Based on Mental Model

Wireless Communications and Mobile Computing

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[1] Y. Zhang, Yiyang, and J. Yang, "Research on Information Retrieval Effectiveness of University Scientific Researchers Based on Mental Model," *Wireless Communications and Mobile Computing*, vol. 2022, Article ID 5852946, 7 pages, 2022.

Hindawi
Wireless Communications and Mobile Computing
Volume 2023, Article ID 9861090, 1 page
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Retraction

Retracted: Application of Data Mining Technology in Software Intrusion Detection and Information Processing

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Hindawi
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Retraction

Retracted: Research on Online Virtual Energy-Saving and Environment-Friendly Building Design and Implementation Based on VRML

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Retraction

Retracted: 5G Edge Computing Access Node Selection Algorithm Based on Energy Efficiency and Delay

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Hindawi
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Retraction

Retracted: Key Point Detection Method of 3D Network Model Based on Virtual Reality Technology

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Hindawi
Wireless Communications and Mobile Computing
Volume 2023, Article ID 9837408, 1 page
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Retraction

Retracted: Electronic Communication Fault Signal Recognition Based on Data Mining Algorithm

Wireless Communications and Mobile Computing

Received 18 July 2023; Accepted 18 July 2023; Published 19 July 2023

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Hindawi
Wireless Communications and Mobile Computing
Volume 2023, Article ID 9831597, 1 page
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Retraction

Retracted: Census and Inventory Method of Pollution Sources Based on Big Data Technology under Machine Learning

Wireless Communications and Mobile Computing

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[1] N. Liu, X. Sun, J. Mi, and S. Zhang, "Census and Inventory Method of Pollution Sources Based on Big Data Technology under Machine Learning," *Wireless Communications and Mobile Computing*, vol. 2022, Article ID 3706065, 7 pages, 2022.

Hindawi
Wireless Communications and Mobile Computing
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Retraction

Retracted: Application Research of Data Encryption Algorithm in Computer Security Management

Wireless Communications and Mobile Computing

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Hindawi
Wireless Communications and Mobile Computing
Volume 2023, Article ID 9827890, 1 page
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Retraction

Retracted: Recognition of English Vocabulary and Speech Corpus Based on Computer Image Processing

Wireless Communications and Mobile Computing

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Hindawi
Wireless Communications and Mobile Computing
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Retraction

Retracted: Application of BIM Technology in Data Collection of Large-Scale Engineering Intelligent Construction

Wireless Communications and Mobile Computing

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Hindawi
Wireless Communications and Mobile Computing
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Retraction

Retracted: Research on Optimization Strategy of Task Scheduling Software Based on Genetic Algorithm in Cloud Computing Environment

Wireless Communications and Mobile Computing

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Hindawi
Wireless Communications and Mobile Computing
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Retraction

Retracted: Development and Application of Sales System Software Based on Computer Network

Wireless Communications and Mobile Computing

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Hindawi
Wireless Communications and Mobile Computing
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Retraction

Retracted: Indifference Computer Experiment for Mathematical Identification of Two Variables

Wireless Communications and Mobile Computing

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Hindawi
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WILEY | Hindawi

Retraction

Retracted: Design and Implementation of Office Automation System Based on Internet of Things Technology

Wireless Communications and Mobile Computing

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Hindawi
Wireless Communications and Mobile Computing
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Retraction

Retracted: Application of Information Encryption Technology in Computer Network Communication Security

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Wireless Communications and Mobile Computing
Volume 2023, Article ID 9812913, 1 page
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Retraction

Retracted: Control Optimization of Scenic Spot Navigation System Based on Map Matching Algorithm

Wireless Communications and Mobile Computing

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Hindawi
Wireless Communications and Mobile Computing
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Retraction

Retracted: Heterogeneous Cluster Application Communication Optimization and Computer Big Data Management

Wireless Communications and Mobile Computing

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Hindawi
Wireless Communications and Mobile Computing
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Retraction

Retracted: Building a Space Model Method Based on the Big Data Map Visual Design

Wireless Communications and Mobile Computing

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Hindawi
Wireless Communications and Mobile Computing
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Retraction

Retracted: Application of Automatic Motor Control System Based on Sensor Technology

Wireless Communications and Mobile Computing

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Hindawi
Wireless Communications and Mobile Computing
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Retraction

Retracted: Integrated Wiring System of Intelligent Building Based on Internet of Things

Wireless Communications and Mobile Computing

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Hindawi
Wireless Communications and Mobile Computing
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Retraction

Retracted: Dynamic Synchronization Modeling and Simulation of Video Sensing Nodes Based on Internet of Things

Wireless Communications and Mobile Computing

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Hindawi
Wireless Communications and Mobile Computing
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Retraction

Retracted: Application of Intelligent Recognition Technology in Recognition of Mechanical Material Structure

Wireless Communications and Mobile Computing

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Hindawi
Wireless Communications and Mobile Computing
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Retraction

Retracted: International Logistics Management System Based on Cloud Computing Technology

Wireless Communications and Mobile Computing

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Hindawi
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Retraction

Retracted: Optimization of Plane Image Color Enhancement Based on Computer Vision

Wireless Communications and Mobile Computing

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Retraction

Retracted: Application of Road Extraction from High-Resolution Remote Sensing Images in Tourism Navigation and GIS

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Retraction

Retracted: Multimedia Image Data Compression Based on Wavelet Analysis

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Retraction

Retracted: Application of 3D Virtual Scanning Technology in Landscape Planning of Complex Landscape Gardens

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Retraction

Retracted: Application of Computer Technology in VR Digital Media

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Retraction

Retracted: Multilingual Machine Translation System Based on Decoder Recurrent Neural Network

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Retraction

Retracted: Interactive Clothing Optimization Design Model Based on 3D Printing

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Research Article

Interactive Clothing Optimization Design Model Based on 3D Printing

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In order to solve the problem of improving the matching degree between the designed clothing and the user's body shape, the author proposes an interactive clothing optimization design model based on 3D printing. The user logs in to the system through the user layer, and the display layer uses 3D scanning technology to scan the human head, torso, and other information to collect human body data, and project the collected human body data to obtain the human body outline, select the human body contour line obtained by the denoising process of the interpolation algorithm, extract the feature points of the human body contour line after the denoising process through the corner point detection method, and use the final feature points to obtain the final contour line, the 3D human body data file is generated and sent to the interface layer, the interface layer designs clothing through style design, adding colors and patterns, and uses the global optimization method to adaptively adjust the clothing pieces to achieve clothing design, fit the designed clothing through the virtual fitting module until it meets the user's needs. Experimental results show that: The system collects user size with an accuracy of higher than 99.5%, and the number of iterations for adaptive adjustment of human body size is less than 30 times. Conclusion: The designed clothing virtual design system can effectively make up for the blank of clothing e-commerce, with high innovation and high practicability.

1. Introduction

In the 1990s, 3D printing technology appeared in the United States, arousing great interest, and has developed rapidly in recent years. 3D printing technology can turn blueprints on computers into real objects, and has been applied in the medical industry, industrial design, engineering construction, aerospace, clothing, footwear, education, archaeology, and other fields, bringing convenience to human life. As a rapid prototyping manufacturing method, it was once believed that 3D printing technology would promote the third industrial revolution [1, 2]. Nowadays, clothing is not only limited to covering the body, but also has a very important position in the textile industry. With the development and application of 3D printing materials and technologies, the apparel field is actively exploring the application of 3D printing technology and product development [3].

3D printers are similar in principle to traditional printers but have some differences [4]. The consumables of traditional printers are mainly paper and ink, the ink ejected during printing is presented on the surface of the paper as a two-dimensional image, 3D printing is to create a three-dimensional model diagram on the computer through Solidworks, SKetchUP, 3DMax, and other software according to people's needs, when printing, the drawn model is inputted into the 3D printer in Stl format, and set the printing parameters such as printing speed and layer thickness according to the actual needs, the printer will automatically layer the constructed 3D model and convert it into several layers of separate sheets, during the printing process, the layers are stacked and printed. Materials to construct entities [5]. 3D printing is subdivided into more than a dozen technologies due to the different types of raw materials used and accumulation methods, among which there are mainly 5 more mature technologies, as shown in Table 1.

The application of 3D printing to the entire process of clothing design makes the conception of the clothing and the final shape consistent, each link is completed by numerical control and data is shared, and any shape and structure are automatically connected to the previous layer through

Table 1: 5 common 3D printing methods.

Method name	Lamination method	Definition
Stereolithography (SLA)	Photopolymerization	A UV laser is projected into a water tank containing a liquid photocurable resin, allowing it to cure to form the manufactured entity
Laminated solid manufacturing method (L0M)	Laminated	Cut plastic, metal, and other thin-layer sheets according to the shape of the model, and obtain the real object by lamination
Selective laser sintering (SLS)	Particle sintering	Repeated irradiation and sintering of powders or granules applied on a machine tool to form 3D printed bodies
Fused precipitation method (FDM)	Extrusion	The filament-like thermoplastic material is melted in the printer and output from the nozzle, allowing it to accumulate to form a solid
3D inkjet printing (3DP)	Injection	A lamination method for jetting color inks and liquid solidified substances from nozzles onto raw powders

the cross-section of each layer that changes layer by layer to create a three-dimensional form [6, 7]. At present, the types of 3D printing technology are mainly divided into six categories: Extrusion, linear, granular, powder layer nozzle, lamination, and photopolymerization, among them, extrusion technology is used to extrude and print thermoplastic plastics, edible materials, etc. layer by layer. Generally, any alloy can be used for linear technology. Granular technology mainly uses powder printing such as metal and ceramics. Powder layer nozzle is gypsum 3D printing, and its printing material is only gypsum. The printing materials of lamination technology include paper, metal film, plastic film, etc. The printing material of photopolymerization technology is light-hardening resin, which hardens the liquid material layer by layer through the control of light, so that it can be pasted and formed. For products realized by 3D printing technology, it is necessary to model the product structure in 3D, and then use layering technology to slice the model, after scanning the data of each slice, it can accurately control the working mode of various types of 3D printers, all operate on the basic principle of layer-by-layer printing and then bonding. At present, the most advanced 3D printing technology in the world is CLIP (Continuous Liquid Interface Production) technology. Its technology uses the principle that light in polymer chemistry can convert liquids into solids, and oxygen inhibits the process to control the continuous molding of 3D printing. Usually, the production link is monopolized by the enterprise. In the traditional design process, the enterprise and the designer are basically leading the design and development of the product. The personalized customization platform based on 3D printing is a social design platform that uses 3D printing as a manufacturing method and provides personalized customization services based on user needs. Using the Internet to connect users in all links of the industry chain, link design providers and design demanders, break through the essential defects of traditional design work, break the difficulty of modifying finished products and the fixed and limited designer's sex. For the participants, any individual from all over the world can become a designer, and they can propose their own ideas and designs, or make suggestions for revision and improvement to the designers who serve them. Such platforms involve more types of users and are accompanied by more complex activities. The interaction design is guided by user goals, and the user behavior in the platform is studied. The users of the platform are defined, and the typical user goals and needs are summarized by combining qualitative and quantitative user research methods. Some samples of existing products in the market are extracted for usability testing and comparative research, the problem domain of existing products is proposed, and the difference between the realization model and the user's mental model in the design of 3D printing personalized customization platform is analyzed based on specific user tasks. On this basis, the general framework and characteristic framework of the 3D printing personalized customization platform are distinguished, and the composition of the characteristic framework is analyzed, mainly including the interactive framework of uploading customization, purchasing, and printing.

2. Literature Review

With the rapid development of modern industrialization, consumers pay more and more attention to the individualization, diversification, and fashion of clothing, and high-quality, low-cost clothing design has become the main design method pursued by people [3, 8]. Consumers can participate in the whole process of clothing design through an efficient clothing design system, and provide opinions in a timely manner, the design system formulates design plans according to consumers' needs, eliminating conflicts between consumers and designers due to individual needs [9, 10].

Traditional clothing design showcases the designer's design ideas through pen and paper. The application of computer technology to clothing design has gradually become popular, and designing clothing through computer has become an important way in the field of clothing design [11]. Internet technology and virtual reality technology with interactive characteristics are applied in the field of clothing design, which promotes the further development of clothing design system [12, 13]. Three-dimensional interactive technology can improve the function of clothing design system, making the clothing design system more powerful. The rapid development of e-commerce promotes the progress of clothing virtual design system, e-commerce can use the clothing virtual design system to realize the remote clothing customization of consumers and meet consumer demand.

In recent years, many researchers have carried out a lot of research on the fashion design system. Mondal, B. et al. studied a 3D interactive clothing design system based on the Flex platform, and used the Flex platform to establish a 3D interactive clothing design system, and realize the three-dimensional interaction between designers and consumers, but there is a big difference between the designed clothing and consumer demand, and the design effect is poor [14]. Tadeja, S. K. et al. studied the clothing design system based on virtual reality technology, and applied virtual reality technology to the clothing design system, which has high interactive performance and can meet the needs of consumer design, but has the defect of poor real-time performance [15]. In order to improve the results of interactive clothing virtual design, the author designs an interactive clothing virtual design system based on the Internet platform, using the Internet platform to design an interactive clothing virtual design system, real-time interaction between consumers and designers is realized, and clothing design is realized through the interactive clothing virtual design system, so that consumers can realize remote customization of clothing [16].

3. Methods

3.1. Interactive Clothing Virtual Design System Based on Internet Platform

3.1.1. The Overall Structure of the System. Fully considering the requirements of the interactive clothing virtual design system, the overall structure of the interactive clothing virtual design system for designing the Internet platform is shown in Figure 1. It can be seen from the overall structure diagram of the system in Figure 1 that the system is divided into four parts: User layer, display layer, interface layer, and data layer, each part cooperates with each other to realize the whole process of interactive clothing virtual design [17, 18]. Users can use mobile phones, computers, tablets, and many other front-end interfaces to enter the system through the user layer, and display the various functions of the virtual clothing design of the system to the user through the display layer, collect the relevant data of the user's clothing virtual design through the display layer, and send the relevant data to the interface layer, after the interface layer receives the user's requirements, realize the corresponding functional processing of clothing virtual design, the system uses the data layer to provide data support, and realizes the management and storage of data related to clothing virtual design.

3.1.2. System Deployment Based on Internet Platform. The system is deployed on the Internet platform, and the system deployment structure diagram mainly includes WeX5 development tools, cloud server and user interface [19]. The data related to clothing design is formed through the user interface, and the relevant request is transmitted to the server, after the server receives the user request, it is sent to the cloud server through internal deployment and structural integration processing, after the cloud server processes the data through the clothing design-related data processing method, it is sent back to the mobile terminal and the web terminal, realize the interaction between background data and users, store and read data separately in different parts, and realize services related to clothing virtual design.

The system is deployed with WeX5 development tool, which contains many open component frameworks, and can customize and integrate many components. WeX5 development tools use the MVC design pattern to separate data and views, separating code logic and page description, it can realize the joint effect of different modes of real machine, browser, and native debugging, and developers can use code to improve system development efficiency. WeX5 development tool supports many back-end development languages, has high convenience and speed, and is a relatively front-end development tool.

WeX5 development tools can support many front-ends such as PC browsers, mobile APPs, WeChat, and other light applications, it is a relatively leading development tool in Internet technology. The WeX5 development framework supports visual design, has high debugging capabilities, has a rich component system, supports device access, and has high scalability.

3.1.3. System Functional Structure. The functional structure diagram of the interactive clothing virtual design system of the Internet platform is shown in Figure 2. It can be seen from the system function structure diagram that the system is divided into four parts: Template style selection, clothing design, 3D virtual fitting, and style generation and processing. The system determines the front and side clothing styles according to the template style selected by the user, generates a processing template, adds patterns and colors to the generated processing template, and generates a parametric Figure. The generated parametric pictures are used for fitting through the virtual fitting module, which improves the interactive performance, saves the final product that the user is satisfied with, and sends the relevant production parameters to the production department for processing. Apply high-end 3D virtual shopping special effects to the 3D virtual fitting module, improve user interaction performance through user sensory experience. The 3D virtual fitting module is designed by using the Web/HTML5 version, which is cross-platform and cross-device terminal, only a browser that supports the WebGL specification is required, and the module can be run without installing plug-ins. The 3D virtual fitting can realize interactive rotation, translation, and zooming, and the parameters of the model can be modified to match the user's body shape, and functions such as spotlight effect, lighting color, and whether to rotate or not can be selected.

3.1.4. 3D Human Body Data Collection. The clothing virtual design system uses the collected human body data as the design basis, uses 3D scanning technology to scan the human head, torso, and other information, the system preprocesses the collected data, and uses the preprocessed data to provide clothing design prototypes. The collected three-dimensional human body data is analyzed, and the collected human body data is projected and processed to obtain the human body contour, an interpolation algorithm is selected to perform denoising processing on the obtained human body contours to remove the noise around the human body

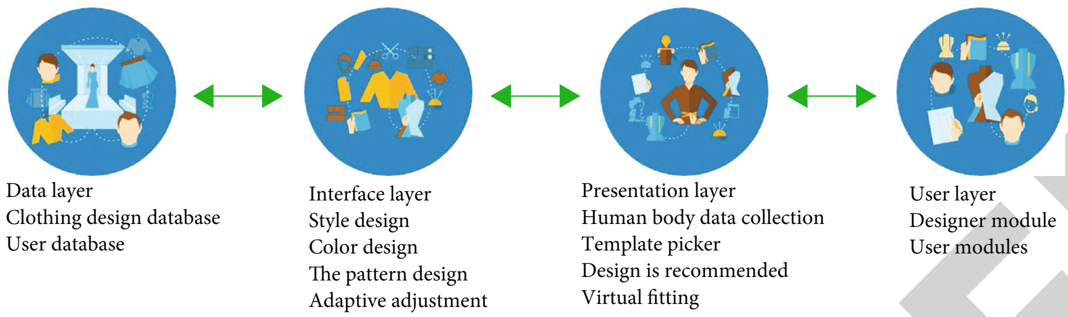

Figure 1: Overall structure of the system.

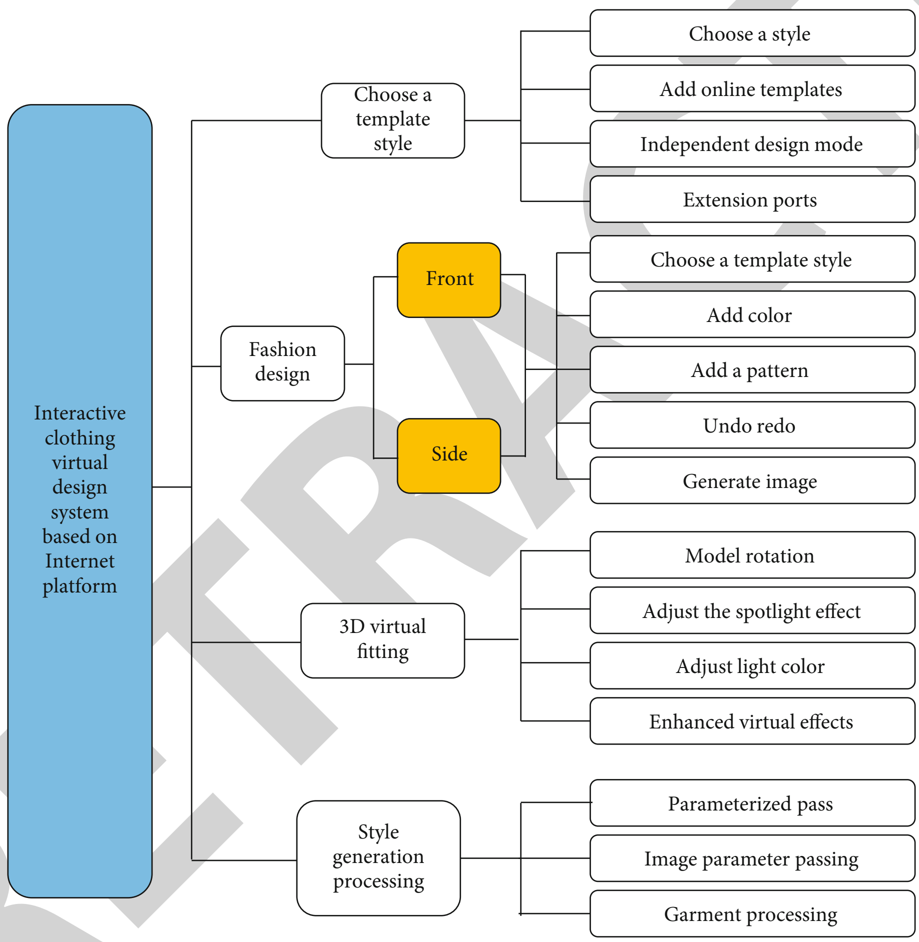

Figure 2: System function structure diagram.

contours. The Lagrangian interpolation algorithm is used to denoise the human body contour, the algorithm has the advantages of high precision and simple structure, the Lagrangian interpolation algorithm realizes data preprocessing through quadratic interpolation polynomial, the processing formula is as follows:

$$Q(x_i) = y_i, \tag{1}$$

$$Q(x_i) = y_{k-j}h_{k-j}(x) + y_k h_k(x) + y_{k+j}h_{k+j}(x), \tag{2}$$

where: $i = k - j, k, k + j$; x_i and y_i represent the independent variable and the value of the function at point i, respectively; h represents the interpolation basis function.

The two-dimensional contour point noise reduction processing is realized by using the Formulas (1) and (2). Extract the preprocessed human body contour feature points through the corner detection method, and obtain the curvature of all points on different curves according to the extracted human contour line feature points, the larger curvature is selected as the feature point of the final body contour, the dividing point is added to it to classify and decompose the body contour, and the contour line of the body contour is obtained to cross the line, so that the obtained contour line conforms to the vertical dimension of the clothing. When the extracted contour line

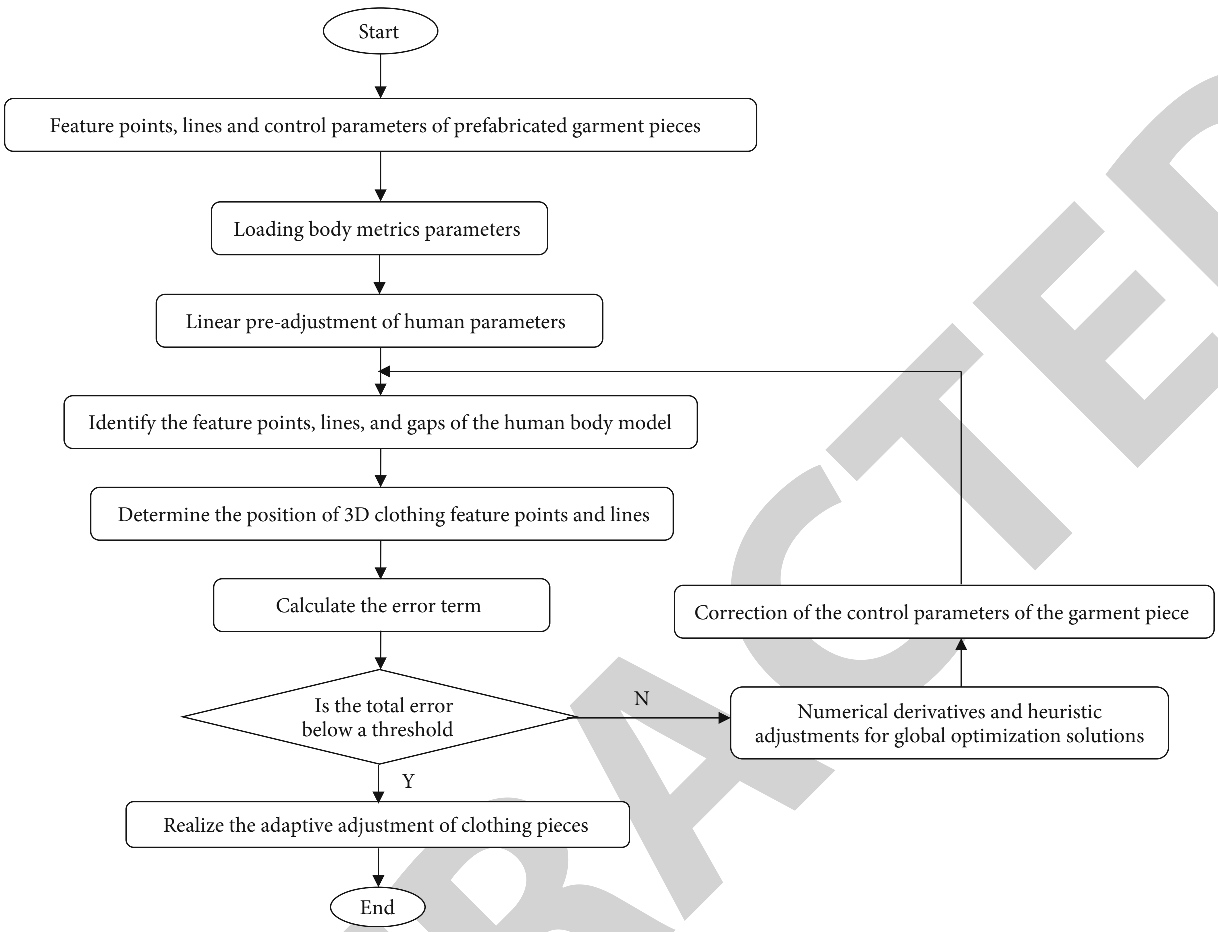

Figure 3: Adaptive adjustment process of garment pieces.

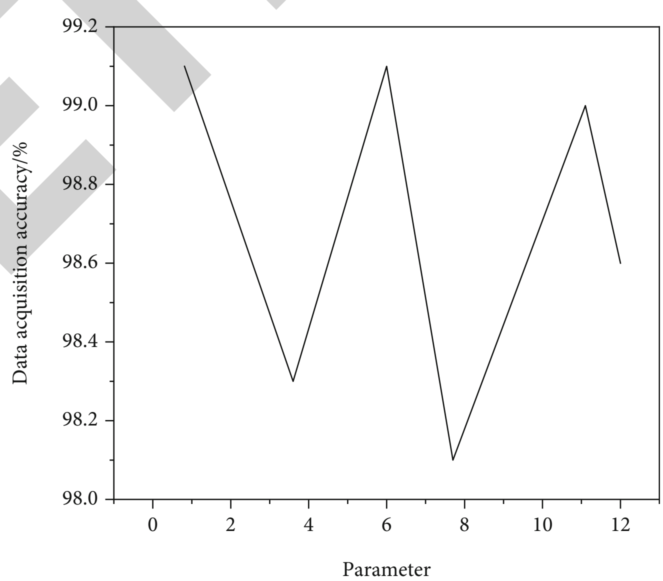

Figure 4: Comparison of size acquisition accuracy.

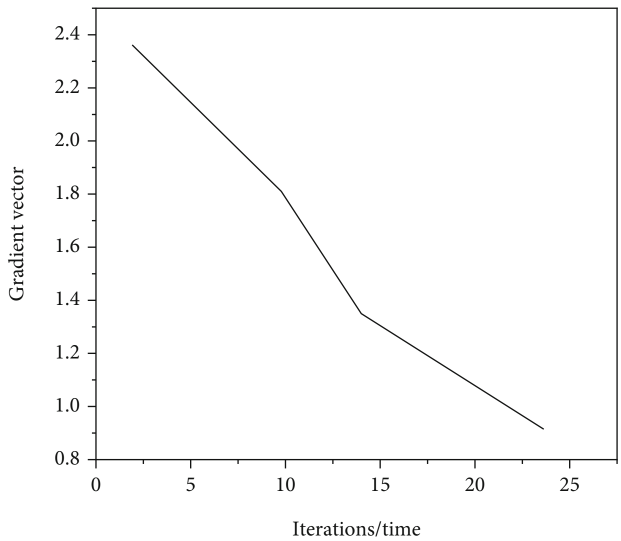

Figure 5: Gradient vector under different iterations.

does not meet the designer's requirements, adjust the contour line by deleting and adding feature points. The three-dimensional human body data file is generated according to the obtained final contour line, and the virtual design of human body clothing is realized according to the data file.

3.1.5. Adaptive Adjustment of Clothing Pieces. Figure 3 shows the adaptive adjustment process of clothing pieces in the process of clothing virtual design.

The global optimization method is used to realize the adaptive adjustment of garment parts in the process of garment virtual design. In the previous clothing design process, the adjustment of the corresponding clothing pieces needs to be adjusted sequentially through the designer's clothing design experience, and the adjusted items can only be applied to the clothing piece points, and the local and global optimization extremum of the objective function cannot be achieved. The mathematical formula is solved by the gradient descent method, realize automatic global optimization of all control parameters of the garment piece. When the derivative and partial derivative cannot be calculated or the calculation is too complicated, numerical derivatives are a common way to find derivatives. The vector $x = (x_1, x_2, \cdots, x_n)$ is used to represent all the adjustable parameter variables of the clothing piece in the process of clothing design, and the one-dimensional variable modified by a random piece of clothing is represented by $x_i (i = 1, 2, \cdots, n)$, this variable is the one-dimensional displacement of the control point, and the partial derivative x_i can be calculated using the total error term σ_{Total}, the formula is as follows:

$$\frac{\partial \sigma_{\text{Total}}}{\partial x_i} = \lim_{\varphi \longrightarrow 0} \frac{\sigma_{\text{Total}}(x_1, \cdots, x_i + \varphi, \cdots) - \sigma_{\text{Total}}(x_1, \cdots, x_i, \cdots)}{\varphi}. \quad (3)$$

In the formula: φ represents the independent variable derivative of the numerical gradient.

The partial derivative of Formula (3) can be approximated by the numerical derivative when φ is sufficiently small, the formula is as follows:

$$\frac{\partial \sigma_{\text{Total}}}{\partial x_i} = \frac{\sigma_{\text{Total}}(x_1, \cdots, x_i + \varphi, \cdots) - \sigma_{\text{Total}}(x_1, \cdots, x_i, \cdots)}{\varphi}. \quad (4)$$

After calculating the numerical partial derivatives of the different dimensions of the vector x, the formula for obtaining and calculating the parameters of the primary clothing piece is as follows:

$$\boldsymbol{x}^{r+1} = \boldsymbol{x}^{r} - \lambda \frac{\partial \boldsymbol{\sigma}_{\text{Total}}}{\partial \boldsymbol{x}} \bigg|_{x = x^r}. \quad (5)$$

In the formula, λ represents the step size, and r represents the dimension.

The step size is determined by linear search and fixed value, and the global error term of each garment piece is stably reduced by obtaining the optimal step size.

4. Results and Analysis

4.1. Performance Test Experiment of Interactive Clothing Virtual Design System

4.1.1. Subject-Related Settings. In order to test the effectiveness of the interactive clothing virtual design system based on the Internet platform studied in this paper, an e-commerce user who is to buy clothing is selected as the experimental object to evaluate the effectiveness of the virtual clothing design system of the system. The height of the user is 159.5 cm; the cervical spine point is 135 cm; the back length is 38 cm; the neck circumference and bust circumference are 37.5 cm and 85 cm, respectively; the waist circumference and hip circumference are 65 cm and 91 cm, respectively; the width and back width are 41 cm and 34 cm, respectively; the wrist circumference is 15 cm, and the chest width is 32.5 cm. The user's requirement is to design two different styles of summer dresses, the colors of which are red and blue.

Statistics adopt the system to collect the data accuracy of various parameters of the human body for the user's virtual design of clothing, and compare the system with the 3D interactive clothing design system based on the Flex platform and the clothing design system based on virtual reality technology, the comparison results are shown in Figure 4.

From the experimental results in Figure 4, it can be seen that, the size of each parameter collected by the system has high accuracy, and the size accuracy of each parameter collected by the system is above 99.5%. The 3D interactive clothing design system based on the Flex platform and the clothing design system based on virtual reality technology collect various parameters of the user and the dimensional accuracy is between 97.5% and 99.5%, the dimensional accuracy of various parameters collected by the system is significantly higher than that of the other two systems. The accurate performance of data collection provides an effective data basis for the matching of clothing design, and the

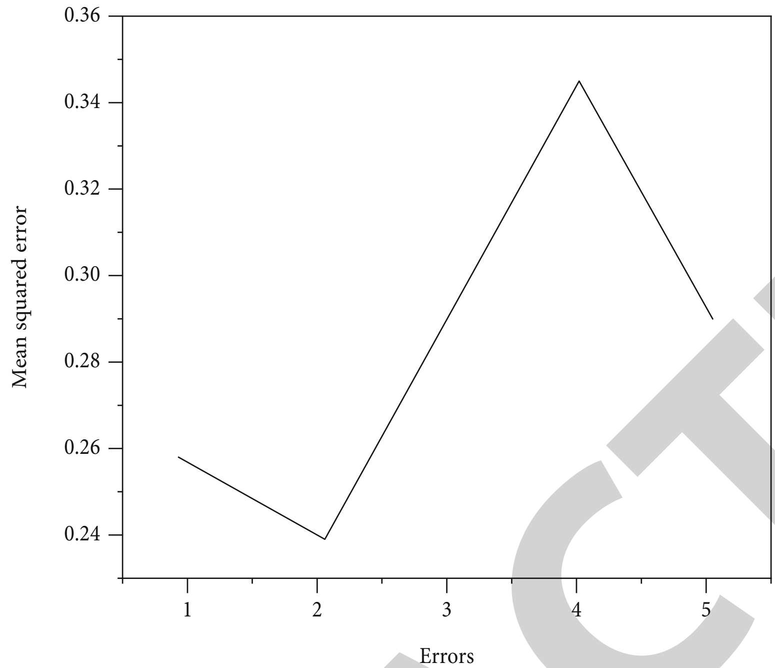

Figure 6: Comparison of mean square errors of different systems.

system data collection accuracy is high, providing a data basis for the system to accurately design clothing.

The system design clothing has a high degree of fit, and the color and style can meet the needs of users. The system uses the precise size of the user's body parameters as the clothing design data to tailor the clothing for the user, fully considering the user's body shape, the designed clothing has a high degree of matching with the user's body shape, which improves user satisfaction. Count the number of iterations required in the size adjustment process using different systems to design clothing.

Using the system to design the clothing required by the user, the number of iterations required to adjust the size of various parameters of the human body is significantly lower than the other two systems, the system only needs less than 30 iterations to realize the self-adaptive adjustment of various parameters of the human body, which has high self-adaptive adjustment effectiveness. Statistics use three systems to adaptively adjust the gradient vector of each design parameter with different iteration times, when the gradient vector is close to 0, it indicates that the clothing and the user are in a stable matching state, the statistical results are shown in Figure 5.

From the experimental results in Figure 5, it can be seen that, when the number of iterations is 2, the gradient vector of the system in this paper is close to 1.0, indicating that the matching degree of multiple feature lines and perimeters is low, and the feature points of different parts do not match the feature lines. As the number of iterations increases, the system reduces the error by adjusting the feature points. Until the number of iterations is 24, the gradient vector result tends to 0, it shows that after 24 iterations of the system, most of the feature points, lines, and gaps can meet the 3D clothing dressing effect, and the optimization target value within the convergence threshold can be achieved, which has a high design effect.

Calculate the mean square error after adjustment of each error item in the clothing design process of different systems, and the statistical results are shown in Figure 6.

From the experimental results in Figure 6, it can be seen that, using the system to adjust the mean square error of each error item is less than 0.1, indicating that the system can effectively adjust the errors of the left and right points of the neck, the left and right points of the shoulder, the chest feature line, the hip feature line, and the waist gap, after adjustment, it has a low mean square error, which verifies that the system has high adjustment effectiveness.

5. Conclusion

The existing 3D printers tend to be functional, and cannot well adapt to the current rich usage scenarios and diverse user needs. Therefore, the human-computer interaction system of 3D printers needs to be improved. In this study, users log in to the system through the user layer, and the display layer uses 3D scanning technology. Scans the human head, torso, and other information to collect human body data, projects the collected human body data to obtain human body contour lines, selects the interpolation algorithm to denoise the obtained human body contour lines, and extracts the denoised human body through the corner detection method. Contour feature points, use the final feature points to obtain the final contour line, generate a 3D human body data file, and send it to the interface layer. The interface layer designs clothing through style design, adding colors and patterns, and uses the global optimization method to adaptively adjust the clothing pieces to achieve clothing design., and try the designed clothing through the virtual

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Retraction

Retracted: Robot Structural Optimization Based on Computer Intelligent Image

Wireless Communications and Mobile Computing

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This article has been retracted by Hindawi, as publisher, following an investigation undertaken by the publisher [1]. This investigation has uncovered evidence of systematic manipulation of the publication and peer-review process. We cannot, therefore, vouch for the reliability or integrity of this article.

Please note that this notice is intended solely to alert readers that the peer-review process of this article has been compromised.

Wiley and Hindawi regret that the usual quality checks did not identify these issues before publication and have since put additional measures in place to safeguard research integrity.

We wish to credit our Research Integrity and Research Publishing teams and anonymous and named external researchers and research integrity experts for contributing to this investigation.

The corresponding author, as the representative of all authors, has been given the opportunity to register their agreement or disagreement to this retraction. We have kept a record of any response received.

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[1] J. Zhao, "Robot Structural Optimization Based on Computer Intelligent Image," *Wireless Communications and Mobile Computing*, vol. 2022, Article ID 3328986, 6 pages, 2022.

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Research Article

Robot Structural Optimization Based on Computer Intelligent Image

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In order to solve the problems of low degree of automation, difficult identification of picking objects, and large picking damage in traditional fruit and vegetable picking operations, the author proposes a robot structure optimization method based on computer intelligent images. This method introduces the computer imaging technology, examines the principle of imaging the computer imaging technology as the in-depth study of the computer imaging technology, completes the mechanical design of the selected robot, and optimizes all hardware models of choice robot. At the same time, the computer image acquisition system, image acquisition module, and execution module are designed; finally, the computer image information processing flow design of the picking robot is completed, and the simulation experiment of the picking robot is carried out. Experimental results show that in the experiments with 166, 142, and 165 tomato identification numbers, the identification accuracy rates were all over 96%. *Conclusion*. The picking robot based on computer images has a simple structure, high recognition accuracy of picking targets, less damage to the picking targets, high safety and stability, and great promotion value.

1. Introduction

In recent years, in the course of the continuous development and progress of science and technology, the use of technology has made great progress, given strong support for economic development, culture and other economic activities in the community, and to facilitate global development. It effectively expands people's daily lives and access to information. While people acquire information more quickly, the requirements for computer technology applications are also constantly improving [1]. Under the background of the new era, the promotion and application of computer image processing and recognition technology give full play to its image digital processing function, and with the help of the application advantages of computer technology, the processing and storage requirements of massive data can be effectively met [2].

In various image analysis and processing processes, the application of computer image processing technology can effectively improve the utilization of image information, the application process includes the following aspects: first, analyze and transform the image to be processed, this process provides a strong reference for the computer system to carry out information identification later and provides a strong support for improving the quality and efficiency of image processing; scientifically process the selected images and effectively guarantee the validity of the image information; rationally and scientifically apply the processed images, so that the application value of computer image processing technology can be fully utilized, it plays an effective role in promoting the sustainable development of various industries [3]. In addition, in the application of computer image processing technology, various types of images need to be scientifically classified. For example, in different industries, the application direction and application of analog images and digital images should be clarified [4]. Through the effective application of processing technology, the image can be processed into data, and the image data can be analyzed and processed with professional computer software, and the processed data can be restored, and the required image can be effectively extracted [5]. Therefore, the computer digital image processing technology needs to be based on the visual information technology, using the principle of object imaging, and using computer software tools to realize the data transformation and processing of the image, and then use the algorithm processing method for the processed image, so that the data can be converted into image [6].

In the application process of computer image processing and recognition technology, images, as the most common information carrier, can effectively describe the similarity and vividness of objective objects [7]. The images include visual information extracted from photos, paper, computers, and televisions and can be divided into digital images and analog images. With the rapid development of computer technology and related edge disciplines, computer image processing technology is also becoming more and more mature, and it is widely used in many fields such as industry, remote sensing, biomedicine, and traffic monitoring and has prompted new developments in these disciplines [8]. The application of computer image processing technology in the field of agricultural engineering will also be paid more and more attention by people.

2. Literature Review

Fruits and vegetables need to be picked in time after maturity, otherwise they will rot or fall, which will seriously affect the quality and yield of fruit and vegetable production; therefore, fruit and vegetable picking plays a crucial role in fruit and vegetable planting [9]. However, the level of automation of agriculture in our country is low, the method of harvesting fruits and vegetables is still at the level of writing books, and fruits and vegetables are often affected by human events. Manual picking requires a lot of energy and materials due to lack of time, lateness, and incorrect selection, which increases the price of fruits and vegetables and makes it unachievable [10].With the development of automation technology and artificial intelligence technology, the operation mode of fruit and vegetable picking has changed, and it has begun to develop from traditional manual picking to mechanical picking and automatic picking; the application has greatly improved the efficiency of agricultural production [11]. However, a single picking robot arm and manipulator cannot accurately identify the picking target and perform precise positioning during the fruit and vegetable picking process, so the picking efficiency needs to be improved, and the identification and positioning of the picking target determines the quality of fruit and vegetable picking [12]. Computer image technology adopts the principle of profiling and replaces human eyes and brains with machines to complete image acquisition and processing.

To harvest fruits, vegetables, and berries, the main task is to identify the fruit from the background, determine the three-dimensional spatial position, and then write it down. The fruit and area identification process has a good relationship with the different colors and background of the fruit. Fruits such as apples, citrus, tomatoes, and strawberries have red skin when ripe and are easily distinguished from the green background. Such fruits are mostly identified by color camera systems and image processing systems. A variety of vegetable and fruit picking robots have been developed abroad, such as tomato and fruit picking robots, banana harvesters, and mushroom picking robots. Domestic research on agricultural robots began in the mid-1990s, although it started late compared to developed countries, but it has grown rapidly, and many universities and research institutions have conducted research on agricultural robots and intelligent agricultural machines. Yu et al., using a computer vision as a guide and using chromaticity and intensity information for fruit picking in natural backgrounds, proposed using color features only, the Bayesian decision classification model was used to discriminate the tomatoes in the natural background, and the centroid calculation technology was used to evaluate the classification model, and it was concluded that the accuracy of the tomato pixel classification was more than 80% [13]. Dundar et al. studied the use of LAB color space to realize the extraction of ripe tomato images from the background [14]. Yu et al. applied the a^* channel information in the L^*a^*b color model of the strawberry image to identify the ripe strawberry, and initially established a bridge-type Cartesian coordinate robot [15].

To this end, the author introduced the computer image technology, on the basis of an in-depth study of the imaging principle of embed computer image technology into fruit and vegetable picking robots, it ensures that the fruit and vegetable picking robot has high target recognition and positioning capabilities, effectively improves work efficiency and picking quality, and has a very important guiding significance for promoting the intelligent development of agricultural production.

3. Methods

3.1. The Principle of Computer Imaging Technology. Computer image technology mainly includes image acquisition technology and computer technology, using image acquisition technology to collect target images, the target image is transmitted to the image processing center (computer) for target judgment, recognition, and positioning, after the image processing center completes the image processing, it controls the actuator to pick the target according to the set path [16].

The imaging principle of computer imaging technology is similar to that of pinhole imaging, it uses dual cameras to collect target images, the two images captured by the dual cameras are integrated through computational analysis to obtain the same point image, which corresponds to the same depth of field information in real space [17].

Computer imaging technology selects two cameras to work at the same time, and the focal length and internal parameters of the two cameras are exactly the same [18]. The dual cameras maintain a physical position parallel to each other, at the same time coincide with the imaging plane. Let $O_1(x_1, y_1)$ and $O_2(x_2, y_2)$ be the corresponding pixel coordinates of the two cameras in the imaging plane, respectively, and establish a coordinate system with the origin of the two cameras, they are the left camera coordinate system $O_1X_1Y_1Z_1$ and the right camera coordinate system $O_2X_2Y_2Z_2$, respectively, the focal length of the camera is f, and the center distance between the two cameras is B.

The center line O_1O_2 of the two cameras is the center B, the intersection of the optical centers of the two cameras is the target P, and the point of view is $Q(x, y, z)$. Figure planes of the two cameras overlap, and the distance (d), the triangle from P to O_1O_2, can be obtained by a similar rule

$$d = \frac{bf}{|x_1 - x_2|}. \tag{1}$$

The distance (d) from P to O_1O_2 is the coordinate from the target point P to the Z axis, then,

$$Z = \frac{bf}{|x_1 - x_2|}. \tag{2}$$

In the same way, the coordinates of X and Y are

$$X = \frac{b(x_1 + x_2)}{2(x_1 - x_2)}, \tag{3}$$

$$Y = \frac{b(y_1 + y_2)}{2(y_1 - y_2)}. \tag{4}$$

Since the focal length f and center distance B of the camera are known, the observation point $Q(x, y, z)$ can be obtained in the image pair of the two cameras, and the coordinates of the target point P are

$$\begin{cases} X = \dfrac{b(x_1 + x_2)}{2(x_1 - x_2)}, \\ Y = \dfrac{b(y_1 + y_2)}{2(y_1 - y_2)}, \\ Z = \dfrac{bf}{|x_1 - x_2|}. \end{cases} \tag{5}$$

3.2. Structural Design of Picking Robot. The manufacturer has chosen to get a tracked chassis, which can achieve a simple path regardless of the terrain and obstacles, which makes the robot work efficiently and change the environment around. Computer-based selection robots combined with computer graphics in the form of traditional selection robots improve the objective complexity and the known problem area of traditional selection robots [19]. The computer graphics-based robot consists of a computer graphics system, electric claw, control box, and joint operation [20]. The computerized imaging system is often used to complete the acquisition of the selected target, which is easy to identify and locate the selected target and send the image data to the controller, review, analysis, and integration after completion. As the system follows the parameters, the power claw can be placed in the right direction and the target can be moved quickly to complete the selected task. Joints usually include joint devices used to drive the electric motor to determine the position, push rod, forearm motors, upper arm, and lower arm.

Table 1 shows the importance of each joint in robot selection.

Computer vision is an important part of any pick-up robot and similar to the human eye, it is mainly responsible for collecting images of the environment. Target selection and target acquisition, it has a CCD camera and a graphics card, preprocessing, and segmenting the target image using video cable and computer, extracting image feature values, matching, aligning, and calculating image pairs are shown in Figure 1.

Table 1: Main parameters of each joint mechanism in the picking robot.

Joint name	Parameter
Lifting device	0~0.8 m
Rotation joint	-160~160
Main arm joint	-80~80
Forearm joint	-80~80

3.3. Hardware Design of Picking Robot. The computer driver is usually based on the robot model selection, which includes a computer, data acquisition card, graphics card, camera, various pressure sensors, RS-232 converter, AC servo drive, drive motor, and a joint mechanism and related photoelectric encoders [21].

The business computer is the basis of all the robot hardware used to analyze, process, and calculate image data and sensor data, and the RS-232 converter is used to complete the data communication. End effectors are controlled to perform their actions in accordance with the quality control.

Frame grabber collects the image data from two cameras, process the image, and send it to the computer to complete the location calculation of the selected location; data acquisition cards usually receive sensor data collected by various sensors, such as photoelectric sensors, pressure sensors, and limit sensors, which improve the accuracy and quality of robot selection [22].

The final equipment is a specialized robotic launcher for selected tasks, including various AC servo drives, motor drives, and various joint systems. After receiving the image data of the material collected during the operation, the production computer calculates and analyzes the selected target location and calculates the control parameters for each operation; the parameters can be sent to each AC servo drive through the RS-232 converter to control AC servo motor control, coupling, electric push rod, cable small arm, and large arm according to actual needs move; the incremental photoelectric encoder sends the operation state of the end actuator to the AC servo drive in real time, continuously adjusts the control parameters of the end actuator, and finally switches to the operation state of the target device to complete the selection. Figure 2 shows the hardware structure of a computer graphics system.

In Figure 2, the dual camera adopts the Bumbelee2 camera, which contains two image sensors, the model is Sony ICX204. The dual cameras are fixed on the base bracket of the picking robot, near the electric gripper. The technical parameters of the Bumbelee2 camera are shown in Table 2.

3.4. Design of Picking Robot Information Processing Process. Target recognition and target localization are the goals of

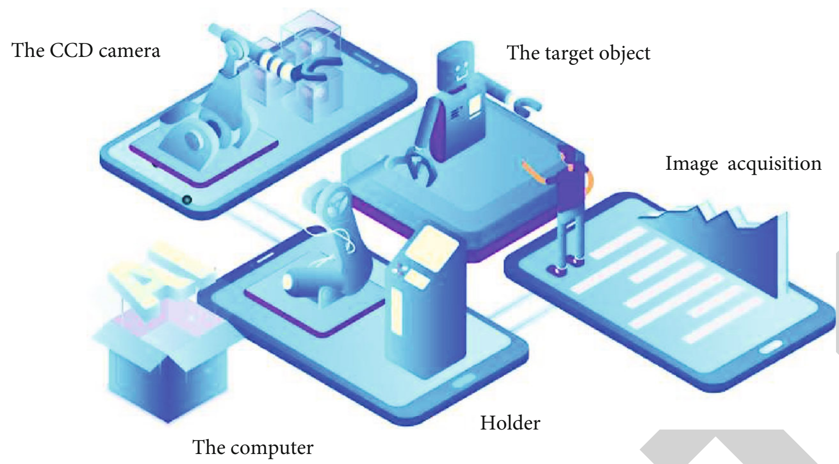

Figure 1: Hardware composition of computer graphics system.

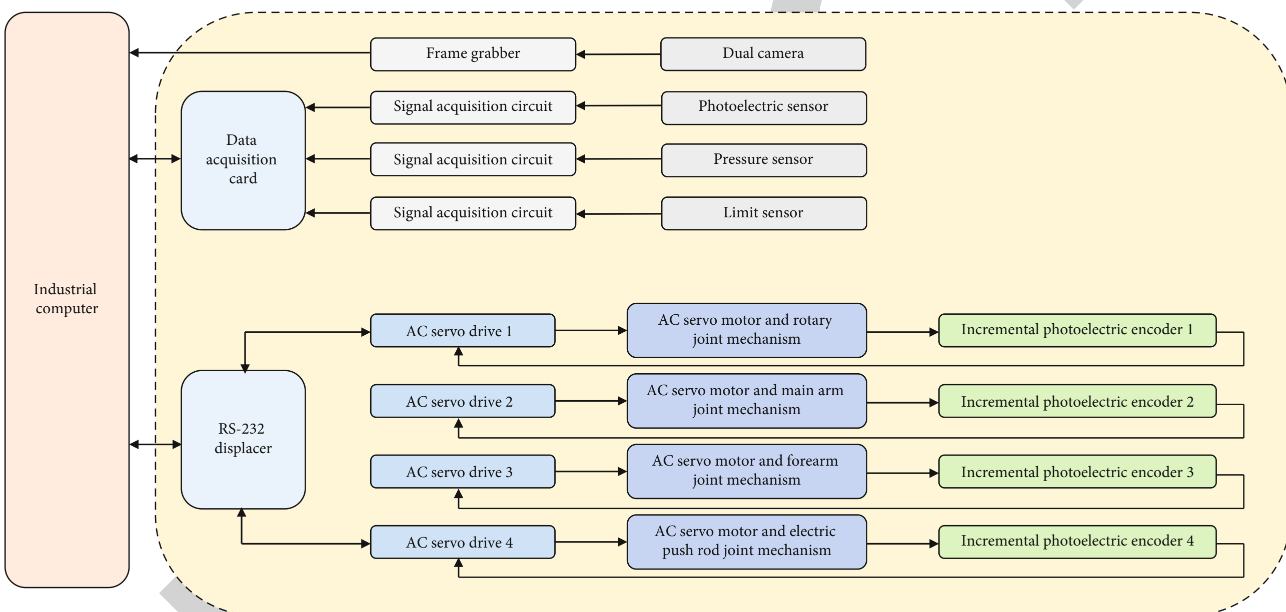

Figure 2: Hardware composition of computer graphics system.

Table 2: Technical parameters of Bumbelee2 camera.

Parameter name	Unit	Parameter value
Resolution		640x480
Frame rate		20FPS
Sensor model		Sony ICX204
Sensor category		CCD
Sensor format		1/3"
Focal length	mm	2.5
Pixel size	μm	4.65
Aperture		f/2.0
Power supply	V	12
Operating temperature	°C	0~40
Interface		FireWire 1394a

computer image technology, and the main technology for target recognition and localization is the image data. In the process of image data processing, the computer image-based robot picking robot includes a location information system and a guidance information system: location information robot. To reach the selected target, each actuator moves to a location near the selected target to connect with the selected target; personal information is often used to provide image information such as environmental information, location information about target selection, initial selection control, final effector and driver control, and final control and other functional materials [23].

A dual-camera camera shows itself, receives images, and sends image data to the graphics card for processing; after calculating and analyzing the image data, start the relationship management option; since the controller cannot adjust the operation of the controller, the control function can be

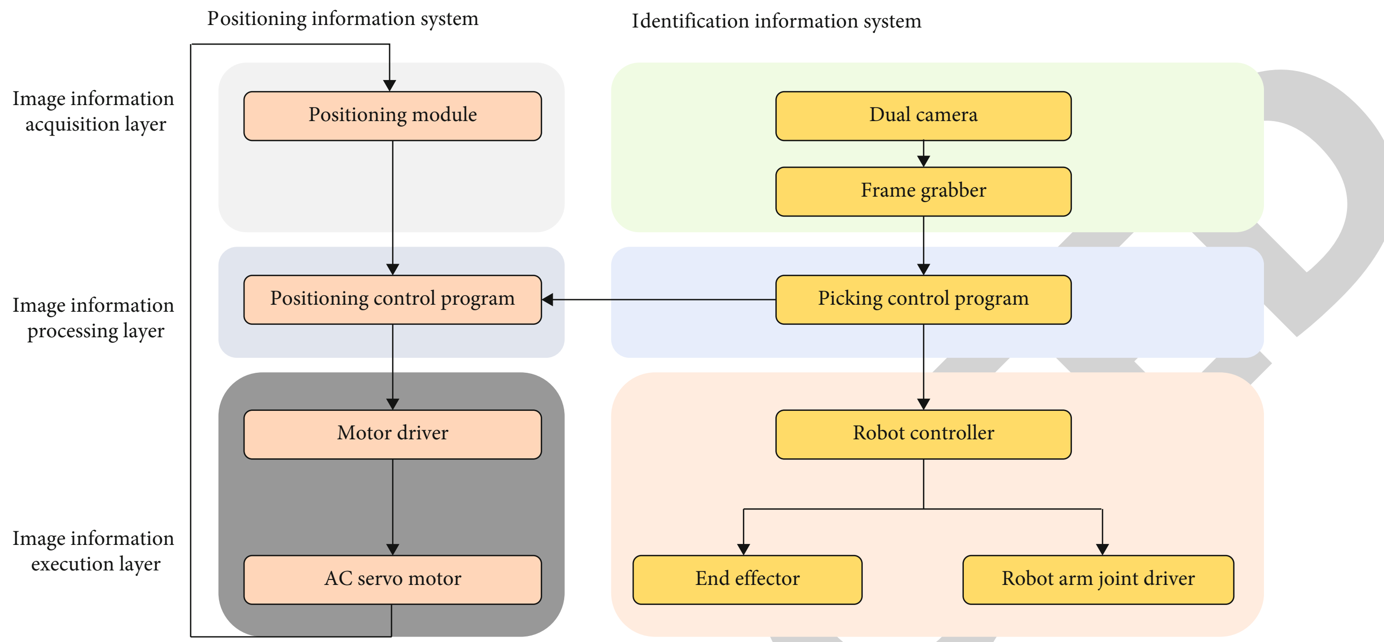

Figure 3: Design of the information processing flow of the picking robot.

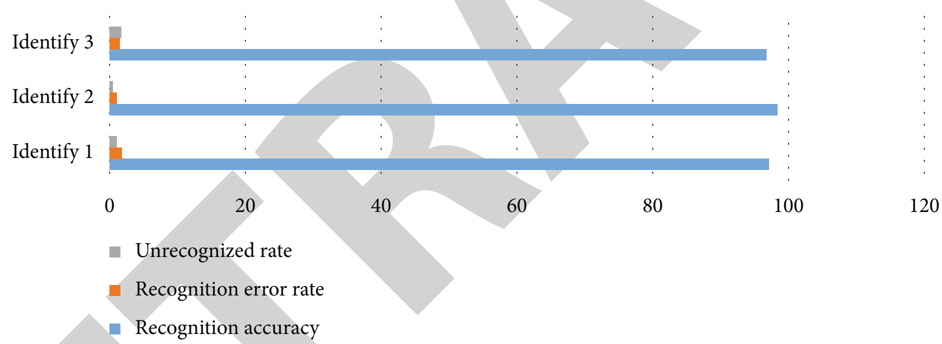

Figure 4: Identification of picking targets.

started and the driver walking on the driver can drive the driver to the target area; at the same time, the site continuously collects the current position of the selected robot, sends it to the control center in time, continuously updates the position of the carrier, and finally reaches the target area. Figure 3 shows the generation of functional data for selected products [24].

4. Results and Discussion

In order to verify whether the computer graphics-based robot picker has a high target recognition and location capabilities, a simulation experiment was conducted on the robot pick recognition function. Analysis of the simulation experiment by eating tomato in the farm as a test product, using the computer image system of the selected robot to collect tomato image data, count the number of target tomatoes, calculate the correct value, the confirmed error, and the unknown value of the selected target [25]. An analysis of selected targets is shown in Figure 4.

It can be seen in Figure 4 that the accuracy is over 96% for the tests with tomato juice numbers of 166, 142, and 165. This shows that people who make choices based on computer images can identify the chosen target and have a high recognition rate.

5. Conclusion

The author presents an intelligent computer image-based robot optimization model for accurate and efficient fruit and vegetable selection and robot selection based on computer graphics. Based on the analysis of the art principle of computer graphics technology, the traditional selection robot has been optimized, and the computer graphics system has been introduced, and all the design and hardware schemes of the robot have been successfully selected, and the data has been released at the same time. Streamlines the carrier's operational flow and conducts simulation on the target's knowledge and operations. The result is that the computer graphics-based transporters have adopted

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Retraction

Retracted: Numerical Simulation and Optimization Control of Precious Metal Jewelry Process Based on VR Virtual Technology

Wireless Communications and Mobile Computing

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This article has been retracted by Hindawi, as publisher, following an investigation undertaken by the publisher [1]. This investigation has uncovered evidence of systematic manipulation of the publication and peer-review process. We cannot, therefore, vouch for the reliability or integrity of this article.

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Research Article

Numerical Simulation and Optimization Control of Precious Metal Jewelry Process Based on VR Virtual Technology

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In order to solve the problem that the design direction of precious metal ornaments in virtual reality environment which is complicated and most of them are operated by human, and the speed of obtaining the global optimal design result is not good, this paper proposes the numerical simulation and optimization control of precious metal ornaments process based on VR virtual technology. Through the hierarchical modeling structure design of precious metal jewelry and the coding of jewelry modeling gene, the fitness function is used to evaluate the fitness of individuals and determine the fitness of coding individuals; the evolution of jewelry modeling design scheme is supported by genetic operators. After the artificial participation conditions are met, the design scheme is evaluated manually in the virtual reality environment until a satisfactory scheme is produced. The experimental results show that under the same conditions, the design results of industrial ornaments based on genetic algorithm are 410 times less than those generated by conventional methods. *Conclusion*. It can accurately converge to the global optimal design result, which indicates that the genetic algorithm converges to the global optimal result faster and better in the industrial jewelry modeling design under the virtual reality environment.

1. Introduction

With the rapid development of social economy and the continuous improvement of the people's material living standards, precious metal jewelry has gradually been widely concerned by people. It plays an important role in meeting people's aesthetic needs, spiritual and cultural needs, and health function needs [1]. First of all, precious metals are generally bright and brilliant. In addition, they have strong extensibility and are easy to be processed into various exquisite handicrafts. By wearing these precious metal ornaments, people can effectively meet their needs for beauty and reflect the master's taste and beauty; Secondly, precious metal jewelry itself has a very profound cultural connotation. As early as the Bronze Age, people began to use precious metals to make jewelry. Precious metal jewelry was a symbol of wealth and identity at that time. At the same time, precious metal jewelry itself has rich connotations. For example, the "longevity lock" made of gold has the meaning of warding off evil, pursuing good fortune, and avoiding evil. For example, the "dragon and Phoenix Bracelet" worn in ancient marriage takes the meaning of "dragon and Phoenix presenting good fortune", which expresses the appeal of the ancient working people for a better life [2]. Finally, precious metal ornaments also have good health care functions. For example, metal silver has a good bactericidal effect and can also be used for drug testing. It can prevent bacteria from breeding, calm the five viscera, calm the mind, stop the economy, dispel evil gases, and effectively protect people's health [3].

Precious metals refer to gold, silver, platinum, palladium, rhodium, etc. Precious metals have different material performance characteristics from ordinary heavy metals. In the traditional jewelry processing industry, artisans rarely create design drafts, and more rely on oral skills and production experience to complete the processing of jewelry. When special customized jewelry is needed, it is difficult to produce suitable jewelry at one time. In this repeated deduction and production, a lot of production materials and time are wasted [4].

Therefore, what is missing when communicating with craftsmen is a transitional demonstration. The virtual reality technology can fill the gap of this technical communication well. By using Rhino3D software, the splicing, inlay of different materials, and various structural details of the whole can be accurately produced in the virtual space, so that the refined and transformed decorative elements and ornaments can be more skillfully combined. The intuitive display facilitates the communication between peers and saves the production materials and time [5]. As a new scientific and technological achievement, virtual reproduction technology has become more and more closely integrated with all aspects of design, and has become an important technical means and component of jewelry design.

2. Literature Review

With the development of science and technology, in addition to visual display, virtual reproduction technology can also realize the docking and conversion between virtual objects and real entities through technical means such as numerical control machine tools [6]. In the virtual space, the design of ornaments can be processed and modified repeatedly, and every detail of the ornaments can be adjusted constantly, so that the ornaments can be perfected day by day through repeated deliberation [7]. Jewelry is not only an independent individual, but also has certain requirements for its functionality. Necklaces and pendants should match the matching of clothing, earrings, and headwear, and also have a modifying effect on the face and hairstyle. The handheld rosary beads and play pieces need to have a certain meaning. The designer needs to consider all aspects when creating, and the refined decorative elements should achieve an organic combination of characteristics and functions [8]. Virtual reproduction technology has run through every production stage of jewelry design under the commodity economy. As an jewelry designer, when refining and transforming the decorative elements with distinctive national characteristics, he should not only keep the creative attitude of traditional craftsmanship and excellence but also adapt to the new technologies and challenges brought by the development of science and technology. Only when we truly master the technical means suitable for the development of the discipline can we contribute our own strength to the development of jewelry design [9].

With the rapid development of science and technology, consumers have higher and higher requirements for jewelry modeling, not only focusing on the use function of jewelry but also pursuing the enjoyment of visual sense [10]. In order to respond to the rapid development of market demand, it is very necessary to use virtual reality technology to assist designers to complete jewelry modeling design. In the process of traditional ornament modeling design, it is mainly based on the function of ornaments to improve the appearance form of ornaments, including the shape design, color design, and texture design of ornaments [11]. The designer needs to first take the user's needs as the design direction, analyze the principle and performance of the jewelry by using his own design experience, and design the basic structure, function, and shape of the corresponding jewelry, which mainly depends on the designer's personal ability [12]. It is difficult to ensure the efficiency of design work and meet the requirements of rapid development and design of jewelry modeling design.

Therefore, the high parallelism and self-adaptability of genetic algorithm are used to solve the jewelry modeling design [13]. In order to better integrate the needs and preferences of users and the experience of designers, and avoid the subjective views of designers and the process of users participating in the evaluation, virtual reality, and genetic algorithm are combined. Through interactive means, manual evaluation is used to adjust, and the fitness value in genetic algorithm is replaced by manual evaluation to obtain the optimal result, which can not only reduce the workload of users but also improve the convergence speed of jewelry modeling design results.

3. Method

3.1. Application of Genetic Algorithm in Jewelry Modeling Design. Genetic algorithm can process multiple design objectives at the same time, and obtain multiple satisfactory jewelry modeling design results in one jewelry modeling design process [14]. The application of genetic algorithm in jewelry modeling design is based on evolution theory and genetic theory. It codes each individual design element in jewelry modeling, and then arranges and combines genes through selection, crossover, and mutation operators until satisfactory new individuals are generated [15]. After the evolution process meets certain conditions, it enters the manual evaluation stage for scheme adjustment. If the output result is not optimal, it enters the natural stage of computer operation to form a cycle until the optimal design scheme is generated [16]. Because the computer can search multiple objects in parallel at the same time, it can improve the design efficiency of jewelry modeling. The jewelry modeling design process based on genetic algorithm is shown in Figure 1.

3.2. Design Jewelry Modeling Gene Coding. In the operation of genetic algorithm, the floating-point coding method is used to convert the actual feasible solution variable into individual coding, which can represent more patterns in the population with a certain size [17]. In the initial population, jewelry shape, color, etc. can be expressed as specific hierarchical structure data, each functional unit corresponds to a structural feature parameter, and each chromosome contains a series of feature parameter sets [18]. The feasible solution is transformed from the solution space to the search space, and the characteristic floating-point parameters are encoded into the jewelry individual through this hierarchical structure [6]. The modeling elements of ornaments are represented by hierarchical chromosome structure, as shown in Figure 2.

The gene locus of the jewelry chromosome is the chromosome of the functional unit, the chromosome gene locus of the functional unit is the chromosome of the characteristic parameter, and the functional characteristic parameter is defined by the floating point value [19]. Set the parameter code of each jewelry modeling design element, including the name, quantity, shape characteristics, geometric size, and jewelry color of the functional unit. The data types of

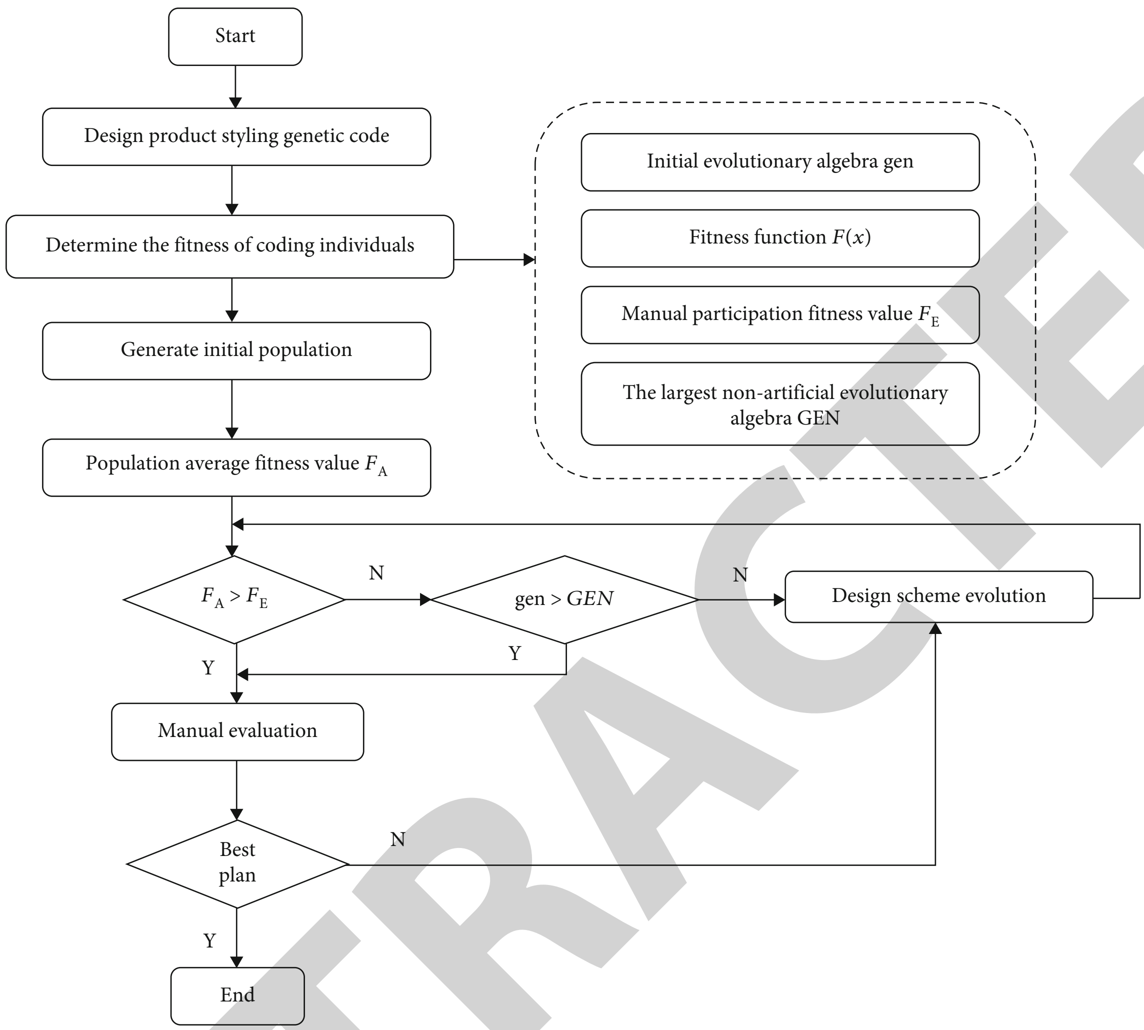

Figure 1: Jewelry modeling design process based on genetic algorithm.

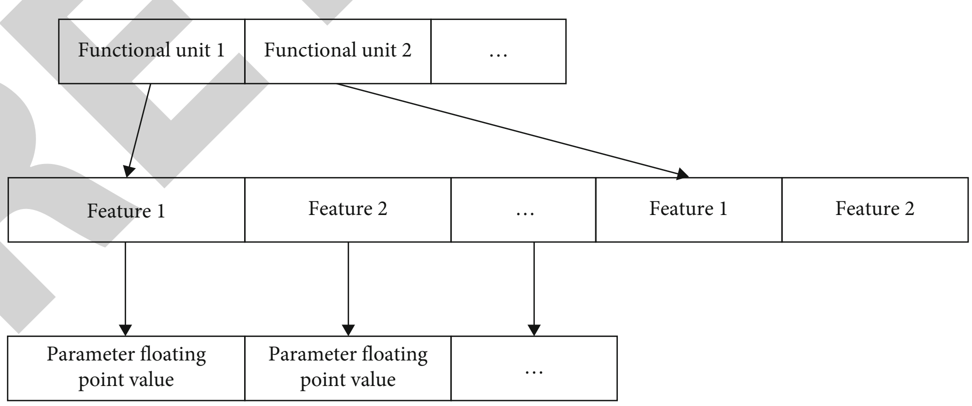

Figure 2: Chromosome structure of modeling elements of hierarchical ornaments.

coding parameters of some jewelry modeling design are shown in Table 1.

Before importing the coding parameters into the computer-aided software, the designer needs to extract the required data from the market and conceptual design, and encode the data according to the above hierarchical structure. The corresponding characteristic parameters of different ornaments are different, and this difference will affect the genetic algorithm to obtain an effective solution. Therefore, the floating-point values of the encoded data are

Table 1: Data types of coding parameters of jewelry modeling design.

Serial number:	Name	Data type
1	Name of functional unit	Character string
2	Number of modeling design elements	Integer
3	Shape features of modeling design elements	Integer
4	Geometric size of accessories	Floating point value
5	Jewelry weight	Floating point value
6	Main color of jewelry	Floating point value
7	Accessory color	Floating point value
7	Decoration color	Floating point value

forcibly mapped within the same effective range, so that each corresponding gene locus is in the range of [0, 1], and the problem of parameters in different ranges is solved.

3.3. Determination of Coding Individual Fitness. In the non-artificial evaluation stage; that is, the natural stage, the fitness function is obtained from the objective function transformation, and the fitness value of the individual is evaluated. The fitness function is expressed by

$$F(x) = \begin{cases} C_{\max} - f(x), f(x) < C_{\max,} \\ 0, f(x) \geqslant C_{\max}, \end{cases} \quad (1)$$

where: $F(x)$ is the fitness function; $f(x)$ is the objective function; $C_{\max}$ is a preset relatively large positive number to ensure that most solutions are positive. Set the population average fitness value $F_{A\circ.}$

Jewelry modeling design is a multiobjective optimization process. The actual process includes a variety of characteristic parameters, corresponding to different states of jewelry. The morphological semantic weighting method is used to set an appropriate weight value according to the importance of design elements in the design scheme, and the user semantics is correspondingly linked with the description of jewelry features to reflect the advantages and disadvantages of design individuals in various aspects. Investigate each design element, and take the arithmetic mean value of the investigation results to obtain the manual evaluation fitness value $\mathrm{F_E}$.

Randomly generate N individual strings, where n individuals are the initial population size, the initial evolution algebra is gen, and the maximum non artificial evolution algebra is Gen.

3.4. Evolution of Jewelry Modeling Design Scheme. The evolution of jewelry modeling design scheme is supported by three genetic operators. The iteration starts from the initial population. After obtaining the average fitness of the initial population, the individuals with high fitness are selected to pair up, and then the new individuals are regenerated through crossover and mutation operations in genetic operations. The process is repeated until the new population is generated. The new population generated after each generation of operation will replace the old population. Crossover operation is to randomly select two individuals in the previous generation population for crossover under the control of crossover probability P_c, and provide more genes by the individuals with higher fitness values among the two individuals. The initial mutation probabilities P_m and $P_m \in [0, 1]$ are first set in the mutation operation.After the generation of the next generation population, compare the fitness values of the optimal individuals in the two generations. When the optimal individuals in the new population are smaller than the fitness values of the optimal individuals in the old population, increase the initial mutation probability PM by 0.05, otherwise, decrease by 0.05, but always keep the mutation probability between the initial mutation probability value and 1. In order to ensure that the individual with the best fitness value is retained in the next generation population, the individual with the highest fitness value in the current population is directly substituted for the individual with the lowest fitness value generated by crossover and mutation genetic operation. At the same time, if the fitness value of the optimal individual in the previous generation population is higher than the fitness value of the optimal individual in the current population; that is, the optimal individual in the previous generation population is used to replace the individual with the lowest fitness value in the current population. When the algorithm runs to generate a new jewelry modeling design scheme and meets the conditions of manual participation, the decoding enters the stage of manual evaluation in the virtual reality environment.

3.5. Artificial Evaluation Design Scheme under Virtual Reality Environment. The artificial evaluation stage in the virtual reality environment is mainly controlled by the computer host with the help of the virtual reality technology. The algorithm content stored in the knowledge base and database is displayed in the virtual scene through the four-dimensional form, and the final design result scheme, drawing or modeling is output to the customer. The output flow of virtual reality design results is shown in Figure 3.

Whether the optimal scheme is generated is manually evaluated. Set the design jewelry evaluation target as $u = (u_1, u_2, \cdots, u_n)$, and the corresponding weights are q_i, which are expressed as $Q = (q_1, q_2, \cdots, q_n)$ by matrix, and score the jewelry evaluation targets according to

$$B = \begin{bmatrix} b_1 \\ b_2 \\ \vdots \\ b_m \end{bmatrix} = \begin{bmatrix} b_{11} & b_{12} & \cdots & b_{1n} \\ b_{21} & b_{22} & \cdots & b_{2n} \\ \vdots & \vdots & \ddots & \vdots \\ b_{m1} & b_{m2} & \cdots & b_{mn} \end{bmatrix}. \quad (2)$$

If the user is satisfied with the scheme in the manual evaluation stage, stop the operation of the algorithm; otherwise, continue the operation in the natural stage, and eliminate the scheme that does not meet the design requirements. So far, the application of genetic algorithm

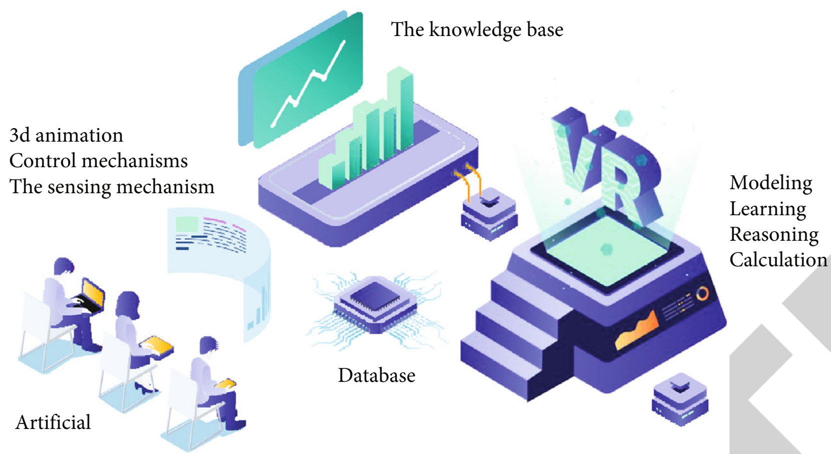

Figure 3: Output process of virtual reality design results.

Table 2: Partial operating parameters required by genetic algorithm.

Operating parameters	Parameter value	Algorithm type
Population size	9 ~ 302	
Number of iterations	9 ~ 901	
Maximum crossing probability	0.81	Optimal individual preservation strategy
Minimum crossing probability	0.06	
Maximum variation probability	1	Elite strategy
Minimum variation probability	0.06	

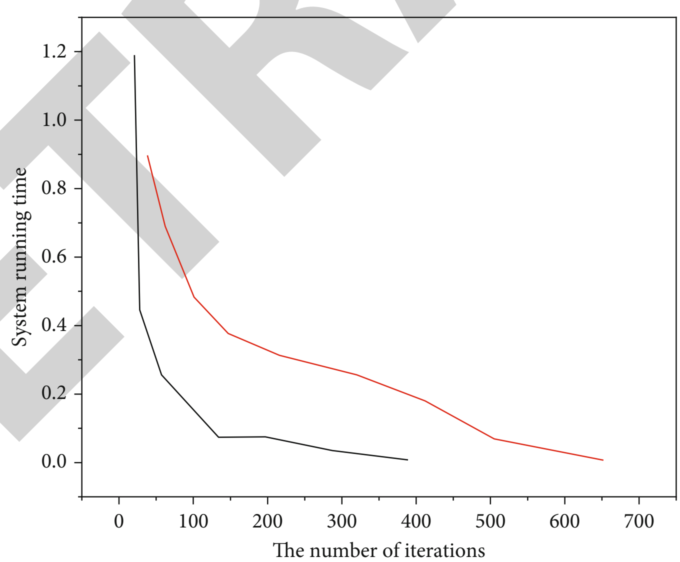

Figure 4: Convergence curve of generated design results.

in industrial jewelry modeling design under virtual reality environment has been completed.

3.6. Experiment Preparation and Operation Parameter Setting. A simulation experiment is designed to compare the convergence speed of the optimal industrial jewelry modeling design results generated by genetic algorithm in the virtual reality environment and the convergence speed of the design results generated in the conventional virtual reality environment.

The global optimization toolbox of MATLAB software is used to run the algorithm in the original modeling system. According to the designer's experience, the operating parameter values in the genetic algorithm are set in advance, including the maximum/minimum population number, the range of generations, the crossover probability, and the mutation probability. Genetic algorithm type selection is the best preservation strategy and elite strategy. Some operating parameters required by the genetic algorithm are shown in Table 2.

4. Results and Discussion

Taking the number of iterations as the horizontal axis and the system running time as the vertical axis, the algorithm convergence curve is drawn as shown in Figure 4.

It can be seen from Figure 4 that the convergence speed of the conventional generation of the optimal precious metal jewelry modeling design results needs about 700 iterations, while the precious metal jewelry modeling design based on the genetic algorithm accurately converges to the global optimal solution after 290 iterations. Under the same conditions, the design results of industrial ornaments based on genetic algorithm are 410 times less than those generated by conventional methods. The results show that under the same conditions, the design results of precious metal ornaments based on genetic algorithm converge faster, and can converge to the global optimal solution more quickly, which improves the design efficiency.

5. Conclusion

In this paper, the numerical simulation and optimization control of precious metal jewelry process based on VR virtual technology are proposed. Combined with virtual reality and genetic algorithm technology, the artificial evaluation stage is implemented in the virtual reality environment. Users can observe the design results more intuitively and conveniently. At the same time, designers can play the positive role of subjective experience to make up for the shortcomings of conventional design methods. The evolution process of the design scheme is automatically completed by the computer, and the advantages of the genetic algorithm with strong global search ability are brought into play to approach the global optimal solution. In addition, since the artificial evaluation stage is conducted after certain conditions are met, if no artificial satisfactory results are generated, it will be transferred to the computer natural stage to continue to run. Therefore, most of the iterative process of genetic algorithm is completed automatically by the computer, which can effectively reduce the number of manual participation, reduce the workload of users, and avoid the limitation of iteration times. In addition, the manual evaluation process is carried out in the virtual reality environment, which is easy for users to operate and further reduces the workload of users. The application of genetic algorithm in the modeling design of precious metal jewelry in the virtual reality environment is completed.

Data Availability

The data used to support the findings of this study are available from the corresponding author upon request.

Conflicts of Interest

The author declares that they have no conflicts of interest.

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Retraction

Retracted: Application of Data Mining Model in Smart Chemistry Education

Wireless Communications and Mobile Computing

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This article has been retracted by Hindawi following an investigation undertaken by the publisher [1]. This investigation has uncovered evidence of one or more of the following indicators of systematic manipulation of the publication process:

(1) Discrepancies in scope
(2) Discrepancies in the description of the research reported
(3) Discrepancies between the availability of data and the research described
(4) Inappropriate citations
(5) Incoherent, meaningless and/or irrelevant content included in the article
(6) Peer-review manipulation

The presence of these indicators undermines our confidence in the integrity of the article's content and we cannot, therefore, vouch for its reliability. Please note that this notice is intended solely to alert readers that the content of this article is unreliable. We have not investigated whether authors were aware of or involved in the systematic manipulation of the publication process.

Wiley and Hindawi regrets that the usual quality checks did not identify these issues before publication and have since put additional measures in place to safeguard research integrity.

We wish to credit our own Research Integrity and Research Publishing teams and anonymous and named external researchers and research integrity experts for contributing to this investigation.

The corresponding author, as the representative of all authors, has been given the opportunity to register their agreement or disagreement to this retraction. We have kept a record of any response received.

References

[1] S. Fei, "Application of Data Mining Model in Smart Chemistry Education," *Wireless Communications and Mobile Computing*, vol. 2022, Article ID 2506565, 6 pages, 2022.

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Research Article

Application of Data Mining Model in Smart Chemistry Education

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In order to solve the problem that the activities of teachers and students in traditional teaching methods are constrained by lesson plans, the teaching methods are aging, and they do not have the ability to expand students' learning through big data; due to the problem of low self-learning and extracurricular communication ability of students after class, the author proposes the application of a data mining model in smart chemistry education. The author designs an educational wisdom platform based on big data, and its overall structure includes physical layer, virtual resource layer, logic layer, presentation layer, application layer, network layer, and user layer; the big data center module in the platform collects all business data through devices such as networks and sensors and stores the business data in mass data storage devices; the software design part uses the multi-feature fusion acquisition algorithm to collect student data and completes the early warning of student performance through the performance early warning algorithm based on correlation analysis technology. The results showed that only 5.15% and 4.49% of the students who designed the platform could not improve their after-class autonomous learning and extracurricular communication skills, and more than 95% of the students had good feedback after using the platform. *Conclusion*. It shows that the design platform can effectively improve the students' ability of self-learning and extracurricular communication after class, and the application efficiency is high.

1. Introduction

Chemistry experiment is an important test site for the exam, occupying a major position [1, 2]. The content of the examination includes experimental equipment. It includes the experimental operations of substance separation, preparation, impurity removal, and inspection, experimental analysis, and acid-base neutralization titration curve analysis, and the score is very high. Chemistry experiment is not only the basic knowledge of chemistry but also an important means of chemistry teaching. At present, the experimental teaching methods we carry out include hands-on operation and multimedia teaching. Both types have their own strengths and weaknesses.

The concept of smart education is to use multimedia and Internet technology to realize the sharing and dissemination of teaching resources, information resources, and intellectual resources, forming an open and efficient teaching model [3]. The combination of smart education and chemistry experiment teaching, with the help of information technology means such as video, tablet computer, PPT, network, micro-lecture, physical projector, virtual simulation experiment, and digital experiment, supports and helps students to complete independent learning and cooperative learning. Thus, we use information technology to maximize the efficiency of chemical experiment teaching [4, 5]. Atomic structure, molecular structure, crystal structure, organic molecular space structure, chemical bond formation, reaction mechanism, etc., experiments that cannot be completed or observed in the classroom can be replaced by videos [6]. We use animation production software to simulate it, that is, change the invisible to the visible, the static to the dynamic, and the abstract to the intuitive. This method facilitates students' understanding of knowledge. There are certain requirements for the operation steps and operation specifications of chemical experiments [7, 8]. If a student makes a mistake, it will not only lead to the failure of the experiment but also may cause an experimental accident, and it will also cause the students' fear. Information technology simulation teaching can make some wrong experimental operations to make students feel the danger of wrong operations, so as to avoid the occurrence of wrong operations [9]. For example, I simulated the explosion of hydrogen gas of untested purity, which deepened the students' understanding of the hazards caused by operating errors. Then, I do the right experiment. Through the simulation of information technology, students not only improve the success rate of experiments but also deeply understand the importance of correct operation. The virtual simulation experiment focuses on the experimental exploration process. It involves the construction of experimental instruments, the selection and addition of experimental reagents, the operation of experimental steps, the acquisition of experimental phenomena, and the analysis of experimental data. I built it step by step by the students themselves by clicking the mouse, allowing students to combine hands-on, brain-moving and eye-moving organically.

2. Literature Review

Looking at the infrastructure of the education cloud platform under the Internet big data at home and abroad, smart education has become a hot topic in the modernization of education, relevant research has made basic progress, and at this stage, the unified in-depth infrastructure construction of educational modernization regional service platforms has been listed as a key industry in strategic positioning around the world [10]. However, the construction efficiency is uneven across the country, and developed areas have unified planning and unified infrastructure, and the scope of application is also larger [11]. Currently, there are many courses, broken programs, and lower levels of educational applications that are major problems, but the introduction of education has achieved some results in the development of the network environment and hardware, but not yet done. The uneven development of educational platforms and the inability to provide an online service for teachers, administrators, and students lead to the use of intelligent services behind the data size is the main problem affecting teaching [12, 13]. Smart education is the use of the concept of teaching in education, the wide and deep use of information technology today, and the acceleration of the process of educational reform and development.

The leader of online education management in the intelligent education cloud service layer allows teachers to collect information about education and learning programs for students, agree teachers teach online or video, select the full content of the students' courses and special assignments, and complete them, sharing information between teachers, administrators, and their students [14, 15]. With the continuous deepening of big data analysis technology in the field of education, some emerging education models such as flipped classroom and MOOC have gradually emerged, and technological innovation has promoted the transformation of education models, how to use the characteristics of distributed data storage of big data to build a smart education platform under the big data environment, overcome learning barriers, and realize smart learning is a hot issue that many scholars pay attention to. Big data technology reasonably integrates educational resources, provides virtual services to education industry personnel, assists teachers and students to simplify the development and deployment process of smart education platforms, builds a smart education platform suitable for education and scientific research, and provides platform users with services such as file storage, course management, and course publishing [16]. The development of a smart education cloud platform can provide teachers, administrators, and students with one-stop online services while creating a good learning environment for students [17].

People's learning methods have entered the era of diversified education from classrooms and textbooks, and the use of network and mobile terminal learning has gradually become an important way of learning in the information age; the traditional teaching mode is mostly based on the script, and the activities of teachers and students are constrained by the lesson plan, the unified "programmed" teaching method leads to the aging of the teaching method, and the students' learning efficiency is not high. The traditional education model can no longer meet the current learning needs; therefore, the author designs an educational wisdom platform based on big data and connects Internet resources with the data of the school platform through big data technology to realize smart education [18, 19].

3. Methods

3.1. Design of Educational Intelligence Platform Based on Big Data

3.1.1. Platform Hardware Design. The smart education platform adopts the distributed framework of the big data analysis platform. The big data analysis technology platform reasonably integrates big data processing, data exchange and sharing, and data analysis and mining, and is used in the design process of the smart education platform. The structure of the big data-based intelligence platform is divided into seven layers: physical layer, virtual layer, process layer, presentation layer, application layer, layer, and user layer [20]. Its detailed structure is shown in Figure 1 [21].

3.1.2. Platform Hardware Device Configuration Structure Design. The configuration structure of hardware equipment in the education wisdom platform based on big data is shown in Figure 2 [22]. It usually includes servers, switches, firewalls, network cabinets, cameras, audio-visual distributors and handwriting monitors, and two computers. Among them, the variable changes the location of the machine according to the number of students studying online at the same time. Another layer can be configured as a backup, taking into account redundancy; the firewall uses a VPN firewall with additional connections to ensure the reliable operation of the learning intelligence platform at the highest level; the camera and audio-visual distributor are mainly used to record the teacher's lesson and record the audio and video to the control terminal, and the teacher uses the writing screen to simulate the ideas of board of the screen.

3.1.3. Module Design of Big Data Center. The big data center module is the data distribution center of the business module in the big data-based learning platform; it only collects all the business data from such tools as networks and sensors, stored in a large data storage device, make the data

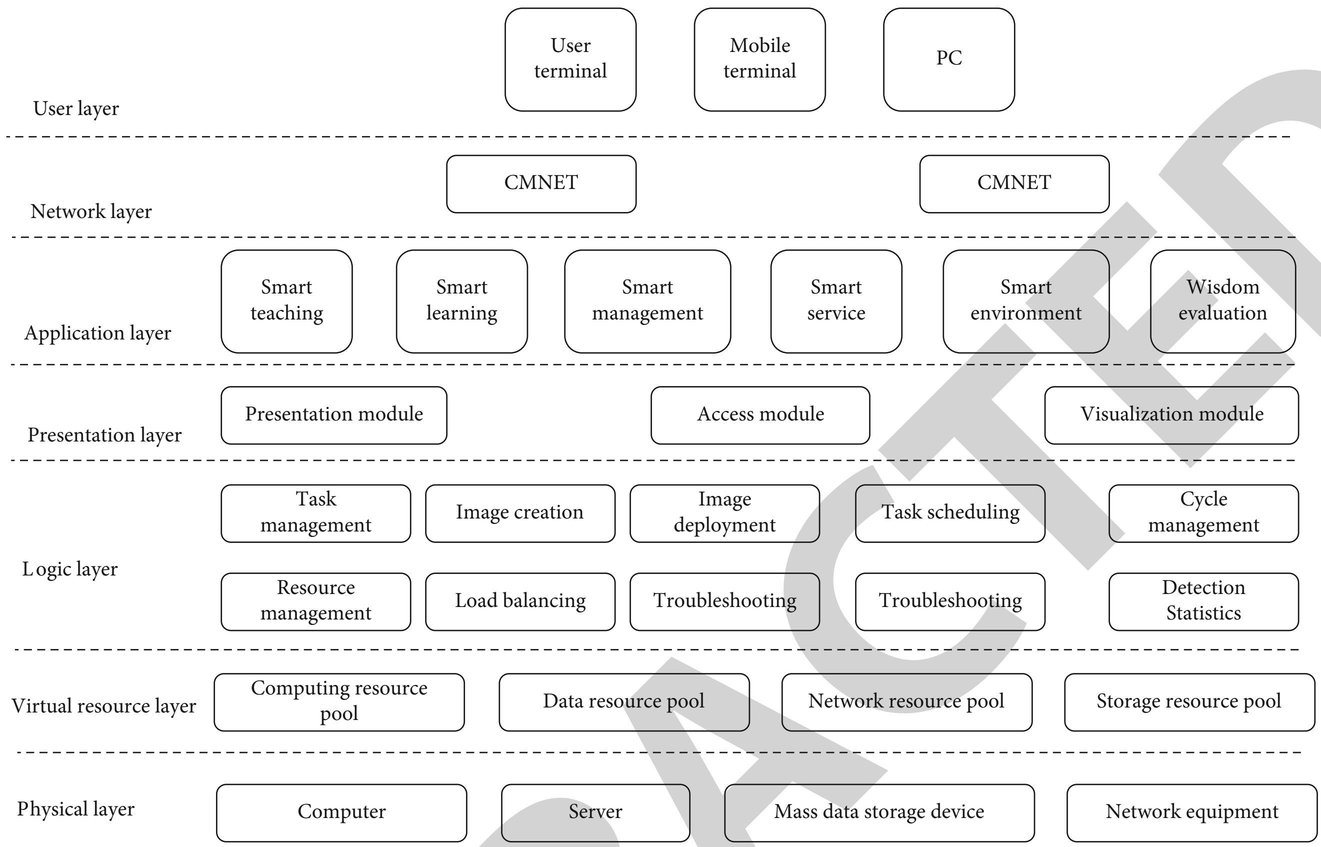

Figure 1: Structural diagram of educational intelligence platform based on big data.

Figure 2: Platform hardware configuration diagram (high-end).

used. Analyze and maintain the data, and then turn the data into applications.

3.2. Platform Software Design

3.2.1. Multi-Feature Fusion Acquisition Algorithm. The multi-feature fusion acquisition algorithm is used to quickly and accurately collect the characteristics of the students in the platform [23].

$$T(a, a_1) = \frac{\sum_{i=1}^{n} \left((q_i - s)^2 (q_i - s - l)\right)\left(q_i - s^2 (q_i - s - l)\right)}{\sqrt{\sum_{i=1}^{n} \left(q_i - s^2 (q_i - s - l)^2\right)^2 + \left(q_i - s^2 (q_i - s - l)^2\right)^2}}. \quad (1)$$

In the formula: $T(a, a_1)$ is the set of student data feature attributes and student feature expression; q_i is the number of data features after classification of student data; s is the content of student features; i is the number [24]; n is a parameter; l is a unique attribute of student data [25]. After identifying the characteristics of student data, it is necessary to remove non-characteristic attributes, which is beneficial to reduce the speed of error improvement during collection; the redundant data removal formula is:

$$L = \vec{q} + \frac{\sum_{i=1}^{n} \left(T(a, a_1)\right)_i (q - e)}{\sum_{i=1}^{n} \left[T(a, a_1)\right]_i^2}. \quad (2)$$

In the formula: L represents the limited removal standard, and those that meet the standard will be removed; $\vec{q}$ represents the filtering requirements used during removal; e represents the existing redundant data removal requirements. Data features can be collected after filtering.

$$C = \beta\left(\bigcap_{i=1}^{n} e_i + \frac{\sum_{i=1}^{n} T(a, a_1)\cdot(a, a_1)_i d^{i\theta}}{\sum_{i=1}^{n} T(a, a_1)_i^2}\right) + (1-\beta)\left(q_i + \frac{\sum_{i=1}^{n}\left(T(a, a_1)_i - \bar{X}\right)^2 T(a, a_1)_i^2}{\sum_{i=1}^{n}\left(T(a, a_1) - \bar{X}\right)^2}\right). \quad (3)$$

In the formula: $d^{i\theta}$ represents the holding weight of the data feature; β represents the balance factor correlation coefficient; $\bar{X}$ represents the data feature collection factor.

3.2.2. Performance Early Warning Algorithm Based on Correlation Analysis Technology. Based on the collected student data, the correlation analysis technology is used to give early warning to the students' grades. Set the transaction set as A_1, the warning item set as A_2, K as the frequent item set, Y as the candidate set, Rules as the warning rule set, seq is the sequence set of early warning items, minsup is the minimum support, and minconf is the minimum confidence; the Algorithm 1 is described as:

Input A_1, minsup, minconf, A_2, seq
Output grade warning rules Rules
1. Initialize frequent item set K_1
2. while (all $L_{K-1} \neq ?$)
3. end
4. while (all Y_K)
5. end

ALGORITHM 1: Performance early warning algorithm based on correlation analysis technology.

3.3. Platform Implementation. Online courses are the main part of the information technology cloud layer of the learning intelligence platform. The online education teaching activities are diverse, the analysis activities are rigorous, and the user experience affects the situation of online communication, the smart learning platform, and the management of teachers and students. Online courses include students, teachers, and administrators.

In online education, administrators often manage information for teachers and students, and classroom monitoring ensures the quality of education on the smart learning platform. Administrators monitor student progress, monitor behavior throughout the learning process, collect data, and provide supporting information for classroom audits.

In the online course of the smart learning platform, teachers prepare lessons, teach students through media or recording, and answer students' questions online, and at the end of the class, the teachers will give the students to practice things like the class and the lesson, the content of lessons, which can help improve the teachers' teaching ability.

Students can choose and confirm course content through online learning, and student courses include live classes and recorded classes, and students must get job training after class; otherwise, they will not be able to learn enough knowledge to enter the next level of course.

4. Results and Analysis

The goal of the functional test of the smart education platform is to ensure that the smart education platform and all levels of the platform can be used normally; during the platform test, a variety of smart terminals are required to implement service access to the platform, test whether the functions of the platform can be realized. For the influence of the experimental statistical platform on students' autonomous learning after class, the results are shown in Table 1.

Analysis of Table 1 shows that after using the education wisdom platform based on big data, 87.37% of students can always recall the relevant knowledge of classroom teaching to solve problems independently after class; 86.92% of students can always solve problems independently after class; 87.21% of students can always find out their problem-solving mistakes after class; 86.33% of students can always correct their mistakes after class. Only 5.15% of students could not improve their ability to learn independently after class when using the platform. It can be seen from this data that the education wisdom platform based on big data can effectively improve the students' ability to learn independently after class.

For the impact of the experimental statistical platform on students' extracurricular communication, the results are shown in Table 2.

Analysis of Table 2 shows that when students use the education wisdom platform based on big data outside of class, only 1.35% of students do not participate in after-class communication on the platform; only 0.34% of students did not ask questions to teachers on the platform; only 1.5% of students did not increase their understanding of teachers; only 0.21% of students did not increase their understanding of classmates; only 1.09% of students did not increase their understanding of knowledge. According to statistics, only 4.49% of the students could not improve their extracurricular communication skills when using the platform of this article. From this data, it can be seen that the educational wisdom platform based on big data can effectively improve the students' extracurricular communication ability.

The results of students' feedback on the platform are shown in Table 3.

Analysis of Table 3 shows that after using the platform, 92.59% of the students agree that using the platform is beneficial to their learning (agree + significant agreement); 97.52% of students agree to use the platform to improve academic performance (agree + strong agreement); 89.88% of students say that using the platform helps them find and correct errors in time (agree + strong agreement); 94.47% of students agree that using the platform facilitates communication between teachers and students (agree + strong agreement); 93.56% of students agree that the platform can be widely used in schools (affirmation + agreement). Only

Table 1: The impact of the platform on students' after-school autonomous learning (%).

Type	Always possible	Often can	Generally can	Can sometimes	Cannot
Can you recall the relevant knowledge taught in the classroom when solving the problem	87.37	6.20	3.20	2.13	1.10
Do you know the process of solving the problem	86.92	6.34	3.33	2.21	1.20
Type	Always possible	Often can	Generally can	Can sometimes	Cannot
Can you recall the relevant knowledge taught in the classroom when solving the problem	87.37	6.20	3.20	2.13	1.10

Note: The data in the table is the proportion of the number of students.

Table 2: The influence of the platform on students' extracurricular communication (%).

Type	Always possible	Often can	Generally can	Can sometimes	Cannot
Participate in after-school communication in the smart education platform	82.36	10.33	3.33	2.63	1.35
Ask questions to teachers on the smart education platform	86.22	10.2	2.22	1.02	0.34
Increased understanding of teachers	83.66	8.6	3.04	3.2	1.5
Increased understanding of classmates	80.52	14.84	3.33	1.1	0.21
Increased understanding of knowledge	84.22	9.31	3.27	2.11	1.09

Note: The data in the table is the proportion of the number of students.

Table 3: Students' feedback on the platform (%).

Type	Agree	Basically agree	Uncertain	Disagree	Disagree
The platform is very helpful for learning	83.26	9.33	4.33	1.68	0.88
The platform improves learning efficiency	84.32	13.20	1.32	0.22	0.94
The platform helps to detect and correct errors in a timely manner	80.67	9.21	4.04	4.80	1.28
The platform helps to strengthen the communication between teachers and students	83.24	11.23	3.45	1.56	0.52
Platform can be widely used in schools	81.25	12.31	3.05	2.34	1.05

Note: The data in the table is the proportion of the number of students.

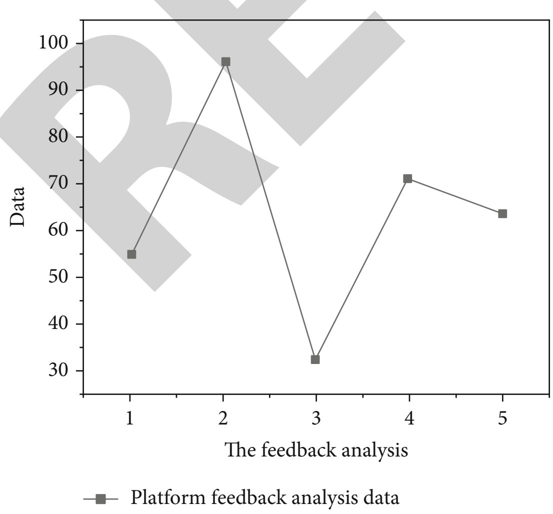

Figure 3: Student feedback analysis data on the platform.

4.67% of students made negative decisions from the platform's feedback. Data shows that approximately 95% of students have better feedback after using the platform. Figure 3 shows the student feedback analysis data on this platform.

5. Conclusion

The author proposes the application of data mining model in smart chemistry education. The author designs an educational wisdom platform based on big data; through the analysis of experimental data, we can see that after students use the platform, more than 85% of students can always recall classroom knowledge after class and discover their own problem-solving mistakes, solve problems independently, and correct them in time; only 4.49% of students did not participate in after-class communication on the platform, did not ask questions to teachers, and did not increase their understanding of teachers and classmates and their understanding of knowledge; and about 95% of the students gave good feedback to the platform. An analysis of the test data

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Retraction

Retracted: Design and Implementation of Office Automation System Based on Internet of Things Technology

Wireless Communications and Mobile Computing

Received 18 July 2023; Accepted 18 July 2023; Published 19 July 2023

This article has been retracted by Hindawi following an investigation undertaken by the publisher [1]. This investigation has uncovered evidence of one or more of the following indicators of systematic manipulation of the publication process:

(1) Discrepancies in scope
(2) Discrepancies in the description of the research reported
(3) Discrepancies between the availability of data and the research described
(4) Inappropriate citations
(5) Incoherent, meaningless and/or irrelevant content included in the article
(6) Peer-review manipulation

The presence of these indicators undermines our confidence in the integrity of the article's content and we cannot, therefore, vouch for its reliability. Please note that this notice is intended solely to alert readers that the content of this article is unreliable. We have not investigated whether authors were aware of or involved in the systematic manipulation of the publication process.

Wiley and Hindawi regrets that the usual quality checks did not identify these issues before publication and have since put additional measures in place to safeguard research integrity.

We wish to credit our own Research Integrity and Research Publishing teams and anonymous and named external researchers and research integrity experts for contributing to this investigation.

The corresponding author, as the representative of all authors, has been given the opportunity to register their agreement or disagreement to this retraction. We have kept a record of any response received.

References

[1] Y. Xiao, Y. Chen, Y. Tang, and H. Jung, "Design and Implementation of Office Automation System Based on Internet of Things Technology," *Wireless Communications and Mobile Computing*, vol. 2022, Article ID 5196542, 8 pages, 2022.

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Research Article

Design and Implementation of Office Automation System Based on Internet of Things Technology

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In order to solve the problem of office automation, this paper proposes the design and implementation of office automation system based on Internet of things technology. This method is to carry out mobile office function through smart phones to realize business message exchange and real-time processing of process approval business. The system adopts b/s structure and adopts the form of front-end machine to realize information sharing between the mobile system and the original system. When users choose to send mail or reply to mail, the client can read the current user name as the sender by itself. The number of uploaded attachments is limited to three at most, and the total size of attachments is not greater than 100 m. *Conclusion*. This method effectively improves the work efficiency of employees.

1. Introduction

With the continuous development of the Internet function, it has been possible to deal with some office businesses through mobile phones. Although office is still in the stage of continuous development, if scientific methods and development tools are used, the office functions of most businesses can be realized. At present, the business system has become an important topic actively planned by the competent government departments and major communication operators. Mobile office system can manage and control business, information, and data; supervise the operation status of various functions in the platform; and carry out fault handling and safety management in time. This system adopts Java, Internet of things (M2M), and SQL Server database technology and pays attention to the functional applications of mobile office, short-distance wireless transmission, and so on, fully taking into account the needs of users, the use process is not only flexible, stable, but also safe and reliable, and the interface is reserved, which can easily access other functions. The research results have practical production significance and application value in the office field.

2. Literature Review

Sisavath and Yu said that sJava is an object-oriented development language and an open technology [1]. Gennaro and others said that they have the characteristics of mutual compatibility. Their advantages are platform portability, versatility, and security. They are applied to all kinds of data centers, personal computers, mobile terminals, etc. and have the world's largest professional developer community [2]. Belkadi and others said that Java is also a widely used programming language. Its main feature is that it is an object-oriented and cross platform language [3]. Gunderson and others said that cross platform refers to that programs can run across multiple platforms (microsoftwindows, applemacincash, Linux, etc.). The cross platform implementation of Java language actually provides a Java virtual machine (JVM) for each computer system [4]. Mohsen and others said that the Internet makes Java the most popular programming language at present, and Java has a far-reaching impact on the Internet [5]. Olowoleni and others said that Java can be seamlessly integrated with HTML, turning static hypertext files into executable applications, greatly enhancing the interoperability of hypertext [6]. Down and others said that Java solved this problem with a special program called applet, which enables Java applets to run through browsers that support Java [7]. LV and Li said that mobile communication technology is a very important part in the field of information technology. Mobile communication technology can enable users to communicate with others at anytime and anywhere and provide good convenience for people's life and work [8]. Tan and others said that in recent years, the mobile communication industry has developed rapidly, and with the continuous improvement of people's living standards, OA systems based on fixed networks and desktop computers have gradually failed to meet the current needs of small and medium-sized companies [9]. Kong and others said that they have stricter requirements on the mobility of communication, the timeliness of communication, and the convenience of information needs [10]. In this way, employees of the company can use mobile communication devices to directly access the Internet, so as to obtain more comprehensive information and complete more work. Mobile Internet is the product of the integration of mobile communication technology and Internet technology, which can meet the purpose of people who want to obtain effective information anytime and anywhere, and has a great impact on all aspects of people's work and life. Therefore, it has gradually become a necessary part of people's life, and "work anytime and anywhere" has also become the most urgent demand for office automation. The office automation system is shown in Figure 1.

3. Method

Due to the rapid development of science and technology, using advanced technology to serve small and medium-sized enterprises, the importance of management and office activities is becoming increasingly prominent. At present, just like many small and medium-sized enterprise office systems, the company has realized the transformation of office from manual mode to digital mode. However, due to the continuous expansion of the company's business, more and more company employees have proposed the idea of "working anytime, anywhere" [11]. Therefore, we need to be familiar with all kinds of work businesses of the company and analyze the workflow of the personnel in all departments of the company, so as to get a reliable basis to provide beneficial information for the system, design, and implementation. Therefore, after detailed investigation and analysis, the company hopes to improve the office efficiency of employees and the business processing ability of leaders through the construction of "mobile office system," so as to improve the competitiveness of the company in the market [12]. In terms of hierarchical topology control, topdisc algorithm only considers forming as few clusters as possible on the premise of ensuring network connectivity. The residual energy of nodes and how to improve the robustness of the network are not considered. The GAF algorithm based on geographical grid clustering and its improved algorithm need to know the exact location of nodes in the network, and the influence of the distance between nodes in the cluster on data aggregation is not considered. The selection of cluster head in LEACH protocol has certain randomness, and other factors that affect the system performance, such as transmission distance and network dynamics, are not fully considered. HEED protocol is a clustering protocol with fixed cluster radius. The selection of cluster head in heed protocol is mainly based on the primary and secondary parameters, which are used to measure the communication cost within the cluster. The primary parameters depend on the residual energy. The standard to measure the communication cost in the cluster is the average reachability power (AMRP) in the cluster. Each node sends campaign messages with different initial probabilities. The initial probability is CH_p, as shown in the following formula:

$$\mathrm{CH}_p = \max\left(\frac{C_p + E_{re}}{E_{\max}, P_{\min}}\right). \tag{1}$$

Among them, C_p and $p_{\min}$ are unified network parameters, which have an impact on the convergence speed, and ere1emx is the ratio of initial energy and residual energy of nodes. Compared with LEACH, this protocol has an improvement in clustering speed and takes into account the communication overhead within the cluster after clustering, but the selection of cluster head is still random. When selecting clusters and cluster heads, VCDAC takes full account of the relationship between the state of the network and the residual energy and distance of nodes. For the network model defined in the above section, assuming that K cluster heads are selected in the r-round election, each cluster contains $(N1k) - 1$ member node and a cluster head node. According to the energy consumption formula, we can get the energy consumed by the cluster head node in a round, as shown in the following formula:

$$E_{\mathrm{CN}} = \left(\frac{n}{k} - 1\right) l \bullet E_{\mathrm{elec}} + \frac{n}{k} l \bullet E_{\mathrm{DA}} + l \bullet E_{\mathrm{elec}} + l \bullet \varepsilon_{fs} d_{\mathrm{toBS}}^2, \tag{2}$$

where k is the number of cluster head nodes, E_{DA} is the energy consumed by cluster head nodes in data fusion, and d_{toBs} is the average distance between cluster head nodes and base stations, as shown in the following formula:

$$d_{\mathrm{tobs}} = \int_A \sqrt{x^2 + y^2} \frac{1}{A} dA = 0.765 \frac{M}{2}. \tag{3}$$

The energy consumed by noncluster head nodes in a round is shown in the following formula:

$$E_{\mathrm{nonCH}} = l \bullet E_{\mathrm{elec}} + l \bullet \varepsilon_{fs} \bullet d_{\mathrm{toCH}}^2, \tag{4}$$

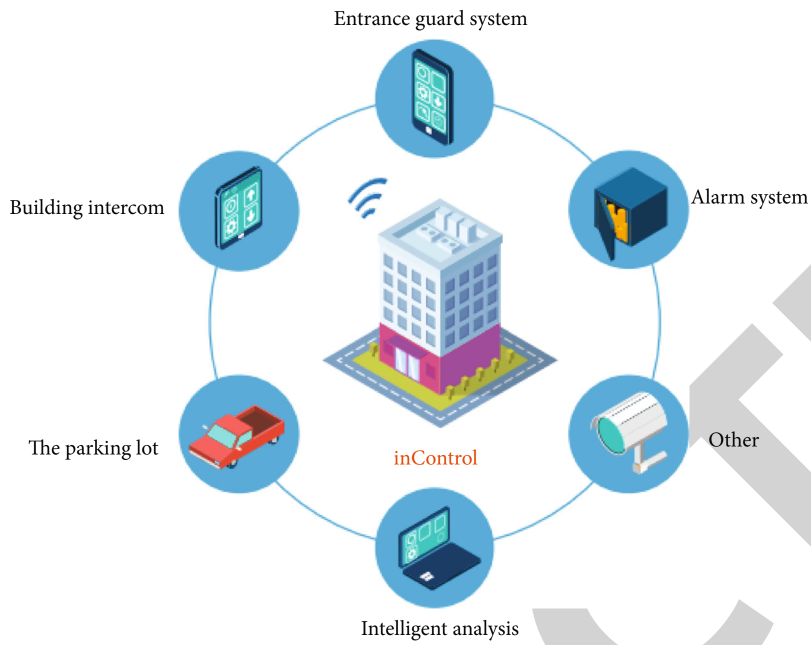

Figure 1: Office automation system.

where d_{toCH} is the average distance from the nodes in the cluster to the cluster head. Assuming that the nodes in the cluster are evenly distributed and the distribution density is $p(x, y)$; then, it is shown in the following formula:

$$d_{\mathrm{toCH}}^2 = \int_{x=0}^{x=x_{\max}} \int_{y=0}^{y=y_{\max}} \left(x^2 + y^2\right) \rho(x, y) dx dy = \frac{M^2}{2\pi k}. \quad (5)$$

Therefore, the energy consumption in a single cluster is approximately as shown in the following formula:

$$E_{\mathrm{cluster}} = E_{\mathrm{CH}} + \frac{n}{k} E_{\mathrm{nonCH}}. \quad (6)$$

In a round of operation, the energy consumption of the whole network is shown in the following formula:

$$E_r = l\left(2nE_{\mathrm{elec}} + nE_{\mathrm{DA}} + \varepsilon_{fs}\left(kd_{\mathrm{toBS}}^2 + nd_{\mathrm{toCH}}^2\right)\right). \quad (7)$$

We take the derivative of E and k and make the result 0, as shown in the following formula:

$$E_r' = l\varepsilon_{fs}\left(d_{\mathrm{toBS}}^2 - \frac{N}{2\pi}\frac{M^2}{k^2}\right) = 0. \quad (8)$$

As shown in the following formula:

$$k_0 = \sqrt{\frac{n}{2\pi}} \frac{M}{d_{\mathrm{toBS}}}. \quad (9)$$

Bring d_{toBS} in as shown in the following formula:

$$k_0 = \sqrt{\frac{n}{2\pi}} \frac{2}{0.765}. \quad (10)$$

It can be seen that in the scenario we set, the optimal number of cluster heads is only related to the number of nodes in the cluster. With the operation of the network, it is necessary to dynamically adjust the number of clusters in the monitoring area to prolong the survival time of the network. In addition, the node information in the cluster, such as residual energy, location, and other information, can be sent to the convergence point by piggyback in order to obtain accurate information without increasing the overhead of the system. In other algorithms, the estimation method is usually adopted, which is extremely inaccurate.

4. Experiment and Analysis

The mobile office platform is composed of two parts: Web terminal and mobile client [13, 14]. The web side has the administrator authority function, which can add and delete ordinary administrators and can add and modify resources. Since I am mainly responsible for developing the client of mobile office platform, this chapter mainly discusses the design of the client. The design and development of the client mainly includes mobile office platform client main interface, system notice announcement, personal schedule management, company internal mailbox, and company employee address book and lunch reservation. The overall structure of the system is shown in Figure 2.

Just like many small and medium-sized enterprises now, the company uses the main enterprise internal information network, LAN OA, and other information systems. Such management cannot achieve the goal of working anytime and anywhere. Therefore, we should master the advanced management methods of large enterprises, so as to improve the office efficiency of enterprises [15]. Mainly to analyze whether the technical conditions can make the development work complete smoothly. In terms of software, we should

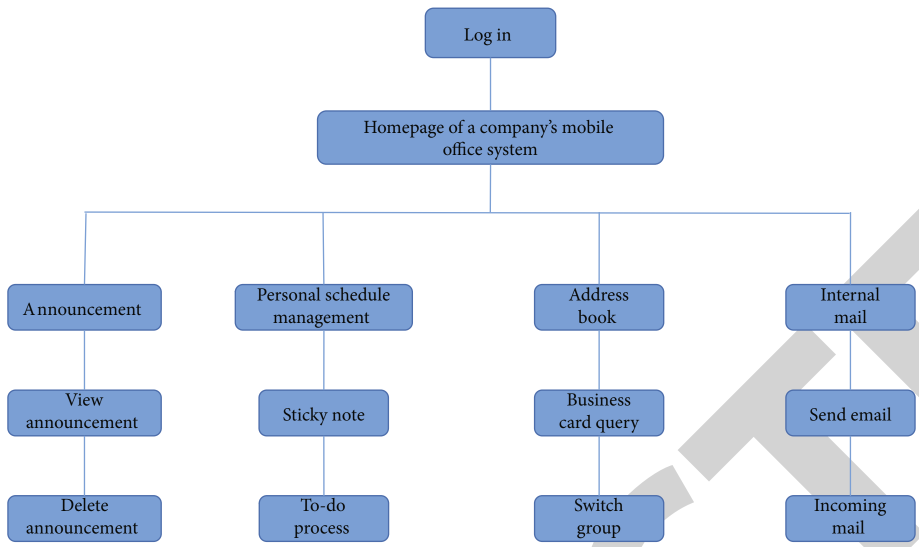

Figure 2: Overall structure of the system.

mainly consider the configuration of the operating system. The configuration and function of the system are easy to use and flexible, which is conducive to the development of this software. And personally, I have a certain programming foundation and have carefully studied the principle of database and can skillfully use it. The mobile office system is analyzed according to the business work and personal schedule management of the personnel of each department of the company, and different rights are given to users according to the permissions of the company's employees, so that the company's employees and department leaders can reasonably use the system [16, 17]. The users of the software are mainly divided into company employees and department leaders. Because the level of company employees varies, the permissions to access system data are also different. The company's employees, including the staff in the company's office, mainly use various application systems for personal schedule management and company information viewing. Department leaders are mainly used to monitor whether the operation of the whole system is normal. At the same time, they have the functions of issuing notices and announcements, managing address book management, managing personal schedule management, and booking lunch. These modules are the main modules of the system [18]. After the system is started, the user needs to verify the user name and password on the main interface of the client. After successful verification, he can enter the main interface of the client, and through the main interface of the system, he can enter each submodule. The system divides the permissions of employees into two types. One has the authority to publish company announcements, that is, after logging in successfully, you can view published announcements, publish announcements, and delete published announcements. The other one does not have the authority to publish company announcements. After logging in, such users can only query published announcements and cannot publish announcements or delete published announcements. Other function modules can be used by all users, such as company announcement, personal schedule management, office business card, email management, and lunch reservation module. Click the icon on the interface to enter the corresponding module. After the user logs in the main interface of the client, the client will immediately send a request for the permission to publish the company's notice [19]. If we have the permission to publish company announcements, the icons of publishing announcements and deleting published announcements will appear: if you do not have the permission to publish company announcements, only the chart of viewing company announcements will appear. The overall use case diagram of this system is shown in Figure 3.

The system is only available to employees of the company, so people outside the company cannot use the software. In order to ensure the security of the system, the username and password of the system are verified to protect the company's information. Due to the different levels of employees, the company's announcement authority is also different. After logging in the main interface of the client, determine whether the employees of the company have the authority to publish announcements and delete published announcements. Therefore, it is necessary to design the main interface module of the client, which has been logged in and authority verification functions [20]. In order to facilitate the company's employees to view the company's notices and announcements anytime and anywhere, so that the notices and announcements can be communicated to each employee in a timely manner, a modification module is specially set up. Through the notification and announcement module, employees can view the announcement information anytime and anywhere, which avoids the problem of notifying each department one by one. At the same time, it also avoids the problem that some employees do not view the announcement information in time and can view the historical announcement at any time. However, since not every employee has the permission to send notices and announcements, the company's employees are divided into two parts according to the login and permission verification

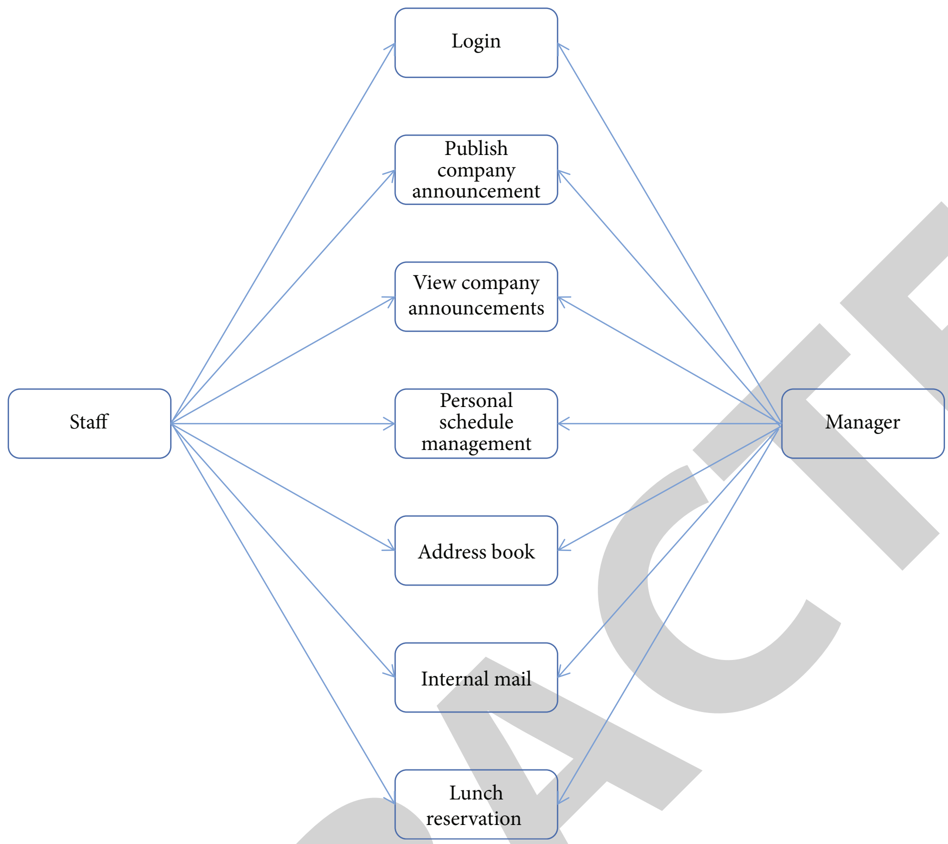

Figure 3: System use case diagram.

module. One part is the company's employees, which only has the function of viewing notices and announcements. The other part is the administrator, which can not only view the announcement notice but also publish the company announcement and delete the issued announcement. The use case diagram of this module is shown in Figure 4.

The personal schedule management module needs to add content according to each user's own definition and requirements, so it is mainly divided into three modules: memo, to-do process, and done process. The memo is used to record the daily life affairs of employees. The to-do process and the done process are related to the company's affairs. If the to-do process is completed, it will be automatically divided into the in-process process. If the in-process process is completed, it will be automatically divided into the done process, which is convenient for employees to query their own work affairs. The use case diagram of this module is shown in Figure 5.

The cluster head election interval of each round is defined as 9 s. The number of client requests is between 1 and 300. All experiments were repeated 30 times to calculate the average value. Each client will wait for a random time interval (selected in the interval [0 s, 9 s]) to broadcast a random service request. If the node providing the service is in the working state at this time, the two interact directly without delay; otherwise, wait for the node providing the service to wake up, and once it wakes up, form a single request/response interaction to use it [21, 22]. We designed a service discovery method without sleep mechanism as a comparison, which is called nondormancy method. In this method, all nodes are always awake. When the client broadcasts the service request, the matching service node will respond and can be used continuously. For the convenience of calculation, we ignore the cluster head election delay and state transition delay. The service request interaction delay of S1B3, S2B3, and nondormancy is given, as shown in Figure 6.

The core of the company's mobile office platform is the enterprise's own LAN. Users mainly rely on the enterprise system domain network and external network for interactive access. The platform of mobile office system is mainly a three-tier c/s structure of client application, web server, and database, which can ensure the maintainability and scalability of the software. The division of the three-tier structure can make the system have more independent logic and can see the tasks of the requirements module more clearly. In mobile client application, mobile phone software developed based on Android system is used to facilitate users' real-time operation. In core application module, this module is mainly responsible for processing data and transaction logic, communicating with the adapter module, and interacting with each terminal. The module adopts J2EE architecture, and the design of the system adopts MVC mode and integrates different technologies, so that the system can have good performance on different operating systems. In adapter module, it implements mobile communication protocol interfaces with various application systems, such as API interface and

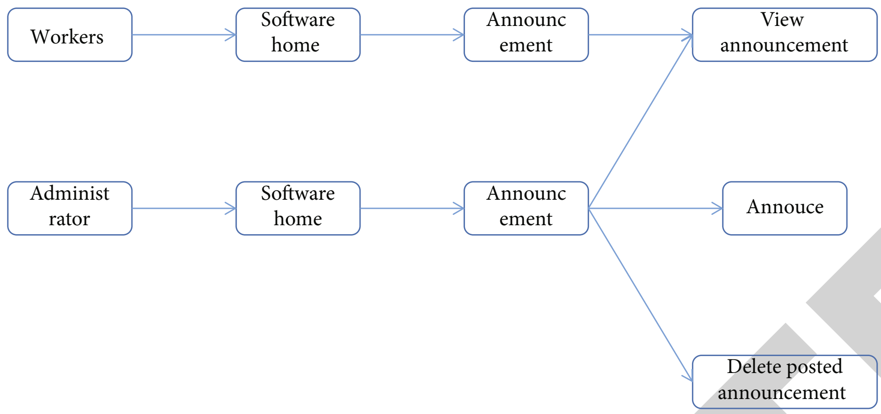

Figure 4: Use case diagram of company announcement module.

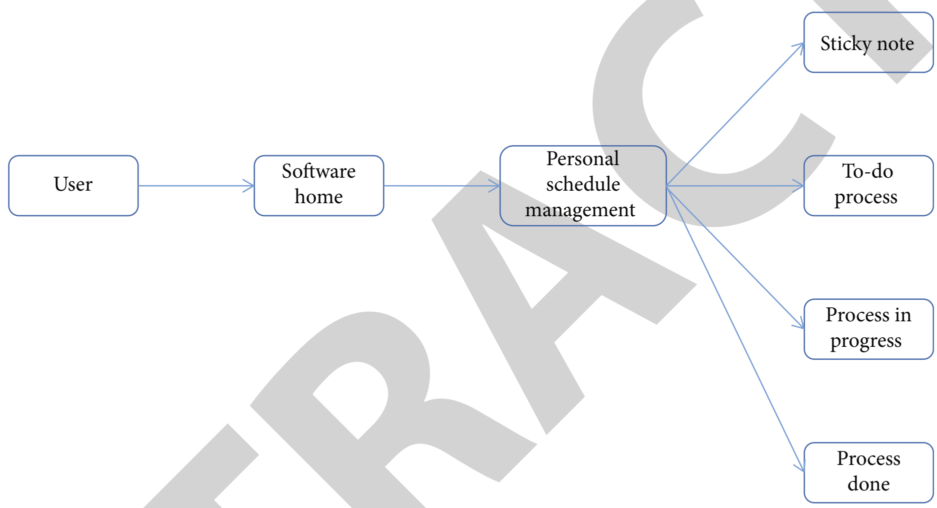

Figure 5: Use case diagram of personal schedule management module.

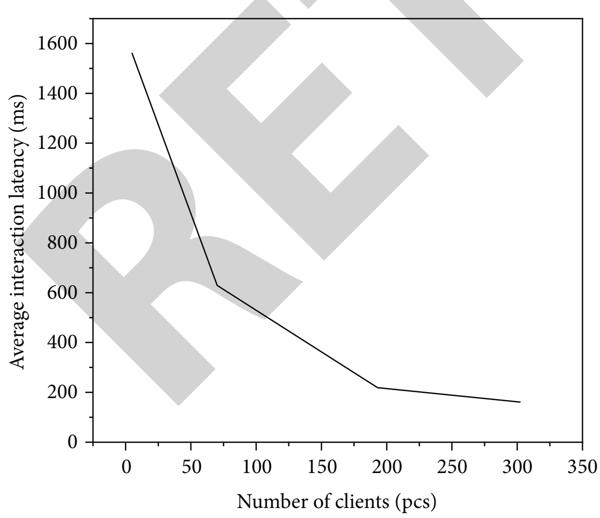

Figure 6: Service request interaction delay.

database interface [23]. The management module is configured and its main function are centralized management and configuration of the system, self-maintenance and management of the system, and the ability to query user status. The design of the client is the most important part of the whole system. If the client program design does not meet the requirements, then, the design of other functions has no effect. MVC mode is adopted in the design of client main interface of mobile office system. In the main interface, the buttons of each function will be displayed on the. When you click the button, the system will read the coordinate value of the icon, then judge according to the corresponding monitoring method and jump to the corresponding interface [24, 25]. Through MVC mode, the interface, data layer, and presentation layer of the system can be effectively isolated, so that the system development is more organized, and it is convenient to modify each functional module in the future. After entering the main interface, the user can see the icon of the notice and announcement and click the image to enter the content page of the notice and announcement. Through the notification and announcement module, the personnel of each department of the company can view the detailed information of all public information anytime and anywhere. For users with the permission to publish announcements, they can also publish announcements and delete published announcements. The company's announcements are sorted according to the release time, which reflects the importance of the latest notice announcements, so that the company's employees can quickly browse the latest announcements. Personal schedule management is mainly used to record personal daily work tasks, including to-do processes, ongoing processes, completed processes, and personal notes. Through the personal schedule management module, the personal information management of the personnel of each department of the company can be realized, and the personal work schedule can be recorded, which is convenient for the personnel of each department of the company to reasonably arrange and plan the time. The small things in daily life can be recorded in a memo. For work affairs, you can add and view to-do processes and query the completed processes to facilitate reporting to leaders. In the to-do process, the time reminder function can be set to assist in managing the progress of work tasks. This module mainly realizes the formulation and planning of personal work plans. Address book design is to build user information table through data form function. The address book function is convenient for company employees to view the public contact information of each department of the company, so as to facilitate the cooperation and communication between departments. You can also add the contact information of friends to my address book, which is clearly grouped and convenient to find. The address book module mainly includes my contact, internal address book, and public address book. The main functions of this module include browsing contacts, adding or deleting contacts, and editing and viewing contacts. After selecting a contact, you can call the contact or send a short message to the contact. The storage of contact information in the address book module requires the use of a database for management and maintenance. This module uses the database provided in Android to implement; now, you can query, modify, add, and delete contacts. In order to realize the function of browsing contacts, you need to design a menu for users to operate, and you can design a list to show to users. At the same time, set the events that users click on a column of information and long-term press on a column of information to facilitate users' choice of contacts. For the interface of adding and modifying contacts, textview is used to display contact phone, name, and other labels. At the same time, EditText is used to realize the contact editing function. The internal e-mail module is mainly used to send e-mails, so that company employees can view their received e-mails in this module, read the contents of e-mails, and choose whether to reply to e-mails [26]. At the same time, the module can also help the company staff transfer electronic materials and download electronic materials. The email content mainly displays the subject of the email, the information of the recipient and sender, the sending time, the body content, and other information. The email and attachments should have a 1-to-many relationship, which is conducive to sending the email to multiple recipients at the same time. Therefore, it is necessary to design the basic information table of e-mail and the information table of e-mail attachments. The system needs to realize the functions of sending email, viewing email, replying to email, deleting email, uploading, or downloading attachments [27, 28]. The interface of the internal mail system is divided into three parts: writing new mail, inbox, and outbox. The inbox and outbox interfaces can display 300 email messages of users. Users can read the details of emails by clicking on the email header. For the convenience of operation, when the user chooses to send or reply to mail, the client can read the current user name as the sender by itself. The number of uploaded attachments is limited to three at most, and the total size of attachments is not greater than 100 m. This paper introduces the overall design of the system; analyzes the overall architecture of the software, the functional design of each submodule, and the design of the database according to the needs of users; and introduces it in detail. Through the research on the overall architecture of the whole system and the functions of each module, the author has a clear architecture of the whole system.

5. Conclusion

With the development of science and technology and the progress of society, the electrical equipment inside the intelligent building is also increasing. As an important part of the intelligent building, the building equipment management system is facing new challenges. On the one hand, the number of electrical equipment and monitoring points is increasing. On the other hand, the system is not running well. At this time, it is necessary to use the Internet of things technology to realize the analysis and processing of massive data in the system and the remote monitoring and management of building equipment. This paper studies the application of Internet of things technology in building equipment management system, studies and designs the remote monitoring scheme of building equipment based on the data application service platform of Internet of things, and verifies its feasibility through an engineering example. The main work of the research is as follows: first, by analyzing the architecture of the Internet of things, the application requirements of the Internet of things technology in the building equipment management system are studied. Second, the widely used M2M technology is used to study the data access of the Internet of things, and the data access between the building equipment management system and the Internet of things platform is realized. Then, it studies the implementation of the building equipment remote monitoring and management system based on the Internet of things platform, puts forward the overall structure scheme of the system, and then designs the elevator remote monitoring subsystem in the building equipment management system for specific engineering projects, which realizes the remote monitoring and management of building equipment and various application services.

Data Availability

The data used to support the findings of this study are available from the corresponding author upon request.

Conflicts of Interest

The authors declare that they have no conflicts of interest.

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Retraction

Retracted: Application of Virtual Reality Technology in Teaching and Training System of Processing Industrial Robot

Wireless Communications and Mobile Computing

Received 25 July 2023; Accepted 25 July 2023; Published 26 July 2023

This article has been retracted by Hindawi following an investigation undertaken by the publisher [1]. This investigation has uncovered evidence of one or more of the following indicators of systematic manipulation of the publication process:

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(2) Discrepancies in the description of the research reported
(3) Discrepancies between the availability of data and the research described
(4) Inappropriate citations
(5) Incoherent, meaningless and/or irrelevant content included in the article
(6) Peer-review manipulation

The presence of these indicators undermines our confidence in the integrity of the article's content and we cannot, therefore, vouch for its reliability. Please note that this notice is intended solely to alert readers that the content of this article is unreliable. We have not investigated whether authors were aware of or involved in the systematic manipulation of the publication process.

Wiley and Hindawi regrets that the usual quality checks did not identify these issues before publication and have since put additional measures in place to safeguard research integrity.

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[1] Q. Chen, "Application of Virtual Reality Technology in Teaching and Training System of Processing Industrial Robot," *Wireless Communications and Mobile Computing*, vol. 2022, Article ID 3415660, 8 pages, 2022.

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Research Article

Application of Virtual Reality Technology in Teaching and Training System of Processing Industrial Robot

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In order to solve the problem of difficult teaching and slow teaching in the traditional teaching method of industrial robots, a virtual reality technology is proposed in the teaching and training system of industrial robots. The binocular vision module is fixedly connected to the end tool of the robot to reduce the limitation of teaching range. A hand-held teaching device with a feature plate and a position and pose measuring rod is designed to teach the position and pose of set points quickly. The least square method is used to calibrate the translation parameters of the end of the feature plate. The system collects the image of the feature plate of the hand-held teaching device through binocular vision module and processes the image to obtain the position and pose information of the end points; the pose information is converted to the robot base coordinate system to realize the robot teaching reproduction, and then the teaching reproduction test of 25 points in space is carried out. The experimental results show that the average error of the robot teaching position is 2.427 mm; after using mobile demonstration, the mean position error decreases by 25.3%. *Conclusion*. The application of virtual reality technology in the teaching and training system of machining industrial robot can improve the accuracy of teaching repetition.

1. Introduction

Industrial robot technology with computer science and control theory of mechanical and electrical engineering and information technology such as the development of technology has gradually become a standard equipment that is widely used in welding assembly handling a variety of domains such as glue. Industrial robots in raising the level of industrial production automation at the same time greatly reduce the labor costs and improve production efficiency. In addition, as the country attaches great importance to manufacturing and the transformation and upgrading of traditional industries, while promoting the construction of new infrastructure, the demand for high-quality industrial robot application talents is more urgent. Currently, more and more opened industrial robot technology specialty in higher vocational colleges, in the course of industrial robot teaching, need to rely on specific industrial robot workstation, related equipment price is higher, the space is larger, the restriction of the funds and site conditions, school training equipment quantity is less, the classroom 5-6 students share a set of equipment, and embrace operation time is very limited. Aimed at the limitations of operating time, training equipment, and students in the teaching process, through the virtual simulation software to simulation and debugging of workstation, then to test the physical equipment, it can reduce the training costs and improve the training efficiency and teaching effect, and it will also to a certain extent solve the students' self-study before class and after class development stage without machine problems with entity operations.

Sensing technology with computer technology and network communication technology, especially in the context of industrial 4.0, intelligent manufacturing (IM) has been further developed. Intelligent manufacturing has become the main direction of a new round of industrial technology reform in China's manufacturing industry. It integrates the development of artificial intelligence, flexible manufacturing, virtual manufacturing system, control network, integrated information processing, and other disciplines and technologies. Specially, virtual reality technology in mechanical engineering (e.g., parts and components maintenance in machine tool design) in the field of application greatly promoted the machinery intelligent manufacturing implementation of major projects. Virtual reality (VR) is a computer system that creates people and the world. It is a human-computer interaction tool. Simulation using virtual reality technology makes people feel like they are in the scene and can manipulate and interact with extremely complex data. According to the different degrees of user participation and sense of immersion, virtual reality system is usually divided into desktop virtual reality system, immersive virtual reality system, and distributed virtual reality system.

This VR technology is also known as virtual integrated display technology in social practical applications. It is an extension of multimedia technology and the crystallization of intelligent research on computer technology and intelligent sensing technology. The technology allows the human body to touch the virtual world and provide a relatively realistic vision of the virtual space. Research on VR technology has been extended to various fields, including medical industry, disease diagnosis, industrial production, policy prediction, and hydrogeological simulation exploration. Workshop training is a key point to VR technology application, in terms of design and the relevant operational system, the theory of mechanical production and standardized production process as the basis, by calling the high and new technology, to participate in training personnel to provide a relatively true, and can meet the demand of real-time interaction of information and resources of all automation workshop [1], as shown in Figure 1.

2. Literature Review

With the continuous development of robot technology, industrial robots have occupied a pivotal position in the field of industrial production in human society. Ordinary industrial robots need to be taught before moving. At present, the traditional way is teaching reproduction and offline programming. In teaching reproduction mode, the position and posture of the robot end-effector need to be adjusted repeatedly. The whole teaching process is time-consuming and labor-consuming, which reduces the working efficiency of the robot. In addition, the operator should be close to the robot to observe the robot when the robot moves, resulting in personal safety risks. Offline programming has higher security, but it needs to build models separately according to different workpieces. In the face of changeable workpieces and processing requirements, heavy preliminary work reduces production efficiency.

In view of the shortcomings of the above traditional teaching methods, many scholars combined binocular vision technology with robot teaching to improve teaching efficiency. Ortt, R. proposed a stereo vision teaching method based on binocular camera, which controlled the robot's repeated motion based on fuzzy set theory until the robot reached the specified teaching point [2]. In the teaching process, Wang, Z. collected binocular vision images of objects, extracted object edges through digital image processing method, calculated three-dimensional coordinates of object center, and generated teaching path through spatial fitting difference method of dimensional transformation [3]. The above methods mainly analyze and calculate the processing path through image processing and data optimization, so as to improve the teaching efficiency. However, the lack of robot end tool pose data source has certain limitations in practical application. Therefore, in this paper, binocular vision system is used to continuously take the image of the teaching handle with calibration object and record the motion trajectory of the handle [4]. This method converts the pose information of the teaching handle in the camera coordinate system to the robot base coordinate system to realize the complex trajectory reproduction. However, this method is not universal and requires the robot end-effector and the teaching handle to have the same shape. A teaching programming system for industrial robot based on visual guidance is proposed, which uses a teaching tool with calibration to carry out continuous teaching and converts it into robot motion instruction, so as to realize the reproduction of teaching trajectory [5]. Maslivetc, V. A., builds a visual system to observe teaching tools. Once the system is calibrated, neither the robot nor the visual system can move, which limits the teaching space and movement range of the robot to a certain extent [6].

Aiming at the limitations of binocular vision technology in robot teaching, a robot fast teaching system is proposed by installing binocular vision module on the end tool of the robot to form an eye-on-hand model [7]. The coordinate system transformation of the fast teaching system is studied, and the least square method is used to calibrate the handheld teaching device designed. Finally, the fast teaching reappearance experiment and mobile teaching experiment are carried out with the system.

3. Method

3.1. Binocular Vision Teaching System

3.1.1. Principle of Binocular Vision Ranging. Binocular vision structure is based on the principle of human eyes observing the outside world, the image information of the same target under two cameras is processed and calculated, and the depth information of the target in binocular stereo vision system is calculated by triangular parallax method, so as to obtain the position, shape, and posture information of the target in three-dimensional space [8].

In the parallel binocular vision system structure, the two cameras placed in parallel, two camera coordinate system exists only between two optical center around a translational transform camera attachment b is called the baseline, zero PL and PR d is called the parallax, the coordinates of the difference between using parallax d and similar triangle principle, calculation point P in parallel binocular stereo vision system of three-dimensional coordinate information [9].

The established coordinate system $o_L - x_L y_L z_L$ and $o_R - x_R y_R z_R$ is the coordinate system of the two cameras with the center of light as the origin. The two cameras are placed in parallel, and the optical axes of the two cameras are parallel, that is, $o_L - x_L y_L z_L$ and $o_R - x_R y_R z_R$; the coordinate system is parallel [10]. Plane A and B are the imaging planes of

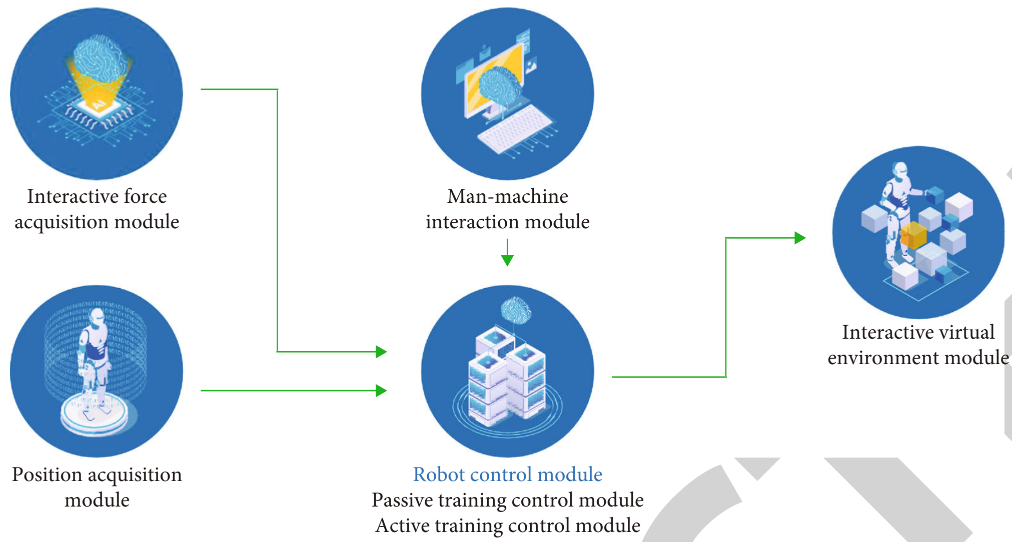

Figure 1: Virtual reality technology.

Table 1: Visual system parameter.

Model of camera	MV-CE050-30GM
Distinguishability	2592x1944
Focal length	4 mm
Baseline distance	80 mm
Working distance	600 mm
Field of view	900mmx700mm

the left and right cameras, respectively, and the projection points of points $P(X, Y, Z)$ on the imaging planes of the left and right cameras are, respectively $P_L(X_L, Y_L, Z_L)$ and $P_R(X_R, Y_R, Z_R)$. In order to obtain parallax d, the imaging plane of the right camera is shifted to the imaging plane of the left camera, so that the two imaging planes are overlapped, and the projection point on the imaging plane P_R' of the left camera P_R is obtained as shown in Formula (1):

$$d = X_L - X_R, \tag{1}$$

$$Z_L = Z_R = f. \tag{2}$$

In Formula (2), it is the focal length of the camera.

In order to obtain the three-dimensional coordinate information of point P in the binocular vision coordinate system, let K be the translation displacement of the imaging plane of the right camera, that is, the distance between the optical axes of the two cameras (baseline length b) [11]. f and K were obtained by binocular camera parameter calibration. According to the similar triangle theorem, the relation between parallax D and depth Z is shown in Formula (3):

$$Z = \frac{fK}{d}. \tag{3}$$

Similarly, X and Y of point P are shown in Formula (4):

$$X = \frac{fX_L}{d}, Y = \frac{fY_L}{d}. \tag{4}$$

3.1.2. Coordinate Conversion of Binocular Vision Teaching System. Binocular vision teaching system mainly includes robot, binocular vision module, and hand-held teaching device. There are five coordinate systems: BCS (robot base coordinate system), TCS (robot end-holding tool coordinate system), CCS (binocular vision coordinate system), SCS (black and white checkerboard coordinate system), and PCS (hand-held teaching device terminal coordinate system) [12]. Among them, BCS is the coordinate system constructed from the center position of the base of the robot body, which is also the reference coordinate system of the robot movement. TCS is a coordinate system with the origin of the end point of the tool held by the robot; CCS is a coordinate system constructed from the optical center of the left camera in the binocular vision system. SCS is constructed by combining the geometric relations between the inner corners of the black and white checkerboard. PCS is a coordinate system with the origin of the end point of the position and pose measuring rod of the hand-held teaching device [13]. T5 is the pose transformation from BCS to PCS, as shown in Formula (5):

$$T_5 = T_1 \cdot T_2 \cdot T_3 \cdot T_4. \tag{5}$$

T_1 is the position and pose transformation relationship between BCS and TCS; T_2 is the position and pose transformation relationship from TCS to CCS, that is, the hand-eye relationship. T_3 is the position and pose transformation relationship from CCS to SCS. T_4 is the position and pose transformation relationship from SCS to PCS [14].

According to T_5, the position and posture information of the end of the position and posture measuring rod (i.e., teaching point) of the hand-held teaching device can be

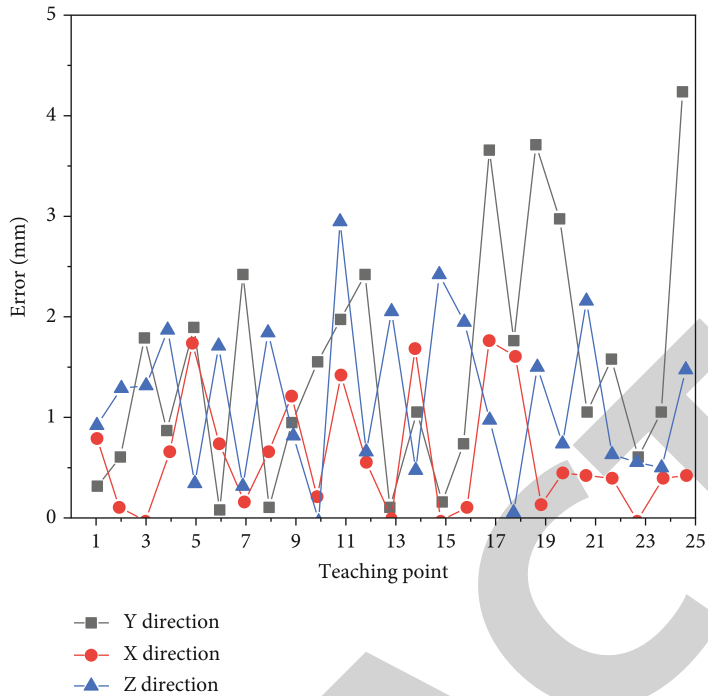

Figure 2: X, Y, Z deflection error.

Table 2: Recurrence error after moving demonstration.

Teaching point	ΔX/mm	ΔY/mm	ΔZ/mm	Δd/mm
5	0.56	1.60	0.50	1.372 042
7	0.10	1.15	0.25	1.533 786
11	1.60	0.02	0.10	2.320 108
12	0.30	1.75	0.50	2.232 151
15	1.25	0.10	0.20	1.767 371
17	1.50	0.70	0.05	1.930 026
19	1.50	1.50	1.20	1.181 101
20	1.00	1.60	0.30	2.048 17
21	1.75	1.10	0.50	1.836 437
25	1.20	1.30	0.20	1.619 907

obtained under BCS, which can be used for the subsequent realization of the position and posture reproduction of teaching point.

3.2. Calibration of Parameters of Hand-Held Teaching Device. The hand-held teaching device contains two coordinate systems, SCS and PCS, respectively. The purpose of calibration is to determine the position and pose transformation relationship T_4 between SCS and PCS. If the design size is directly used to determine the rotation and translation transformation relationship between the two coordinate systems, there will be a large error [15]. Therefore, a translation vector calibration method from SCS to PCS was proposed, and T_4 was calculated based on the design rotation Angle from SCS to PCS (0~90). The calibration steps were as follows:

Step 1. Obtain the three-dimensional coordinate information of the corner points of the visual calibration plate: the visual calibration plate is placed tiled in the effective field of view of binocular vision, and the three-dimensional coordinate information of all corners of the visual calibration plate in the binocular vision coordinate system is calculated and obtained;

Step 2. Solve T_3: randomly select multiple corner points (at least 3) on the visual calibration board, align the ends of the hand-held teaching device with the selected corner points in turn, and collect the black and white checkerboard images on the hand-held teaching device. Corner information of black and white checkerboard was calculated, and T_3 was obtained by constructing pose matrix principle with three-point method.

The black and white checkered board has three inner corner points, respectively, P_1, P_2, and P_3; the coordination record under CCS P_1, P_2, and P_3 is recorded as $P_1\ (x_1, y_1, z_1)$, $P_2\ (x_2, y_2, z_2)$, and $P_3\ (x_3, y_3, z_3)$. The space vector under CCS is constructed according to the space coordinates of three points, with point P_1 as the common point, and points P_2 and points P_3, respectively, form vectors, and the two vectors are perpendicular to each other to form the X-Y axis of SCS, as shown in Formula (6) and (7). The Z-axis is determined according to the right rectangular coordinate system, as shown in Formula (8).

$$\boldsymbol{X}_w = (x_2 - x_1, y_2 - y_1, z_2 - z_1), \tag{6}$$

$$\boldsymbol{Y}_w = (x_3 - x_1, y_3 - y_1, z_3 - z_1), \tag{7}$$

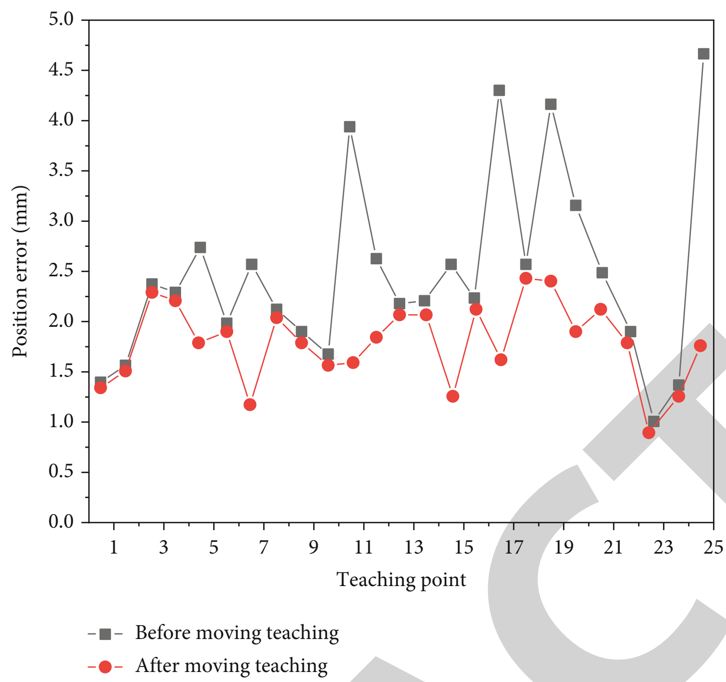

Figure 3: Position error of 25 points before and after moving demonstration.

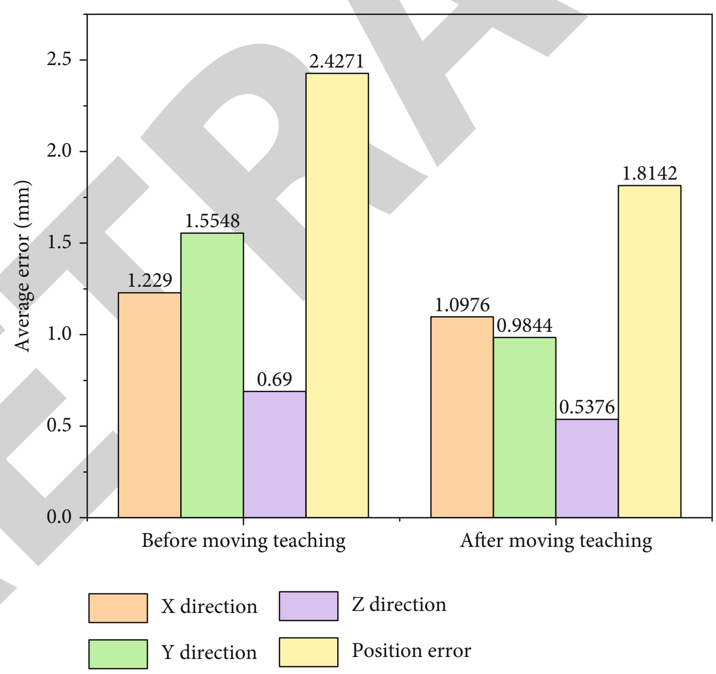

Figure 4: Mean error of 25 points before and after moving demonstration.

$$Z_w = X_w \times Y_w = \begin{bmatrix} (y_2 - y_1)(z_3 - z_1) - (y_3 - y_1)(z_2 - z_1) \\ (x_3 - x_1)(z_2 - z_1) - (x_2 - x_1)(z_3 - z_1) \\ (x_2 - x_1)(y_3 - y_1) - (x_3 - x_1)(y_2 - y_1) \end{bmatrix}^T . \quad (8)$$

The vector X_w, Y_w, Z_w is transformed to unit vector, and the rotation matrix R of SCS relative to CCS is established as shown in Formula (9):

$$R = [X_w^c \; Y_w^c \; Z_w^c] = \begin{bmatrix} X_{we} \cdot X_c & Y_{we} \cdot X_c & Z_{we} \cdot X_c \\ X_{we} \cdot Y_c & Y_{we} \cdot Y_c & Z_{we} \cdot Y_c \\ X_{we} \cdot Z_c & Y_{we} \cdot Z_c & Z_{we} \cdot Z_c \end{bmatrix} . \quad (9)$$

Finally, the point coordinate value (x_1, y_1, z_1) is set as the origin of the coordinate system of the feature recognition unit, that is, the translation vector of the coordinate system. Finally, the pose transformation matrix T_3 between CCS and SCS is constructed as shown in Formula (10):

$$\boldsymbol{T}_3 = \begin{bmatrix} \boldsymbol{X}_{\text{we}} \cdot \boldsymbol{X}_c & \boldsymbol{Y}_{\text{we}} \cdot \boldsymbol{X}_c & \boldsymbol{Z}_{\text{we}} \cdot \boldsymbol{X}_c & x_1 \\ \boldsymbol{X}_{\text{we}} \cdot \boldsymbol{Y}_c & \boldsymbol{Y}_{\text{we}} \cdot \boldsymbol{Y}_c & \boldsymbol{Z}_{\text{we}} \cdot \boldsymbol{Y}_c & y_1 \\ \boldsymbol{X}_{\text{we}} \cdot \boldsymbol{Z}_c & \boldsymbol{Y}_{\text{we}} \cdot \boldsymbol{Z}_c & \boldsymbol{Z}_{\text{we}} \cdot \boldsymbol{Z}_c & z_1 \\ 0 & 0 & 0 & 1 \end{bmatrix}. \tag{10}$$

Step 3. Solve T_4: set the translation vector from SCS to PCS under CCS as T_g, as shown in Formula (11):

$$\boldsymbol{T}_g = \boldsymbol{T}_3 \cdot \boldsymbol{T}_t = \begin{bmatrix} x \cdot R_{11} + y \cdot R_{12} + z \cdot R_{13} + x_g \\ x \cdot R_{21} + y \cdot R_{22} + z \cdot R_{23} + y_g \\ x \cdot R_{31} + y \cdot R_{32} + z \cdot R_{33} + z_g \\ 1 \end{bmatrix}. \tag{11}$$

The translation vector $[x\,y\,z]^T$ from SCS to PCS on the hand-held teaching device is denoted as Formula T_t (11), which is equivalent to Formula (12):

$$\begin{bmatrix} R_{11} & R_{12} & R_{13} & x_{gi} \\ R_{21} & R_{22} & R_{23} & y_{gi} \\ R_{31} & R_{32} & R_{33} & z_{gi} \end{bmatrix} \cdot \begin{bmatrix} x \\ y \\ z \\ 1 \end{bmatrix} = \begin{bmatrix} x_{ni} \\ y_{ni} \\ z_{ni} \end{bmatrix}. \tag{12}$$

i represents the number of calibration points used for calibration, and $i \geqslant 3$; $[x_{ni}\,y_{ni}\,z_{ni}]^T$ is the location of the corresponding standard point in the CCS. Substitute the position information of the i standard points under CCS into Equation (12) and get Formula (13):

$$\begin{bmatrix} R_{11}^i & R_{12}^i & R_{13}^i \\ R_{21}^i & R_{22}^i & R_{23}^i \\ R_{31}^i & R_{32}^i & R_{33}^i \end{bmatrix} \cdot \begin{bmatrix} x \\ y \\ z \end{bmatrix} = \begin{bmatrix} x_{n1} - x_g^i \\ y_{n1} - y_g^i \\ z_{n1} - z_g^i \end{bmatrix}. \tag{13}$$

The matrix is obtained by least square method $[x\,y\,z]^T$.

The rotation relationship between SCS and PCS determines the rotation matrix R_t, which performs a rotation transformation with rotation angle of 45 along the Y-axis of the SCS when building PCS. Then, R_t is shown in Formula (14):

$$\boldsymbol{R}_t = \begin{bmatrix} \cos 45^\circ & 0 & \sin 45^\circ \\ 0 & 1 & 0 \\ -\sin 45^\circ & 0 & \cos 45^\circ \end{bmatrix}. \tag{14}$$

Eventually, T_4 is obtained by $\begin{bmatrix} R_t & T_t \\ 0 & 1 \end{bmatrix}$.

3.3. Experimental Verification. The experimental platform of binocular vision teaching system was set up, including the binocular vision module of Kawasaki RS010NA industrial robot, for teaching repetition test [16]. Visual system parameters are shown in Table 1.

The robot rapid teaching system with binocular vision shows the teaching process: (1.) switch to the desired trajectory fitting mode by pressing the button; (2.) in the effective field of view of binocular vision module, the hand-held teaching device is operated to align with the set point and teach the position and posture of the set point; (3.) the binocular vision system captures the image of the hand-held teaching device during teaching, calculates the position and pose information of the end of the position and pose measuring rod, and converts the position and pose information to BCS to form the robot motion path information; (4.) according to the selected trajectory fitting mode and teaching point information, the path planning is carried out to form the robot movement code and control the robot to reproduce teaching, so as to complete the rapid teaching of the robot. In addition, in the case of teaching requirements beyond the visual field range of the visual system or in order to reduce the impact of low teaching accuracy caused by large distortion of the edge of the visual field, the hand-held teaching device can be moved to a new position by operating the robot to teach in the center of the visual field of vision [17, 18].

4. Result and Analysis

Select a teaching point in the space, use a hand-held teaching device to aim at the set point for teaching, and then use a robot to reproduce the teaching position and posture. The specific process is as follows:

25 points were selected in the space, and they were arranged from close to the center of the camera's field of view to far from the center of the camera's field of view, and marked as$Q_i (i = 1, 2, \cdots, 25)$. Use the hand-held teaching device to align Q_i and record the terminal position information $X_i Y_i Z_i$ displayed by the upper computer of the robot; then, the robot is used for teaching and reproducing, and the error between the robot's reproducing position and teaching point position is measured [19, 20]. The diameter of the robot end welding wire is 1.2 mm, the center of the welding wire is taken as the robot end point, and the feeler gauge is used to measure the error, as shown in Figure 2.

The average distance error between the position XYZ of the teaching point and the position $X'Y'Z'$ of the robot is 2.427 mm, which shows that the principle of binocular vision teaching system is correct [21]. At the same time, the experimental results show that the set point position near the camera's field of vision has a small reoccurrence error, while the set point position far from the camera's field of vision has a large reoccurrence error, which is caused by camera distortion [22, 23]. Therefore, it is proposed to use mobile teaching to conduct a second test on the set point (10 points) with large error to reduce the influence of camera distortion on the experimental results. By moving the robot position, the hand-held teaching device is placed in the center of the camera's field of vision and the teaching is repeated. The results are shown in Table 2.

As shown in Figures 3 and 4, by comparing the test results of the fixed teaching demonstration with the mobile teaching demonstration with the robot moving, it can be seen that the position error of the 25 points after the mobile teaching is significantly decreased: The x-direction mean error decreased by 10.7%, y-direction mean error decreased by 36.7%, Z-direction mean error decreased by 22.1%, and mean position error decreased by 25.3%. The experimental results show that mobile teaching has certain optimization effect on the teaching repetition accuracy and can reduce the influence caused by camera distortion [24, 25].

5. Conclusion

This paper presents the application of virtual reality technology in the teaching and training system of processing industrial robots and proposes a robot fast teaching system based on binocular vision. The experimental results show that the average error of robot teaching position is 2.427 mm after fast visual teaching. After mobile teaching, the average position error decreases by 25.3%. The system is feasible, and mobile teaching can improve the reproducibility accuracy. A hand-held teaching device is designed to simulate the real welding torch and complete parameter calibration based on the least square method to solve the problem that the current teaching tool method is not universal. The hand-held teaching device can make full use of man hands' flexibility to quickly and intuitively confirm the position and pose information of the teaching point and reduce the teaching time required by industrial robots.

Data Availability

The data used to support the findings of this study are available from the corresponding author upon request.

Conflicts of Interest

The author declares that there are no competing interests.

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Retraction

Retracted: Open Sharing Management of Artificial Intelligence Laboratory Based on Deep Fusion of Big Data

Wireless Communications and Mobile Computing

Received 18 July 2023; Accepted 18 July 2023; Published 19 July 2023

This article has been retracted by Hindawi following an investigation undertaken by the publisher [1]. This investigation has uncovered evidence of one or more of the following indicators of systematic manipulation of the publication process:

(1) Discrepancies in scope
(2) Discrepancies in the description of the research reported
(3) Discrepancies between the availability of data and the research described
(4) Inappropriate citations
(5) Incoherent, meaningless and/or irrelevant content included in the article
(6) Peer-review manipulation

The presence of these indicators undermines our confidence in the integrity of the article's content and we cannot, therefore, vouch for its reliability. Please note that this notice is intended solely to alert readers that the content of this article is unreliable. We have not investigated whether authors were aware of or involved in the systematic manipulation of the publication process.

Wiley and Hindawi regrets that the usual quality checks did not identify these issues before publication and have since put additional measures in place to safeguard research integrity.

We wish to credit our own Research Integrity and Research Publishing teams and anonymous and named external researchers and research integrity experts for contributing to this investigation.

The corresponding author, as the representative of all authors, has been given the opportunity to register their agreement or disagreement to this retraction. We have kept a record of any response received.

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Research Article

Open Sharing Management of Artificial Intelligence Laboratory Based on Deep Fusion of Big Data

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In order to improve the efficiency of information management of open laboratories in colleges and universities and reduce the cost of information management of open laboratories in colleges and universities, this paper proposes the open sharing management of artificial intelligence laboratories based on the deep integration of big data. The infrastructure layer of the system transmits the information management data of the university open laboratory to the cloud platform layer. The cloud platform layer completes the data management, cloud computing, and access control and transmits the processed data to the application layer. The application layer realizes the information management of the university open laboratory according to the data fed back by the cloud platform layer. Among them, in the process of data transfer in open laboratories of colleges and universities, pyramid technology is used to realize data transfer, and the optimization calculation of particle swarm optimization algorithm is used to complete the transfer of multidimensional and complex data transmission information, so as to improve the efficiency of data transfer. The experimental results show that the system has high accuracy in transferring multidimensional and complex data in university open laboratories, the average resource utilization rate of the system is as high as 92%, the average response of the system is as fast as 8.5 ms, and the management cost is effectively reduced. *Conclusion*. The system designed in this paper can reduce the information management cost of open laboratories in colleges and universities.

1. Introduction

The Internet has developed rapidly in recent decades, and it has been applied in all walks of life. More and more enterprises, schools, and families cannot live without the use of the Internet [1]. In order to meet the growing market demand and continuously conform to the process of social development, the intelligent and convenient Internet of things came into being on the basis of the Internet. The Internet of things technology is a combination of Internet technology, telecommunications technology, and IT technology [2, 3]. As far as China is concerned, the Internet of things is defined as a network that connects any object we need to use with the Internet through RFID technology, infrared sensing, Bluetooth, and other information technology sensors according to the specified protocol and then carries out communication and data exchange to achieve intelligent identification, supervision, and management. In other words, through the induction system, we can perceive the physical objects, connect the induction system with the Internet, interact the sensed things with the Internet, realize the exchange of information, and realize the requirements of intellectualization [4].

In recent years, with the continuous deepening of higher education reform, especially driven by the construction of "teaching evaluation" and "quality engineering," colleges and universities pay more attention to the cultivation of students' practical ability and innovation ability [5]. The role of open laboratories in cultivating innovative and applied talents is increasingly prominent [6]. However, at the same time, university laboratories are facing the following two new situations: on the one hand, the state's investment in higher education is increasing, and a large number of high-quality advanced instruments and equipment have entered the laboratory. The use of these public resources requires the opening of the laboratory to be more full and effective [7, 8]. On the other hand, the number of students in colleges and universities is growing, and some experimental teaching resources are insufficient, which also requires the laboratory to be effectively and reasonably open, so as to maximize the use efficiency of instruments and equipment.

With the development of society and the continuous progress of computer level, Internet of things technology has entered our vision [9]. The Internet of things has gradually become an important part of the new generation of information technology, showing its powerful functions and playing an important role in promoting the development of the entire information industry [10]. The design of laboratory intelligent control system based on Internet of things should grasp the design principles, take teaching as the purpose, and improve the intelligent management level of the laboratory [11]. At the same time, the performance of the laboratory should be strictly monitored. The intelligent connection between devices plays an important role in the maintenance and repair of devices.

2. Literature Review

With the expansion of the scale of colleges and universities, the number and types of instruments and equipment owned by laboratories have increased, their value has increased, and their scientific and technological content and precision have improved, resulting in the overall level of experimental technicians not keeping up with the development of instrument hardware construction, which has seriously affected the full play of the advanced functions of instruments in teaching and scientific research [12]. The reform of experimental teaching system and open laboratories has also increased the workload of experimental technicians so that they do not have enough time to carefully maintain and maintain instruments and equipment, develop the functions of instruments and equipment, let alone scientific research and innovation [8, 13]. The instability and slow development of the experimental staff have seriously hindered teaching reform and scientific research innovation. The operation of open laboratories makes the teaching and scientific research activities of university laboratories more frequent, and the full-time laboratory personnel are obviously insufficient. It is common for temporary workers and students to be on duty in the laboratory, but the corresponding safety measures are often not implemented, leaving many potential safety hazards to the laboratory.

The open laboratory in colleges and universities is the core place of teaching resources in colleges and universities, which mainly provides students with academic exchanges, experimental courses, social skills training, graduation design, and other services [14]. College students can make full use of the open laboratory of colleges and universities to implement independent experiments to improve their practical ability, deeply understand the theoretical knowledge in the course in the process of experiments, and combine theory with practice. In order to improve the overall academic level of college students, major colleges and universities across the country attach great importance to open laboratories in colleges and universities and constantly update and improve the construction of open laboratories in colleges and universities and the development of information management systems [15]. Teachers of open laboratory management in colleges and universities can realize the management of online experimental courses and integrate laboratory teaching resources through the management system. However, at this stage, there are still some problems in the information management of open laboratories in colleges and universities, such as uneven laboratory dispersion, low information sharing, and high system maintenance cost.

The previously designed university open laboratory information management system has some defects. The laboratory management system based on Wi-Fi sniffer technology designed by Raj and others requires the deployment of multiple Wi-Fi sniffers in the process of university open laboratory information management, resulting in increased management costs [16]. The information management system of testing laboratory based on PyVISA designed by Li and others is difficult to effectively transmit information during the management process, which reduces the management efficiency [17]. Cloud desktop technology connects all applications through cloud platform, pushes the information data required by users according to the requirements of users, and realizes information sharing between cloud platform system and users [18]. Therefore, this paper designs an information management system of university open laboratory based on cloud desktop technology to realize the comprehensive and efficient management of university open laboratory information.

3. Method

3.1. University Open Laboratory Information Management System Based on Cloud Desktop Technology

3.1.1. Overall System Structure. In order to improve the efficiency of university open laboratory information management, a university open laboratory information management system based on cloud desktop technology is designed. The overall structure of the system is shown in Figure 1.

It can be seen from Figure 1 that the system is composed of infrastructure layer, cloud platform layer, and application layer. Among them, cloud desktop technology is the guarantee of system operation. The infrastructure layer is composed of hardware, network, and access control components. The infrastructure layer transmits the information management data of university open laboratories to the cloud platform layer, which is the core of the system, and completes data processing and computing in the cloud platform layer. In the data management module, pyramid technology is used to realize data transfer, and particle swarm optimization algorithm is used to optimize the data transfer process of university open laboratory. The processed data is transmitted to the application layer, which realizes the information management of university open laboratory according to the data fed back by the cloud platform layer [19].

3.1.2. System Hardware. The hardware of the system is composed of network switch, knife box, server, and client. The whole system uses three H3C UIS knife boxes, and the server

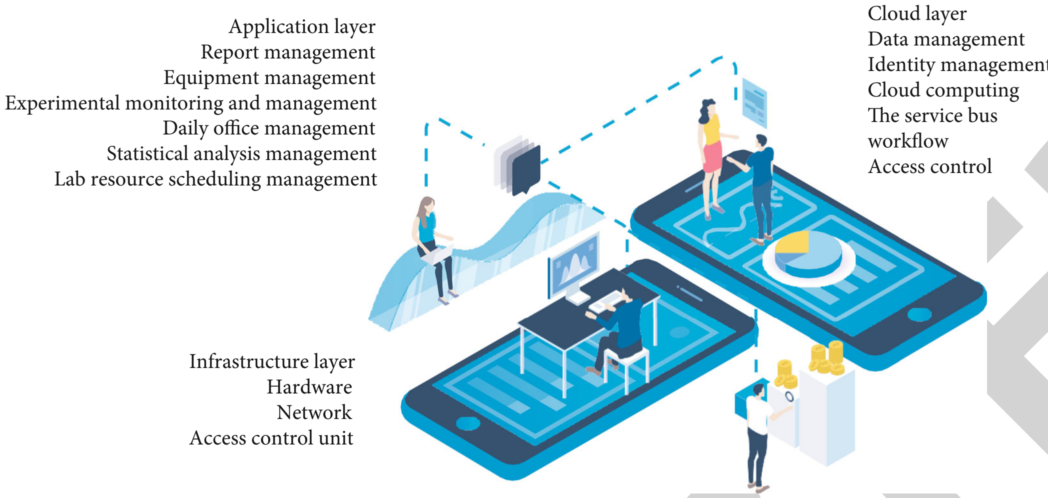

Figure 1: Overall structure of the system.

is configured with H3 blades with 256g and 20g integrated network cards. It is mainly responsible for providing infrastructure guarantee for the system software and improving the running speed of the software.

3.1.3. Optimization of Data Transmission Information Transfer Accuracy

(1) Definition of Data on Storage Primary Key. In the data management module, pyramid technology is used to implement the data transmission information transfer of open laboratories in colleges and universities. In order to obtain the pyramid number of the data transfer decision point, the data is abstracted into a group of binary key values, and the metadata transfer range is given. The amount of data stored in the primary key is to give priority to the data substream with the best quality through the coordinates of the central point and the difference between the judgment points, sort according to the weight of the sub stream, and adjust all the relevant variables of the transferred data, so as to realize the real-time update of the size of the data transferred sub interval.

Suppose that the one-dimensional index of the b -dimensional vector of metadata refers to b_v description, and the node is described by N_i. According to the logical function, it is divided into transfer node and storage node, which are described by IN_i, SN_i, respectively. The data is abstracted into a set of binary key values by using pyramid technology. The specific calculation process is described in

$$B(z, o) = \frac{N_i \otimes IN_i}{SN_i}. \tag{1}$$

Suppose the metadata is described by v_j, and the specific transfer process is described by

$$v_{(1)j} = \frac{\left(v_j - v_{j\,\min}\right) \times B(z, o)}{\left(v_{j\,\max} - v_{j\,\min}\right)[0, 1]}. \tag{2}$$

Among them, the normalized value is described by $v_{(1)j}$, and the value range of metadata is described by $v_{j\,\max}$ and $v_{j\,\min}$, respectively.

Set the data transfer judgment point to be described with a, the pyramid number of the data transfer judgment point to be described with i, and its calculation is described with

$$j_{\max} = \frac{(j|h_v) \times A}{id_v} v_{(1)j} \otimes \Phi. \tag{3}$$

Among them, the interval of one-dimensional index range is described by Φ, and the coordinate difference of center point p in the i-th dimension and the largest one-dimensional vector in data transfer decision point A are described by $(j|h_v)$.

Suppose that the data transfer request is described by $Q_{(P)}$, the effective node of any data transfer in the database is described by label, and the probability that each transfer value has a common prefix with the binary number is described by $\delta(u)$. Define the amount of data storing the primary key by selecting the common prefix through formula (4), and its calculation is described by

$$P_{o\,\min} = \frac{Q_{(P)} \times \text{label} \otimes \delta(u)}{SN_i \otimes q_{j\,\min}} \otimes \text{available}. \tag{4}$$

Let any node in the data center be described by N_{init}. When B is submitted to any node in the data center, the dynamic adjustment of the size of the data transfer subinterval is implemented by

$$\text{INdex} = \frac{N_{\text{init}} \otimes B}{M_{ij} \otimes IN^*} \times \hat{q}_{\text{omin}} \times j_{\max}. \tag{5}$$

Among them, the effective node with the largest number of transfers is described by M_{ij}.

Let the number of different substreams be described with i'', the mapping relationship between the data layer and the substream layer be described with RTT, and the quality of each substream be described with QS_i. The quality of each substream is sorted according to the weight of the substream, and the relevant variables of each data transfer are updated through

$$\mathrm{requ} = \frac{QS_i}{RTT} \otimes \frac{i'' \times (\mathrm{INdex}) \mp \hat{q}_{\mathrm{omin}}}{D(z, o)}. \tag{6}$$

Let the quality of each substream be described by max − RTT and min − RTT, respectively, and give priority to the data substream with the best quality for transfer, as shown in

$$RTT^* = \mathrm{requ} \times (\max - RTT, \min - RTT). \tag{7}$$

Based on the priority data subset, in order to solve the total time of data batch transfer and the urgency of data transfer, particle swarm optimization is introduced into the addition operation of discrete positions, and particle swarm optimization is used to optimize the data transfer process of open laboratories in colleges and universities.

Set the priority transfer data subset to be described with RTT^*, the serial number of the request transfer data package to be described with IP_i, the serial number of the current transfer data package to be described with IP_{piay}, and the size of the transfer window to be described with W_T, and then, the urgency of data transfer is described with

$$U_{ri} = \frac{W_T \otimes (IP_i) - IP_{\mathrm{piay}}}{RTT^*}. \tag{8}$$

Suppose that the time delay of node i is described by D_i, the amount of data waiting to be transferred is described by T_i, and the total time of data batch transfer is described by T_s. The total time of data batch transfer is described by

$$T_s = (T_i \otimes D_i) \otimes U_{ri}. \tag{9}$$

Let the historical optimal position vector be described by $P_{\mathrm{best}} = (p_{\mathrm{best}_1}, p_{\mathrm{best}_2}, \cdots, p_{\mathrm{best}_i})$, the velocity vector by V_i^k, and the updated global optimal velocity and position vector by

$$V_i^{k+1} = wV_i^k \pm \frac{p_{\mathrm{best}} \times a_2 \times \mathrm{rand}}{a_1 \times \mathrm{rand}} - x_i^k \otimes P_{\mathrm{best}}, \tag{10}$$

$$X_i^{k+1} = X_i^k + V_i^{k+1}. \tag{11}$$

The value range of the learning factor is $[0, 1]$, where the x_i^k variogram is a simple random variogram of rand, which is described by

$$x_i^k = x_{\min} + (x_{\max} - x_{\min}) \cdot \mathrm{rand}. \tag{12}$$

Let the individual fitness function be described by $F(X_i)$, and the calculation formula of $F(X_i)$ be described by

$$F(X_i) = \frac{P_{\mathrm{best}} \otimes V_i^{k+1}}{S\left(X_i, P_{\mathrm{b_{est}}}\right) \otimes S\left(X_i, P_{\mathrm{b_{est}}}\right)}. \tag{13}$$

Among them, the storage address before data transfer is described with$(X_i, p_{\mathrm{best}_i})$, the storage address after data transfer is described with $S(X_i, P_{\mathrm{best}})$, and the number of data transfer node sets is described with S.

The global optimal position is described by k_{best}, and the formula for real-time adjustment of particle position is described by

$$\left(k_{\mathrm{best}\,j}\right) = \frac{k_{\mathrm{best}} \otimes F(X_i)}{M_a^b(X_i)} \otimes U_{ri} \times T_s. \tag{14}$$

Among them, the interface grid data set is described by $M_a^b(X_i)$.

3.2. Experimental Analysis. In order to verify the performance of the design management system, the simulation comparative verification experiment is carried out. The specific steps of the experiment are as follows.

Step 1. Select the experimental object, determine the size of the experimental data, and select the simulation tool used in the experiment.

Step 2. Determine the operating parameters of the system during the simulation experiment to ensure the reliability of the experimental results.

Step 3. Select the comparison system used in the experiment to highlight the performance of the designed system.

Step 4. Set the experimental indicators, including the time of system data transfer, root mean square error of data transfer, resource utilization, success rate of data transfer, response time, and management cost.

Step 5. Carry out the comparative experiment of different systems, get the experimental results, and analyze the experimental results.

The flowchart of experimental steps is shown in Figure 2.

The information management work of an open laboratory in a university is selected as the experimental object. The experimental data is the information management data of the open laboratory in a university. The total amount of data is 20 GB. The simulation tool used in the experiment is PlantSim.

The comparison systems used in the experiment are the laboratory management system based on Wi-Fi sniffing technology and the detection laboratory information management system based on PyVISA. The experimental indicators are the time of system data transfer, root mean square

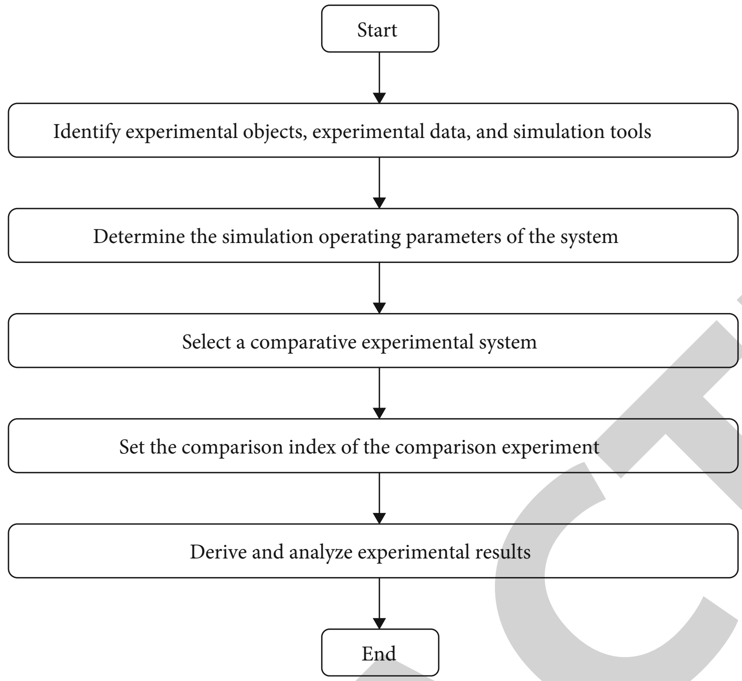

FIGURE 2: Experimental flowchart.

error of data transfer, resource utilization, success rate of data transfer, response time, and management cost.

4. Results and Analysis

In order to test the performance of data transfer in this system, 1000 data were randomly selected in the experiment, and three systems were used to implement the transfer experiment of multidimensional complex data transmission information. The time of data transfer and the root mean square error of data transfer in the three systems were compared, and the results are described in Figures 3 and 4.

From the comparison results of the system data transfer time in Figure 3, it can be seen that under the condition of continuous increase in the amount of data, the data transfer time of the system in this paper is the lowest, and the average data transfer time is 39 ms, which is 17.3 ms and 10.5 ms faster than the other two comparison systems, respectively. Therefore, it shows that this system can efficiently realize the transfer and storage of laboratory data.

According to the comparison results of the root mean square error of data transfer shown in Figure 4, the root mean square error of the system in this paper is much lower than that of the other two comparison systems. The maximum root mean square error of the system in this paper is 0.04, while the maximum root mean square error of the laboratory management system based on Wi-Fi sniffing technology and the detection laboratory information management system based on PyVISA is 0.96 and 0.54, respectively.

The reason why this system has higher data transfer efficiency and lower root mean square error is that in the process of data transfer, pyramid technology and particle swarm optimization algorithm are combined to improve the efficiency and accuracy of data transfer.

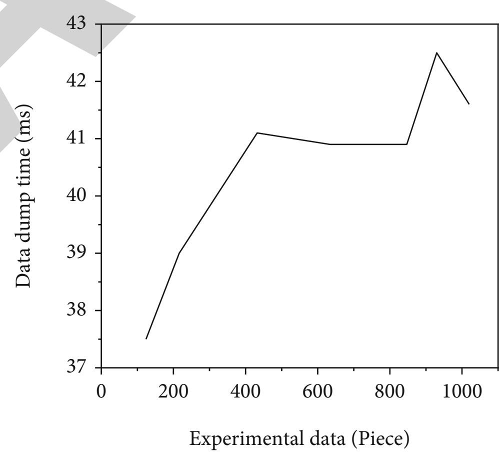

FIGURE 3: Data transfer time.

In order to verify the overall superiority of the system in implementing data transfer, three systems are used to test the resource utilization rate and the success rate of data transfer after the implementation of multidimensional complex data transmission information transfer in university open laboratories.

In order to further verify the performance of the system, three system response time experiments are compared. The experimental results are described in Figure 5.

It can be seen from Figure 5 that the response time of the system in this paper is significantly higher than that of the other two comparison systems. The average response of the system in this paper is 8.5 ms, which is 12 ms and 9 ms faster than that of the other two comparison systems, respectively. It shows that the system response time is fast and the system performance is good. The reason is that this system

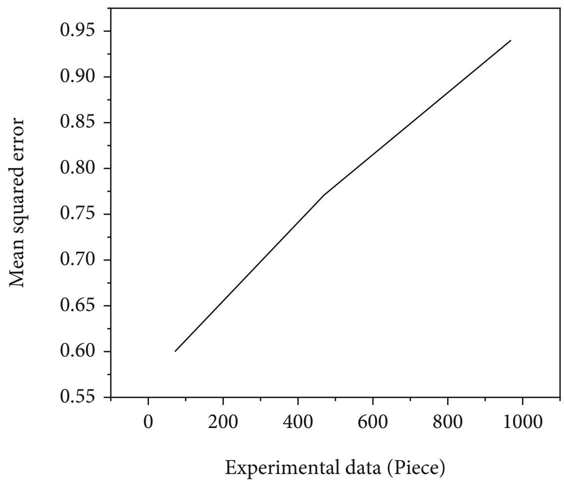

Figure 4: Root mean square error of data transfer.

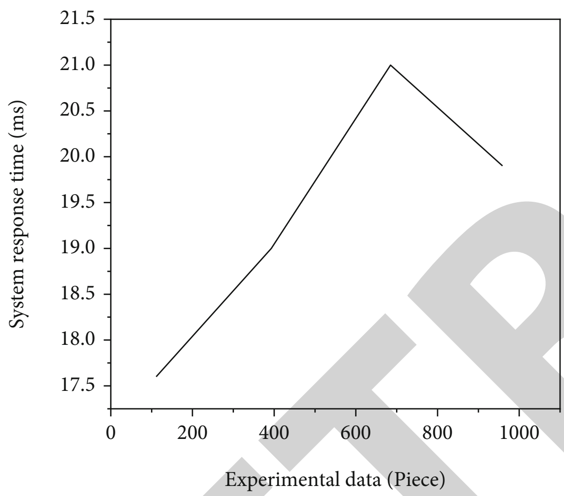

Figure 5: System response time.

first designs a three-tier system architecture and designs an efficient and high memory server in the hardware part of the system, which reduces the response time of the system.

The experiment tests the information management cost of open laboratories in colleges and universities before and after the application of the three systems, and the results are described in Table 1.

According to the analysis of Table 1, compared with the other two systems, the cost of the university open laboratory information management system designed in this paper is lower. The management cost of this system is 1.17 million yuan, which is 640000 yuan and 1.11 million yuan less than the other two systems, respectively. It shows that in the process of realizing the information management of open laboratories in colleges and universities, this system can reduce the cost of information management of open laboratories in colleges and universities and improve the efficiency of information management of open laboratories in colleges and universities. This is because the overall structure of this system is not complex, and the maintenance cost of hardware structure is low, which reduces the cost of laboratory information management.

Table 1: Information management cost of open laboratories in colleges and universities (10000 yuan).

Month	Laboratory management system based on Wi-Fi sniffing technology	Information management system of testing laboratory based on PyVISA	Text system
1	198	152	115
2	199	188	116
3	178	167	118
4	199	186	119
5	208	188	117
6	276	199	116
7	158	165	115
8	199	169	119
9	287	178	118
10	268	197	116
11	278	196	117
12	288	185	118

5. Conclusion

This paper proposes the open sharing management of artificial intelligence laboratory based on the deep integration of big data. In order to improve the efficiency of information management of university open laboratory, an information management system of university open laboratory based on cloud desktop technology is designed. In the process of data transmission and information transfer, pyramid technology is used to transfer multidimensional data into one-dimensional index, and the data conversion quality is the best according to the weight of substreams. At the same time, particle swarm optimization is used to optimize the data transfer process of open laboratories in colleges and universities, so as to realize multidimensional complex data transmission and information transfer, optimize the accuracy of data transmission and information transfer, and ensure the high-quality operation of the management system. The experimental results show that in the process of realizing the information management of open laboratories in colleges and universities, this system can reduce the cost of information management of open laboratories in colleges and universities and improve the efficiency of information management of open laboratories in colleges and universities.

Data Availability

The data used to support the findings of this study are available from the corresponding author upon request.

Conflicts of Interest

The author declares that there are no conflicts of interest.

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Retraction

Retracted: Key Point Detection Method of 3D Network Model Based on Virtual Reality Technology

Wireless Communications and Mobile Computing

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This article has been retracted by Hindawi following an investigation undertaken by the publisher [1]. This investigation has uncovered evidence of one or more of the following indicators of systematic manipulation of the publication process:

(1) Discrepancies in scope
(2) Discrepancies in the description of the research reported
(3) Discrepancies between the availability of data and the research described
(4) Inappropriate citations
(5) Incoherent, meaningless and/or irrelevant content included in the article
(6) Peer-review manipulation

The presence of these indicators undermines our confidence in the integrity of the article's content and we cannot, therefore, vouch for its reliability. Please note that this notice is intended solely to alert readers that the content of this article is unreliable. We have not investigated whether authors were aware of or involved in the systematic manipulation of the publication process.

Wiley and Hindawi regrets that the usual quality checks did not identify these issues before publication and have since put additional measures in place to safeguard research integrity.

We wish to credit our own Research Integrity and Research Publishing teams and anonymous and named external researchers and research integrity experts for contributing to this investigation.

The corresponding author, as the representative of all authors, has been given the opportunity to register their agreement or disagreement to this retraction. We have kept a record of any response received.

References

[1] J. Sun, "Key Point Detection Method of 3D Network Model Based on Virtual Reality Technology," *Wireless Communications and Mobile Computing*, vol. 2022, Article ID 5650795, 6 pages, 2022.

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Research Article

Key Point Detection Method of 3D Network Model Based on Virtual Reality Technology

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In order to meet the higher requirements of today's society for the details and fidelity of 3D models, a key point detection method for 3D network models based on virtual reality technology is proposed. The key technical steps include model normalization preprocessing, feature extraction, and similarity calculation. The 3D model retrieval test of cars, trucks, and buses is carried out using the VTFT algorithm. The results showed that in different databases, the highest success rate was 86.4% and the lowest was 77.10%. Practice has proved that this method can effectively improve the efficiency and accuracy of current 3D model processing and can better meet social needs such as games and entertainment.

1. Introduction

With the development of computer graphics and the improvement of 3D model acquisition technology and computer hardware technology, 3D models not only have a leap in quantity but also are more and more widely used. The main application fields include industrial product design, virtual reality, 3D games, building design, film and television animation, medical diagnosis, and molecular biology research. As shown in Figure 1, virtual reality is a computer system that can create and experience a virtual world. It is generated by a computer and acts on users through viewing, listening, touching, smelling, etc., to produce an immersive interactive experience for users. Immersion, interactivity, and conceptualization are the three basic characteristics of virtual reality system [1]. The digital entertainment industry represented by animation cartoon, online games, mobile games, and film and television products, with its unique and rich artistic forms and huge market prospects, has become another new economic growth point after the industry [2]. People are not satisfied with the display form of two-dimensional plane. In order to get more intuitive visual effects, three-dimensional model technology came into being [3]. Some subtle surface details on the surface of the model, such as bumps, creases, and wrinkles of the model, are usually very sensitive features in visual cognition. 3D modeling software is used to draw 3D models with high fidelity, and the effective operation of surface details makes them have special visual effects. The main function of the high-quality intelligent 3D model library management system is to establish a reasonable and reusable 3D model library with intuitive 3D model retrieval capability [4]. At the same time, this is also an open system, and animators can continue to supplement data as needed.

Nowadays, not only a large number of 3D models exist but also a large number of 3D models are generated every day. Facing the huge three-dimensional model database, how to quickly search the required model has become an urgent research topic, which involves the knowledge of computer graphics, computer vision, pattern recognition, and other fields. In the international standard MPEG-7, it has also been stipulated that the relevant media data include not only two-dimensional multimedia information but also virtual multimedia information such as three-dimensional models and three-dimensional scenes [5].

With the development of scientific and technological life, the actual combat scene is built through the virtual reality

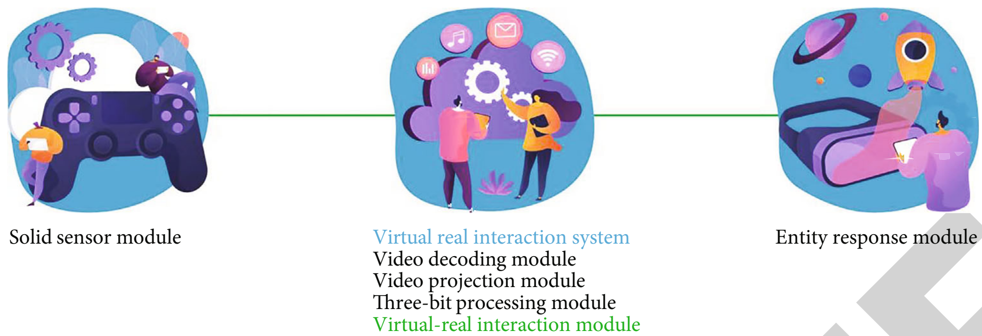

Figure 1: Virtual interactive system.

simulation platform, and the action and posture information of the human body is collected through relevant equipment to interact with the virtual scene. In addition to improving the sense of experience of game operation, the combat and training can also be carried out in the virtual combat scene, so that the soldiers' combat skills can be improved [6]. In addition, the virtual environment can also provide some complex human interaction and behavior tracking to cooperate with the simulation system for testing, training, and control, which has considerable potential and research significance.

2. Literature Review

Human posture recognition has always been one of the hot areas of computer vision research. The main purpose is to predict the human posture types in video by computer and to divide the correct prediction results into the corresponding posture type labels. Luo et al. used the dense trajectory (DT) algorithm to extract the track of video dense tracking by using the optical flow field [7]. Each block is calculated, and the motion information in the video and the surrounding environment are intensively extracted to capture the motion information of the video. At the same time, the gradient histogram (HOG) and optical flow histogram (Hof) corresponding to each block in the trajectory motion process are extracted to describe the surface features and local motion information in the video, respectively. In addition, the motion boundary information histogram (MBH) is introduced to improve the accuracy of pedestrian posture detection in the video, and good classification results are achieved on several large behavior recognition data sets. On this basis, an improved dense trajectory (IDT) algorithm is also proposed. Through the optimization of optical flow images, surf features and dense optical flow information are used to match feature points to improve the estimation of camera motion position, so as to eliminate the impact of camera jitter [8]. The L1 regular expression is used to normalize the features, and the accuracy is 91.2% on the data set ucf50. Miklós et al. adopt the single stream convolution method, use the pretrained conv2d neural network, and extend the information connectivity of the fusion time series to extract the local space-time information of the video and greatly improve the operation performance of CNN. It uses a single architecture to fuse the video frame information in the final stage. The disadvantage is that because the spatiotemporal feature points do not capture the posture characteristics of the characters when they are moving, it becomes more difficult for the neural network to learn effective features [9]. Wu et al. in the direction of single stream convolution, combined with the advantage that RNN neural network can further map the input of video length, further proposed long-term time recursive convolution neural network (LRCN), added LSTM layer after convolution module, weighted and averaged the predicted results of input RGB and optical flow information, and finally obtained the best results. The whole network architecture is an end-to-end training and learning framework [10]. Pan et al. proposed 3D convolution neural network (C3d). Compared with 2D convolution network, the biggest difference lies in the use of 3D convolution block for convolution. The convolution result is no longer a 2D feature map, with more time dimension feature information, and has good generalization performance and compression performance [11]. However, compared with the recognition results of 2D convolution on static pictures, the effect of human posture recognition is not ideal, and the training process needs to occupy a lot of computing and memory resources.

On the basis of current research, this paper proposes a 3D model retrieval technology, which is a content-based retrieval method. Firstly, model standardization preprocessing is carried out. Then, the features of the 3D model are extracted, and a set of feature vectors are obtained. Finally, 3D model retrieval is realized by comparing the similarity between feature vectors. The key technical steps include model standardization preprocessing, feature extraction, and similarity calculation.

3. Method

3.1. Feature Extraction Algorithm of Rigid 3D Model. At present, most algorithms for feature extraction of rigid 3D models focus on 3D model retrieval between different categories. These algorithms are mainly divided into four categories. These four kinds of algorithms can be further divided into many subclasses. We mainly introduce the classic algorithms, as shown in Figure 2.

(1) Statistical feature-based extraction algorithm: as shown in Table 1, the method based on statistical

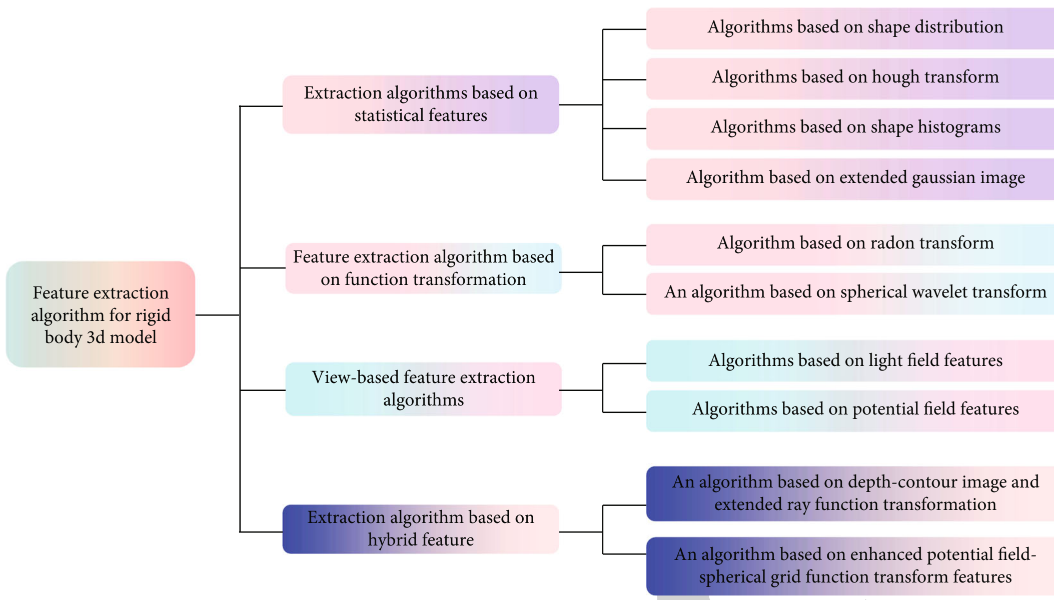

Figure 2: Classification structure of feature extraction algorithm for rigid 3D model.

Table 1: Comparison of feature extraction algorithms for rigid 3D models.

Feature extraction algorithm	Advantage	Shortcoming
Statistical feature-based extraction algorithm	Feature extraction requires a small amount of computation, features have good invariance, and there is no need to standardize the model	These features do not adequately describe the content of the three-dimensional model, and the recognition ability is not high
View-based feature extraction algorithm	The three-dimensional model is projected into two-dimensional images from different perspectives, which greatly reduces the complexity of matching. The extracted features are relatively simple and easy to calculate and generate indexes	The process of projection needs different constraints, so it is easy to lose some important information to represent the three-dimensional structure
Feature extraction algorithm based on function transformation	The analysis space is different from the spatial space, so this kind of features and other features have a good complementary effect, can provide multiresolution analysis, can achieve coarse to fine description, and can better describe the three-dimensional model	It is necessary to normalize the three-dimensional model, but some models are difficult to be expressed in the form of function, and the amount of calculation for feature extraction is relatively large
Extraction algorithm based on mixed features	The comprehensive application of two or more features can fully describe the three-dimensional model	The fusion of multiple features sometimes results in feature redundancy and a large amount of computation for feature extraction

features mainly calculates the accumulation degree of geometric features on a specific dimension in the feature space. It is characterized by simple calculation and fast speed, so it is widely used in the field of 3D model similarity calculation. This method has good invariance and does not need the standardized pretreatment of 3D model. However, the description ability of this method is generally not strong enough, and the description of three-dimensional model is not enough

(2) View-based feature extraction algorithm: in this method, the 3D model is projected into a set of 2D images, and the 3D model is described by the features of multiple images obtained from different viewpoints. The idea of this method is that if two 3D models look similar in all directions, they are considered to be similar. The research focus is on where to dye the image, how many images to render, and how to organize these images. This kind of method can use more mature image matching technology to reduce the complexity of matching. The extracted features are relatively simple and easy to calculate [12]. However, in the process of projecting a 3D model into an image, it is necessary to make conditional constraints to project at the vertex of a regular polyhedron or an

approximate regular polyhedron, so it is easy to lose some important information representing the 3D structure

(3) Feature extraction algorithm based on function transformation: transformation feature refers to the mathematical transformation of the three-dimensional model, and the transformation coefficient is used to describe the feature. Because the transform domain uses the analysis space which is different from the spatial domain, this kind of feature has a good complementary effect with other features. Moreover, the transform domain signal can provide multiresolution analysis of features, can realize the description of features from coarse to fine, and can better describe the three-dimensional model, but the amount of feature extraction calculation is large [13]

(4) Extraction algorithm based on mixed features: from the above analysis, it can be seen that each method has both advantages and disadvantages. Therefore, recently, some scholars proposed to comprehensively use two or more features to complement each other, so as to improve the accuracy of 3D model retrieval

3.2. Feature Extraction Algorithm Based on Function Transformation. After extracting the view features, we only get the "outer" features of the 3D model. In order to obtain the "inner" features of the 3D model, we extract features based on function transformation [14]. The feature extraction of function transformation is realized by using two forms of three-dimensional transformation: radial integral transformation and spherical integral transformation. Before extracting the feature of function transformation, the 3D model needs to be voxeled. Because the view features of the 3D model have been extracted, it is not necessary to voxel the outermost surface of the 3D model. The systematization process is to first calculate the bounding box of the 3D model, which is the same as that used in rendering 2D images in the section, as shown in the figure. Then, the smallest box surrounding the 3D model is divided into equal voxel blocks. We divide the box into $64 * 64 * 64$ meshes, as shown in the figure. Each small voxel block forms an independent element v. We binarize each cell as shown in the figure. When the mesh cell contains part of the 3D model, the value of the cell is defined as 1; otherwise, it is defined as 0, so that u represents the set of voxel blocks containing part of the 3D model inside the surrounding box. In this way, the description of the discrete binary voxel function is as follows:

$$f\hat{}(v) = \begin{cases} 1, & v \in U_{\mathrm{In}}, \\ 0, & \text{others}. \end{cases} \tag{1}$$

The discrete binary voxel function is used to calculate the value of each voxel block. The specific process is as follows: scan the voxel blocks of the 3D model along the $X/Y/Z$ axis, respectively. First, determine the start and end voxel blocks, along each line of the X axis. Among them, the voxel blocks with $f\hat{}(v_s) = f\hat{}(v_e) = 0$ located between the Us line segment and Ue form a set Sx in each line. Similarly, Sy and Sz can be generated. The function value of the part of the voxel block that belongs to the intersection of three sets is set to 1; otherwise, it is set to 0. After completing the two-value voxelization of the three-dimensional model, we begin to extract the radial integral function transformation features and spherical integral function transformation features of the three-dimensional model. The radial integral function and spherical integral function are introduced, respectively, below [15]. Let u be the unit vector and r be the real value.

The integral expression of the three-dimensional Radon transform formula for the function on the plane $\Pi(u, r) = \{v | v^T \cdot u = r\}$ is as follows:

$$R(u, r) = \int_{v \in \Pi(u,r)} f\hat{}(v) dv. \tag{2}$$

The retrieval speed is measured by the average feature extraction time and average retrieval time. Table 2 summarizes the average feature extraction time and average retrieval time. Our algorithm is implemented on a PC configured with Intel-Core2Duo, 2.53GU7 CPU, and 2G memory. From Table 2, we can see that the VFTF algorithm proposed in this chapter is slower than the retrieval algorithm using a single feature. Compared with the other two hybrid feature algorithms, the VFTF algorithm is slower than the design algorithm and faster than the ARTED-SGD. Feature extraction is completed offline. The retrieval speed of the VFTF algorithm will not affect the real-time requirements of the retrieval system. Considering the retrieval accuracy and retrieval speed, VFTF algorithm has better retrieval performance [16].

3.3. Multiscale Key Point Detection. We first detect the key points of the model at a fixed scale and then establish an automatic scale selection mechanism to realize the process of multiscale key point detection [17]. We define the points that meet the following three constraints as key points. The three constraints are that the detected key points must have a high degree of repetition between the dimensional view and the 3D model of the same object. In order to extract invariant local features, a unique 3D coordinate base can be defined from the neighbor surface. The neighbor surface of a key point must contain enough description information to uniquely represent the point, so as to ensure that the local features extracted at the key point are unique and can be accurately identified. For a 3D model, it is likely to detect a large number of points that meet the above three constraints, which weakens the initial purpose of key point detection, which is to detect a limited number of key points and improve the efficiency of feature extraction [18]. We can use sparse sampling or random sampling to form a subset of key points for feature extraction. However, according to the two criteria of repeatability and local surface description ability, sparse sampling or random sampling cannot form the best set of key points. To solve this problem, we use the principal curvature based on the local surface as the standard metric to measure the quality of key points, which is mainly used to classify key points and select the best set of key points [19]. Figure 3 shows the relationship between key

Table 2: Comparison of time performance of six algorithms on and model base.

Performance	Average feature extraction time (s)		Average retrieval time (s)	
	PSB model library	ESB model base	PSB model library	ESB model base
Radon algorithm	5.26	5.09	0.27	0.25
LFD algorithm	4.43	4.26	0.24	0.23
Ed algorithm	4.19	4.03	0.22	0.21
Detail algorithm	3.97	3.88	0.33	0.32
ART-ED-SGD algorithm	6.31	6.23	0.39	0.38
VFTF algorithm	6.23	6.15	0.38	0.35

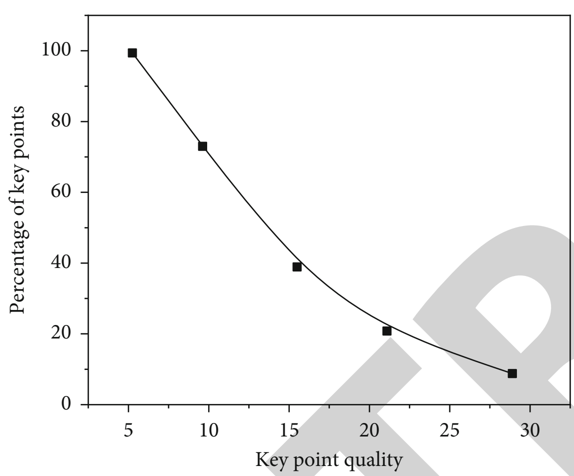

Figure 3: Key point quality and key point percentage.

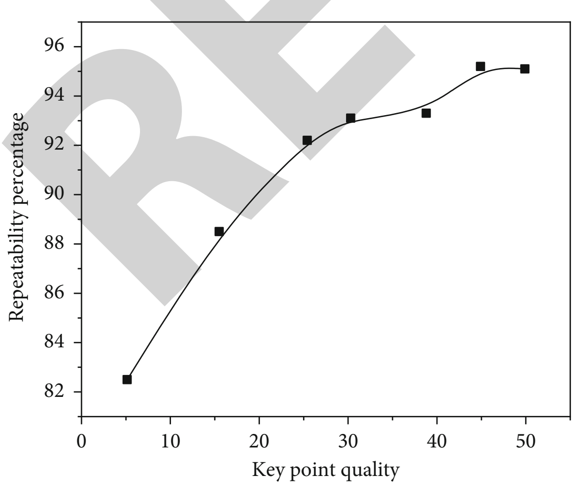

Figure 4: Key point mass and repeatability percentage.

Table 3: Retrieval performance analysis of VTFT algorithm in the created rigid body 3D model library.

Performance index Model category	MAR	MAP	F-measure First tier	Second tier
"Car" category	82.4%	83.7%	75.3%	77.8%
"Truck" category	84.2%	86.4%	77.10%	78.9%
"Bus" category	83.6%	84.9%	80.5%	82.7%
"Human" category	77.3%	79.9%	71.6%	73.7%
"Trees" category	73.4%	75.2%	65.1%	67.8%
"Dog" category	76.7%	78.6%	69.8%	71.4%

quality and percentage of key points. It can be seen from the figure that the percentage of key points will decrease linearly with the increase of key quality. Figure 4 shows the relationship between the key quality and the percentage of repetition. It can be seen from the figure that the key repetition increases with the increase of key quality. It can be concluded from Figures 3 and 4 that the repeatability will increase with the reduction of key points, which shows that the quality of key points can correctly reflect the repeatability of key points.

After the key points are determined, we begin to extract features with invariance and strong description ability at these key points. We extract local features from multiscale key points by using local features of thermonuclear signals (HKS). The local features of thermonuclear signals are equidistant invariant and robust to topological noise, connection variation, and random sampling. However, HKS local features are sensitive to scale change. In order to solve this problem, we incorporate HKS local features into the feature bag framework. In the feature bag framework, the scale problem is transformed into a translation problem, and the translation invariance is achieved by quantifying the histogram to solve the scale sensitive problem [20].

4. Results and Discussion

In the general 3D model library (1400 3D models in total) created by our laboratory, we use the VTFT algorithm proposed in the third part for retrieval test, and the evaluation criteria also use MAR, MAP, and F-Measure. These 1400 3D models are formed by the combination of 800 models in the above three-dimensional model library and 600 models in the nonrigid 3D model library, including 63 categories. On all these classes, the experimental results show that the MAP is 75.4%, the MAP is 77.3%, the first tier is 73.1%, and the second tier is 74.3%. Table 3 shows the retrieval performance indicators using VTFT algorithm on "cars," "trucks," "buses," "people," "trees," and "dogs" [21–23].

5. Conclusion

This paper presents a 3D model retrieval technology, which is a content-based retrieval method. Firstly, model standardization preprocessing is carried out. Then, the features of the 3D model are extracted and a set of feature vectors are obtained. Finally, 3D model retrieval is realized by comparing the similarity between feature vectors. The key technical

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Retraction

Retracted: Application of 3D Virtual Scanning Technology in Landscape Planning of Complex Landscape Gardens

Wireless Communications and Mobile Computing

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This article has been retracted by Hindawi following an investigation undertaken by the publisher [1]. This investigation has uncovered evidence of one or more of the following indicators of systematic manipulation of the publication process:

(1) Discrepancies in scope
(2) Discrepancies in the description of the research reported
(3) Discrepancies between the availability of data and the research described
(4) Inappropriate citations
(5) Incoherent, meaningless and/or irrelevant content included in the article
(6) Peer-review manipulation

The presence of these indicators undermines our confidence in the integrity of the article's content and we cannot, therefore, vouch for its reliability. Please note that this notice is intended solely to alert readers that the content of this article is unreliable. We have not investigated whether authors were aware of or involved in the systematic manipulation of the publication process.

Wiley and Hindawi regrets that the usual quality checks did not identify these issues before publication and have since put additional measures in place to safeguard research integrity.

We wish to credit our own Research Integrity and Research Publishing teams and anonymous and named external researchers and research integrity experts for contributing to this investigation.

The corresponding author, as the representative of all authors, has been given the opportunity to register their agreement or disagreement to this retraction. We have kept a record of any response received.

References

[1] C. Huang and Y. Zheng, "Application of 3D Virtual Scanning Technology in Landscape Planning of Complex Landscape Gardens," *Wireless Communications and Mobile Computing*, vol. 2022, Article ID 5495825, 7 pages, 2022.

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Research Article

Application of 3D Virtual Scanning Technology in Landscape Planning of Complex Landscape Gardens

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In order to solve the problem of technical precision in landscape planning of complex landscape garden topography, the authors propose a research using 3D virtual scanning technology. The main content of this research is based on the overall architecture of the 3D virtual landscape planning system, the construction of the system architecture, and the optimization of VR design scenarios; finally, through experiments, the feasibility of 3D virtual scanning technology is obtained. Experimental results show that the number of landscape connection points measured by the author is more than 1500, and the accuracy is between 0.2 and 0.6 pixels, indicating that for the mutual connection and orientation between models, the system has a good application prospect in the landscape planning of complex landscape garden topography. The research on 3D virtual scanning technology is proven, and it can meet the application in the landscape planning of complex landscape garden topography.

1. Introduction

With the acceleration of China's economic development and urbanization, garden landscape has gradually been paid attention to [1]. Garden terrain landscape is the ground with objects such as garden pieces, water bodies, garden buildings, plants, and roads within the set range and is the basic structure of the garden skeleton. Garden topography is usually an artificially constructed ground topography on the flat ground based on natural landscape topography. Reasonably adding terrain landscape to the garden landscape can improve the artistry of the garden landscape and create a more delicate and beautiful landscape. Terrain includes complex and diverse types, mainly divided into two categories: natural terrain such as valleys, mountains, hills, grasslands, and plains. From the perspective of the garden, the terrain includes mounds, terraces, slopes, flats, or horizontal changes caused by steps and slopes, which are artificial terrains.

In terms of form, natural beauty is the main way of Chinese gardens, the design of landscape topography is random and flexible, and it is necessary to constantly modify and adjust the design scheme, which increases the difficulty of garden topography and landscape design [2]. There are usually overlapping areas in the complex landscape garden terrain landscape; in order to improve the artistry of garden design, it is necessary to carry out three-dimensional reconstruction of the superimposed area existing in the complex landscape garden topography and landscape; the current three-dimensional reconstruction method of the superimposed area of the garden topography and landscape exists. In the problem of low reconstruction efficiency and low precision, in-depth analysis is needed, and the 3D reconstruction method of the overlapping area of garden topography and landscape needs to be studied.

Landscape design has existed since ancient times, but with the development of computer technology, AutoCAD, Photoshop, 3Ds Max, and other drawing software have been developed, which has promoted the design of landscape architecture to be systematic, comprehensive, real, reasonable, beautiful, accurate, efficient, easy to modify, and so on [3]. However, with the development of society, on the basis of new ecological civilization and informatization requirements, the landscape architecture planning industry has covered the construction of urban ecological areas and infrastructure, making urban landscape architecture planning more difficult. To this end, some scholars have proposed digital landscape planning, using computer computing and graphics capabilities to analyze the spatial environment of landscape planning, rationally constructing objective and rigorous design logic, so that landscape architecture has scientific, artistic, and social value.

2. Literature Review

With the vigorous development of the country's current economy, at present, the research on digital landscape architecture landscape planning methods at home and abroad needs to be planned from several aspects such as genealogy, parametric design, and computer-generated design [4]. Foreign countries have also established a digital landscape architecture landscape planning method with four processes of digital model-sensitive system network urbanism-self-realization from the part to the whole and the whole to the part and completed the digital landscape architecture landscape planning, but this set of methods only stayed at the research level and did not carry out specific practice. In China, from the perspective of landscape parametric design, the basic system framework and parameter composition types are studied; based on this, the landscape garden landscape is planned on the computer through digital methods; however, there are landscape garden landscapes, and the software cannot use the full parameters. For this reason, the visualization technology is introduced; according to the spatial geographic information of the landscape architecture, the landscape architecture is planned digitally, and the design of the digital landscape architecture landscape planning system based on the visualization technology is proposed. At present, 3D modeling tools and computer graphics technology are gradually developing, and 3D virtual reality technology is gradually becoming mature [5]. 3D virtual VR technology is an advanced technology combining perception ability and information interaction, which integrates Internet technology, multimedia technology, and 3D mapping technology. The integration of science and technology and artistic atmosphere has become an important concept in modern landscape planning and design, so the requirements of landscape design are constantly improving, not only to consider the visual experience but also to integrate the designed landscape into the surrounding environment, and it is necessary to consider whether the ecological vegetation is in a state of sustainable development. Therefore, ordinary landscape design systems cannot meet the high demands of modern landscape planning. For example, the real landscape data collected by the GIS-based landscape planning system is inaccurate, and the visualization effect of the constructed virtual landscape model is poor. During the landscape planning process of the segmented control landscape planning system, the effect of integrating the landscape and the surrounding environment is poor, and it does not meet the standard of three-dimensional virtual landscape planning and design. The authors use three-dimensional virtual VR technology to design a landscape planning system, which improves the effect and effectiveness of landscape planning; it can reach modern planning standards for different types of landscape planning and has won unanimous praise from the masses in many aspects.

In view of the above problems, the authors propose the application of 3D virtual scanning technology in the landscape planning of complex landscape garden topography. The main content of this research is based on the overall architecture of the 3D virtual landscape planning system, the construction of the system architecture, and the optimization of VR design scenarios; finally, the feasibility of 3D virtual scanning technology is obtained through experiments [6].

3. Research Methods

3.1. Overall Architecture of the 3D Virtual Landscape Planning System

(1) Extraction of contour edge features of garden topography and landscape overlay area

The contour edge of the landscape overlay area of the garden has undulating characteristics, which can be represented by the positional relationship between the reference point and the midpoint of the contour edge [7]. With the 3D simulation method for complex landscape garden topography and landscape overlay area, the characteristics of the superimposed area of garden topography and landscape are described by the relative position relationship of local extreme points. Let R_i and H_i represent the position parameters, and normalize the position parameters to

$$r_i = kR_i, \tag{1}$$

$$h_i = kH_i. \tag{2}$$

In the formula, k represents the normalization coefficient. Through the normalized position parameters, the feature vector T of the contour edge of the landscape overlay area of the garden is obtained, which is

$$T = (t_1, t_2, \cdots, t_{N-1}) = [(r_1, h_1), (r_2, h_2), \cdots, (r_{N-1}, h_{N-1})]. \tag{3}$$

The eigenvector T is called the eigenvector of the contour edge of the garden topography and landscape overlay area, and it is a vector formed by the arrangement of two-dimensional data points; any data unit represents the relative position of the extreme value in the contour edge of the garden topography and landscape overlay area [8].

(2) System architecture

The authors conduct virtual landscape planning from two aspects of 3D landscape modeling and virtual VR technology. Through 3D laser scanning technology, the main point cloud data of a landscape scan is obtained. 3ds Max software and cloud data are used to build the main landscape planning model, and satellite maps and other data are used to obtain the landscape plan [9]. Based on the plan, plan the main buildings, flowers, trees, roads, and other landscape facilities of the landscape. Use PS technology and real scene photos to get the actual landscape situation, set the lighting and material maps, and introduce the processed photos into the VR virtual landscape simulation platform; design the VR

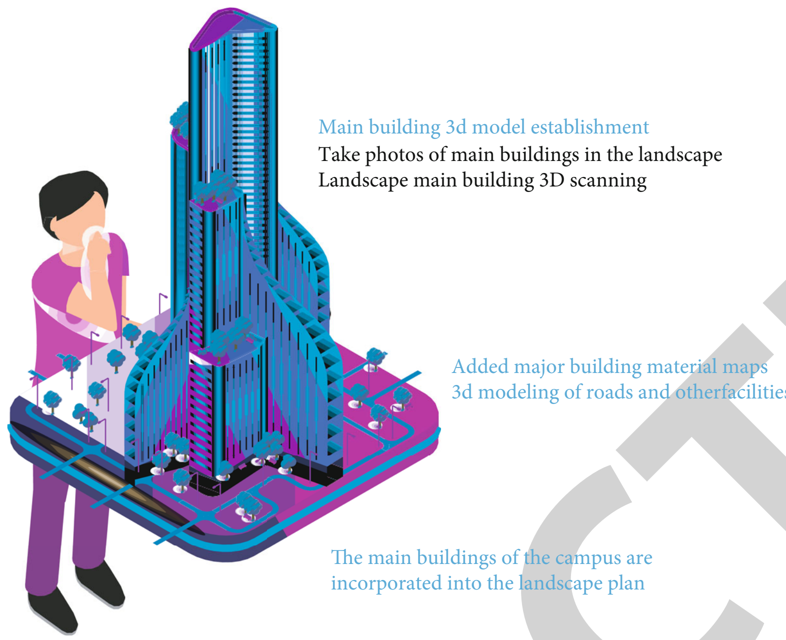

Figure 1: Frame diagram of the landscape 3D virtual system.

interface and add scripts to obtain a 3D virtual landscape planning roaming system, and the system contains a variety of roaming methods. Figure 1 is a design frame diagram of a landscape planning system of 3D virtual VR technology.

Scan buildings in a landscape with a Trimble TX5 3D laser scanner to get color point clouds. Taking a building as an example, since the building is divided into multiple components and has a complex structure, in order to ensure accurate registration in the later stage and reduce redundant data, multiple scanning sites are set up; in order to ensure that there are overlapping parts between sites and avoid setting up too many sites, the point cloud data obtained by registration and splicing scans need to be further processed and saved. The processing of point cloud data includes filtering noise, deleting useless points, processing redundant points, and optimizing the number of points [10]. Finally, change the format of the point cloud data, and import it into 3ds Max to build a 3D model of the virtual landscape.

(3) Establishment of a 3D model of road in landscape

The system makes a landscape 3D model in 3ds Max software, the 3D model is the basis of 3D virtual VR technology landscape planning system design, 3D virtual VR technology creates a scene through the 3D model and achieves the effect of roaming landscape, and the quality of the 3D model seriously affects the interaction effect of the system. Build a three-dimensional model according to the actual situation of the landscape, select large buildings and all objects around the buildings in the landscape to build the model gradually, form a complete landscape, build a 3D model reasonably according to the scale, and arrange it in a suitable position [11].

Taking a landscape building as an example, the whole process of building a model using point cloud data in 3ds Max is analyzed. When constructing a 3D model, the point cloud data is regarded as a reference, the point cloud data of the building is captured, and the main outline of the building is drawn; select the extrude command in the modifier, convert the sketched building spline into a 3D wall model, an editable polygon, and then draw the door of the building based on the point cloud data by dividing, connecting, contouring, and chamfering windows and other accessories [12].

If the 3D model of the building landscape wants to achieve the effect of roaming, it needs to be imported into the VR design software; therefore, it is required that the number of faces of the model should not be too many when building the 3D model, and the model should be simplified as much as possible to achieve coexistence of speed and accuracy. If the model is closely connected or the distance is small, the above models are combined [13]. It should be noted that each submodel constructed is required to be named in a tree-like nomenclature, and finally, the three-dimensional model of the landscape building is obtained.

The 3D modeling process of the road is shown in Figure 2; it can be seen that after the data is input, the road is faced with the choice of straight and curved roads; if the road is not straight, the road point cloud data needs to be discrete, and then, the next step is performed; finally, save the completed road model for output.

Based on the above-mentioned method for establishing a three-dimensional model of a landscape building, a three-dimensional model of a road is constructed; the following is the main data information of the road: (1) the road is a flat curve. It consists of the road centerline, the road red line, and the two lane edges. (2) The road has vertical information. The determination method is the road vertical curve or road end level. (3) The road has discrete spacing. Refer to the default value of the system, which can be modified according to the specific situation.

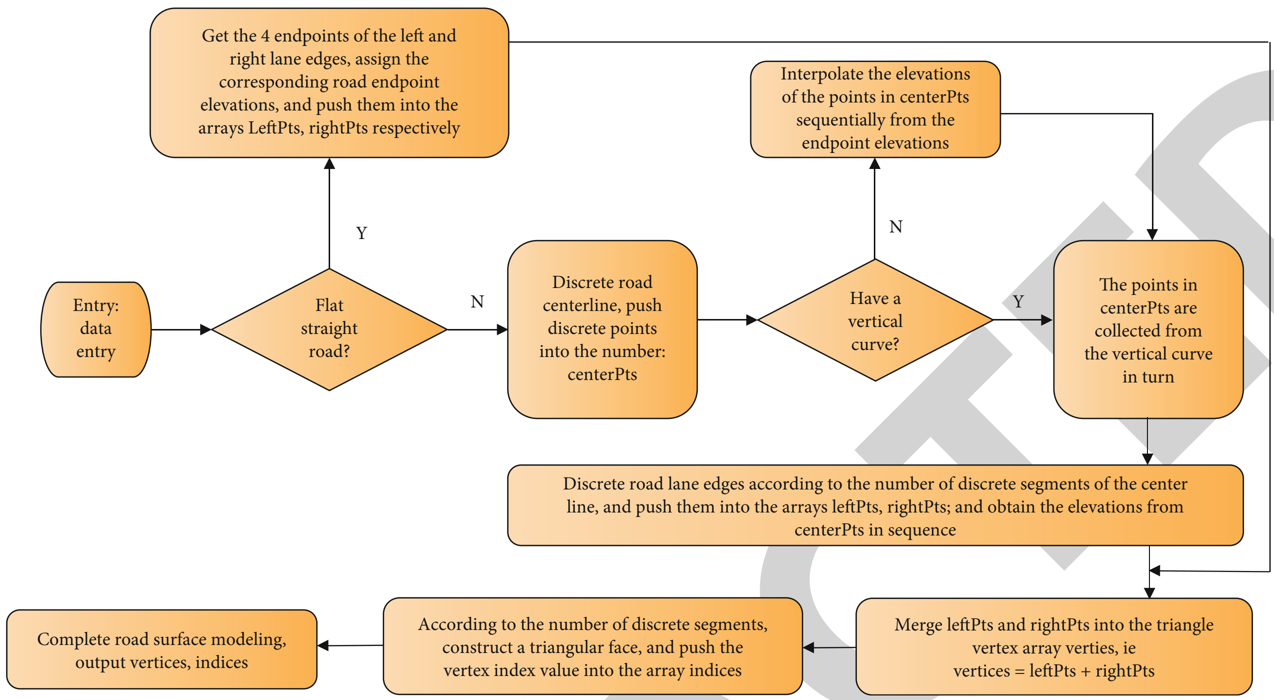

Figure 2: Flow chart of road 3D modeling.

3.2. *VR Design Scene Optimization*

(1) Scene design

After being imported into VR, the architectural landscape scene is prone to some situations such as nondisplay and flickering of some patches; during 3D modeling, some models that have been built should be imported into the VR design platform in time; determine whether there is a problem with this part of the model; if there is a problem, it should be corrected in time to prevent the same problem from subsequent 3D modeling; follow this method to gradually import the built 3D model of building landscape; reduce the problems after baking, and avoid increasing the workload [14]. After the scene is baked and imported into the VR design platform, check the model in the scene in detail; if there is a seam problem in the model, scale the model in the VR design platform. If the model is damaged, etc., the model needs to be corrected again by 3ds Max. Use the editor in the VR design platform to adjust the shadows, textures, and other phenomena of the scene. Use PS to match colors, adjust the scene saturation and texture hue, and improve the light and dark comparison of texture hues by changing curves, sharpening, and other commands. It is worth noting that when the glass material in 3ds Max is imported into the VR design platform, it needs to be modified because the glass material cannot automatically render the transparent effect in VR [15].

(2) Design of the VR virtual landscape simulation platform

As a new technology, VR virtual simulation is of great significance to the development of economy and society, and there is a lot of room for expansion. Figure 3 shows the VR virtual landscape simulation platform.

It can be seen from Figure 3 that the VR virtual landscape simulation platform consists of a cluster simulation and network communication module, a simulation core work module, a VR scene editing module, and modeling and output modules [16]. The functions of each module of the VR virtual landscape simulation platform are analyzed, and the results are as follows:

(1) Cluster simulation and network communication module. The main function of this module is to reach. For the purpose of off-site simulation, the main function is to effectively exert the computing power of landscape planning VR virtual design [17]

(2) Simulation core working module. Taking the OSG 3D virtual module as the center point, adjust the kernel simulation task scheduling, including the simulation database management module and the large-scale terrain module; this module is a large-scale terrain simulation module based on the OSG 3D simulation support platform, a hydrodynamic particle system simulation module, and a special effects simulation module [18]

(3) Modeling and output module. Use this module to build models and scenes in 3D roaming, import models into VR to build VR scenes, and add simulation properties [19]

(4) VR scene editing module. Using the VR scene built by the previous module, use the VR scene editing

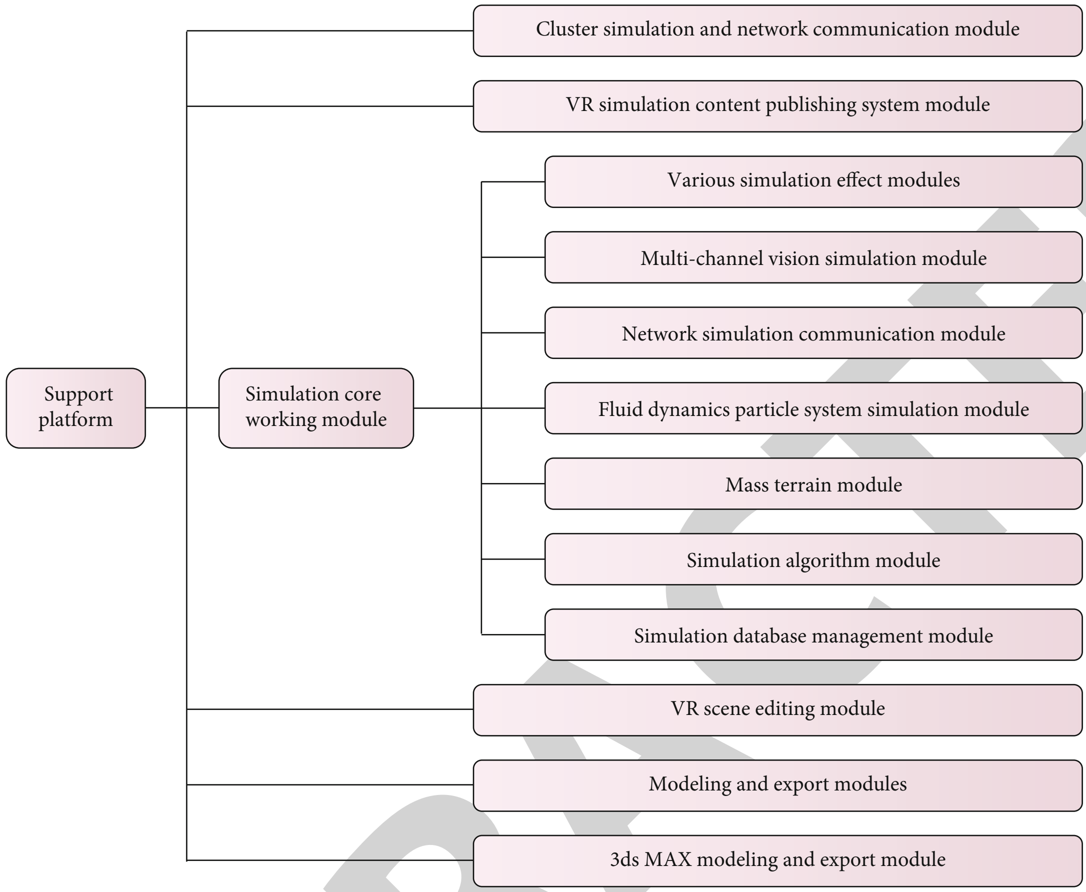

Figure 3: Design block diagram of the VR virtual landscape simulation platform.

module to add multiple attributes to the scene and implement 3ds Max modeling of architectural landscapes

4. Analysis of Results

In order to verify the effectiveness of landscape planning through the system, a simulation experiment study was carried out. The experimental comparison systems are the segmented control landscape planning system and GIS-based landscape planning system.

The landscape layout of a park is systematically planned, including factors such as the slope and aspect of the landscape, and the landscape planning performance of the system is analyzed from the perspective of data. The three-dimensional landscape virtual construction is disturbed by the terrain slope, and a planning suitability table needs to be formulated according to the virtual landscape grade. Table 1 shows the suitability classification of the three-dimensional landscape slope [20].

In the process of analyzing the landscape planning of the three systems, the comparison of the accuracy of processing 3D point cloud data is shown in Figure 4.

Analyzing Figure 4, we get that, under the same processing time, the system has much higher accuracy of point cloud data processing than the other two systems; the highest is 99%, and as the processing time increases, the accuracy of the system processing data also increases. If the landscape planning and design workload is large, the system has a great advantage. The accuracy rate of the segmentation control landscape planning system processing point cloud data is basically above 80% to 90%, and the highest is 89%, but compared with the system, there is still a lot of room for improvement. The accuracy rate of the GIS-based landscape planning system is basically 50% to 60%, and the highest is 59%. Therefore, the system has high accuracy in the processing of 3D point cloud data for landscape planning, which reduces the difficulty for overall landscape planning [21].

The experiment set 8 experimental park landscape models, analyzed the number of connection points and model orientation accuracy when the system constructed a 3D landscape model of the park, and verified the accuracy and stability of the ingested landscape points when the system constructed a 3D landscape model. Table 2 shows the obtained experimental results.

Analysis of Table 2 shows that the number of landscape connection points measured by the author is more than 1500, and the accuracy is between 0.2 and 0.6 pixels; it shows that for the mutual connection and orientation between models, the system can obtain a sufficient number of connection points accurately and effectively to provide help for the calculation of model parameters. In addition, the interval fluctuation of the model orientation accuracy is small, indicating that the stability of the 3D modeling of the system is better. Therefore, the system has high reliability and stability

Table 1: Landscape suitability classification based on a three-dimensional slope.

Landscape planning	Slope (degree)				
	0-5	6-10	16-25	26-30	Over 30
Terrain utilization	Suitable for any landscape	Suitable for ordinary landscape	Simple landscape	Not suitable	Not suitable
Landscape design	Trees, lawns, flower beds, statues	Tree, lawn, flower bed	Lawn, flower bed	Lawn	Not suitable
Soil and water conservation	Unnecessary	Unnecessary	Unnecessary	Plant dwarf shrubs	Planting vegetation

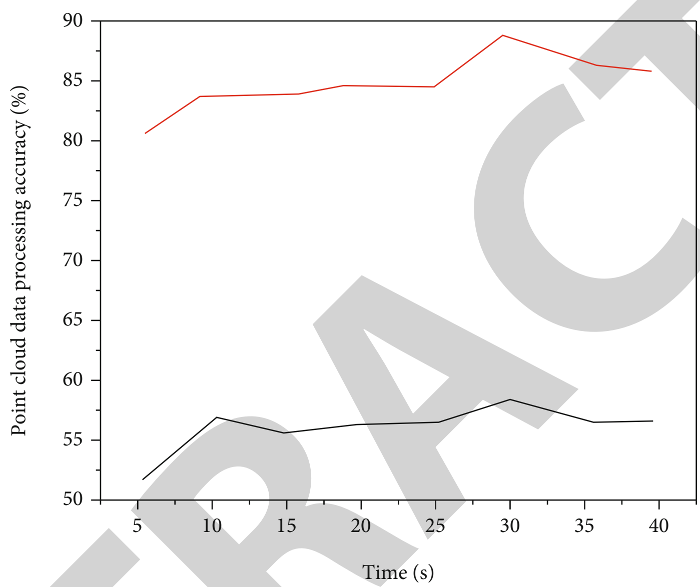

Figure 4: Comparison of 3D point cloud data processing accuracy.

Table 2: Experimental results.

Model number	Number of connection points (piece)	Model orientation accuracy (pixel)
M.0-3	1742	0.5995
M.1-3	2446	0.4698
M.2-1	2006	0.4719
M.3-2	2318	0.4433
M.4-3	1591	0.2281
M.5-6	2118	0.3857
M.6-7	1986	0.3298
M.7-8	1621	0.2883

in 3D virtual landscape modeling, laying a solid foundation for landscape planning. The advantage of the system is to accurately obtain the 3D point cloud data of the landscape through 3D laser scanning technology, build a 3D model based on the point cloud data information, create a 3D stereoscopic picture of the landscape, and improve the realism of the 3D virtual landscape. The simulation results show that the system has high satisfaction in landscape planning, provides help for urban landscape construction, and has a good application prospect in 3D virtual landscape planning and design.

5. Conclusion

In order to solve the problem of technical precision in landscape planning of complex landscape garden topography, the authors propose a research using 3D virtual scanning technology. The main content of this research is based on the overall architecture of the 3D virtual landscape planning system, the construction of the system architecture, and the optimization of VR design scenarios; finally, the feasibility of 3D virtual scanning technology is obtained through experiments. The number of landscape connection points measured by the authors is more than 1500, and the accuracy is between 0.2 and 0.6 pixels, indicating that for the mutual connection and orientation between models, the system has a good application prospect in the landscape planning of complex landscape garden topography.

Data Availability

The data used to support the findings of this study are available from the corresponding author upon request.

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Retraction

Retracted: Multilingual Machine Translation System Based on Decoder Recurrent Neural Network

Wireless Communications and Mobile Computing

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This article has been retracted by Hindawi following an investigation undertaken by the publisher [1]. This investigation has uncovered evidence of one or more of the following indicators of systematic manipulation of the publication process:

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The presence of these indicators undermines our confidence in the integrity of the article's content and we cannot, therefore, vouch for its reliability. Please note that this notice is intended solely to alert readers that the content of this article is unreliable. We have not investigated whether authors were aware of or involved in the systematic manipulation of the publication process.

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[1] F. Deng, "Multilingual Machine Translation System Based on Decoder Recurrent Neural Network," *Wireless Communications and Mobile Computing*, vol. 2022, Article ID 9714800, 6 pages, 2022.

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Research Article

Multilingual Machine Translation System Based on Decoder Recurrent Neural Network

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In order to solve the problem that traditional machine translation cannot meet users' needs due to its slow translation speed, an in-depth study on English translation model based on neural network was proposed. Firstly, three methods of model frame design, translation system design, and training frame design are studied. In order to improve the effectiveness and stability of the English translation model of recursive neural network, a model of English-Chinese machine translation system is designed. The system uses a knowledge-based context vector to map English and Chinese words, and uses a codec recursive neural network to achieve the results. After experiments and researches, the neural network can also efficiently deal with the long-distance reordering problem of multilanguage machine translation, which is difficult for statistical machine translation to deal with effectively. The neural network has opened a broad field of vision for machine translation research.

1. Introduction

A recursive neural network (RNN) model for English machine translation is designed based on an end-to-end encoder-decoder architecture, which enables machines to autonomously learn features, transform corpus data distribution into word vectors, and map source language and target language directly through the recursive neural network. Choosing semantic errors to construct the objective function during the training can balance the influence of each part of the semantic well and give full consideration to the alignment information, which provides a strong guidance for the training of deep recursive neural network. The purpose of the problem is that traditional translators use online translators as a means of communication and plan to use deep neural networks. Firstly, the model and algorithm of machine translation are analyzed, and the structure of machine translation system is proposed. In addition, the neural network machine translation model was used to design the machine online translation system. Through the continuous in-depth research on statistical machine translation (SMT), remarkable achievements have been achieved. However, there are still many problems, and the application of deep learning theory is urgently needed to solve the bad situation of statistical machine translation. Current research generally focuses on two things. One is to refine and improve key concepts through in-depth research on the basis of machine translation analysis. Second, end-to-end translation models are aimed at conveying meaning and language using neural networks. In the field of natural language processing, recurrent neural networks are widely used in translation. Besides other languages, Chinese also has many words. Improving the quality of Chinese translations is an important part of working in China. An English-Chinese translation model is developed that uses knowledge-based vectors to convey English-Chinese information and uses an encoder-decoder recurrent neural network. Figure 1 is the structure diagram of the neural network model. The performance of the model based on the activation function is tested. The results show that the linear activation function of encoder layer and the hyperbolic tangent activation function of decoder layer have the best performance.

2. Literature Review

Gin et al. believe that translation is the conversion from one language to another, either sentence-by-sentence or word-

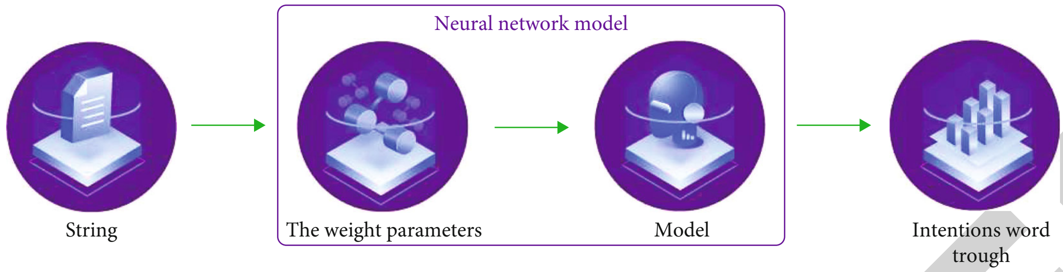

Figure 1: Structure diagram of neural network model.

by-word [1]. More information is gained in a sentence-by-sentence translation than in a word-by-word translation. Wang et al. put forward that Chinese is the language with the largest number of speakers; there are about 1.4 billion people in the world. Translations are longer than text or speech. Therefore, translation technology plays an important role in rapid communication [2]. Meanwhile, Kasim et al.'s machine translator is an open source, extensively trained, self-tuning, and self-adjusting model as new information is added. Machines can process multidimensional data as well as various kinds of data. Machine translation helps to save time, so people do not have to spend time looking for a dictionary to translate a sentence, which improves productivity [3]. Xing et al. have been suggested that in deep learning, feedforward neural networks have unique advantages and play an important role in solving various functions such as distribution. However, the capacity of feedforward neural networks is limited. The human brain contains energy, including energy, and functions only a small part of it [4]. According to Guang et al., not only can people identify patients, but also the reasons for accessing data correlations, which are rich in content, but the physical relationship of the data is very difficult, and the lengths of the data vary [5]. Chen et al. proposed that machine translation refers to the main research direction combining artificial intelligence and natural language processing, which uses computer operations to transform natural language into another language on the basis of preserving the original meaning, so as to achieve mutual translation between the two languages [6]. Selva et al. said that in the context of economic globalization in the modern world, with the continuous development of Internet technology, there are more and more frequent international exchanges, people in different countries who use different languages are more and more closely connected, and the demand for bilingual interaction in social work and life is more and more obvious [7]. Translation is the main method of equivalent transmission of information in different languages, which is particularly important. According to Jiang et al., for another translation from English to Hindi, feedforward and backpropagation artificial neural network is used. In terms of implementation, Java is adopted as the main programming language to realize all rules and modules except the neural network model, and it is implemented in Matlab [8]. According to Luo et al., this document contains setup information to provide machine learning algorithms for training. The main material of this study is English and Chinese continuous sentences. For all English sentences, some Chinese proverbs need to be properly trained and tested [9]. In the study of Jc et al., it indicates that the data is written in English and Chinese, up to 7 sentences in English and Chinese [10]. The dataset consisted of 4000 parallel sentences in English and Chinese. The dataset was divided into 4 : 1 ratios for training and testing.

3. Method

3.1. Model Frame Design. The recursive neural network is prone to the phenomenon of gradient explosion or disappearance. In the training process, this will lead to the inability to continuously send sequences with very long gradients in the training process and eventually make it difficult for the model to be captured for a long time [11]. As for the phenomenon of gradient explosion, the gradient threshold can be set scientifically and reasonably based on model parameter training. When the gradient exceeds the specified threshold, it can be directly intercepted. For the result of vanishing gradients, you can handle it well in several ways, namely, start to study the weights, make sure that the weights of all neurons do not choose as much height as the largest or smallest as possible, and avoid a lot of gradient vanishing; Sigmoid and TANH can be replaced by relu function as activation function. It is constructed by LSTM or GRU structural network model [12]. This process combines Nginx and a web server to improve the performance and reliability of the model. When multiple users send requests, Nginx can not only send the generated requests to the server but also manage multiple request sharing as needed, increase the maximum number of accesses, and prevent failures. The intermediate process is between the scheduled time and the in-memory database module. Data sent by the user is processed as an average over a predetermined period of time, and additional data is efficient and sent as fast as the data in memory [13]. On the basis of improving the level of module time control, the stability and efficiency of data transmission are guaranteed rented. The decoding layer includes GPU and CPU decoding modules. According to the multiconcurrency and hybrid decoding model, the concurrent model achieves high performance, reduces the slow response speed, and ensures high concurrency and low latency of the entire model. Linear activation function and hyperbolic tangent activation function are used in encoder and decoder, respectively, and SIGN function is used in attention layer to obtain the best accuracy [14]. With these configurations, 100 epochs have been performed, and the average error is 0.107. The error of the proposed recursive neural network-based machine translation method is relatively low. Experimental results show that this algorithm has better performance than traditional translation algorithms. Furthermore, considering communicative translation, this kind of translation has the advantage of being able to correctly capture the content of the sentence [15]. Probabilistic formula (1) of modeling translation based on neural network is expressed as follows:

$$p\left(\frac{Y}{X}\right) = P(Y_t). \tag{1}$$

GRU LSTM and other nonlinear elements are applied to the neural network machine translation model, and the hidden state formula (2) ht is calculated based on the current input xt and the previous hidden state $ht - 1$.

$$ht = \mathrm{RNN}(ht - 1). \tag{2}$$

In order to make full use of the information content, two New Year's greetings are made with the words in the text. Put together the coded effects of different instructions to make it the final hidden state. Formula (3) of this process is expressed as follows:

$$ht = \left[\underset{ht}{\longrightarrow}\right]. \tag{3}$$

The generation formula (4) of the target language through the decoder is as follows:

$$q = g(yt - 1, ct, st). \tag{4}$$

In the formula, q refers to the target side word tensor to be predicted, g refers to the nonlinear unit, st refers to the decoder side hidden states, and ct refers to the weighted sum of all hidden states at the source side [16]. The calculation method of c_t and a_t is shown in the following formulas.

$$c_t = \mathrm{attention}(s_{t-1}, h), \tag{5}$$

$$a_t = \mathrm{softmax}\, V_a^T. \tag{6}$$

Demonstration of English translation based on neural connections is shown in Figure 2.

3.2. Translation System Design Method. When explaining the subsystems of the design process, there are eight functional combinations. Modules such as Thorn Lexical Analysis and Shallow Syntax can identify words. The use of the match module example is based on the example. The sentence target generation module is the key point, that is, the output of target translation. The knowledge of translation is the knowledge of language rules, and it is also the process of converting real text words into a series of process words [17]. The parser system includes word processing not preincluded and identifies individual learning outcomes. Based on pos rules and statistics, pos rules are used to input pos array, and invalid pos information and morphology are removed from the whole sentence to create pos sequence. The part-of-speech tagging was counted, and the model parameters

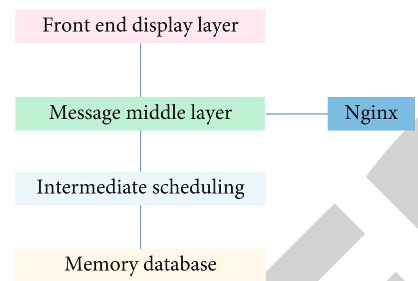

Figure 2: Neural network model framework for English machine translation.

were extracted from the corpus to eliminate the part-of-speech and class ambiguity. The instance pattern matching machine translation method refers to the translation of English sentences by combining examples with patterns. If there are instance pairs in the library and the similarity between the input sentence and the source language is higher than the set threshold, the translation input sentence should be corrected and the sentence translated should be output, or the English sentence should be input using the pattern-based method [18]. If the matching is successful, the syntax generation is realized with the target pattern and phrase level goal, so as to realize the creation of sentence translation output. As shown in Figure 3, instance pattern matching of the coding state of the translation system can be promoted through the search tree. If the matching is not successful in the instance pattern, sentence pattern transformation can be realized by transformation, and in-depth analysis is conducted; finally, translation transformation and sentence generation can be realized.

3.3. Training Frame Design. The English translation model is constructed by the concept of componentization, so that the role of components in translation work can be measured quickly and effectively, and the joint training mode can be adopted in training to reflect the critical components. (O, Q) is used to represent corpus sentences; (o, q) stands for phrases or rules chosen based on corpus. To clarify sentences and phrases in general, sentences are represented by Ox and words are represented by Ox. Preliminary data usually includes monolingual sentences and bilingual prepositions and selection rules, and word vectors created by retraining the neural network are called neural recurrent networks for training. The number of local layers learned by a neural network is similar to a tree derivation for sentence generation. Training includes phrase encoder and encoding code [19]. The standard training framework selects a sentence or a rule for each sentence, first obtains the first word vector represented as a recurrent neural network, then represents the word vector as a recurrent neural network to obtain a representation vector (Zf, Zt), and passes the sentence and the rule's internal product similarity. The English translation model is generally divided into two parts: one is to obtain vector words through repeated neural networks and switch to standard translation neural network recursion; the other is divided into sentence encoders and variables according to translation model. Linguistic encoders and

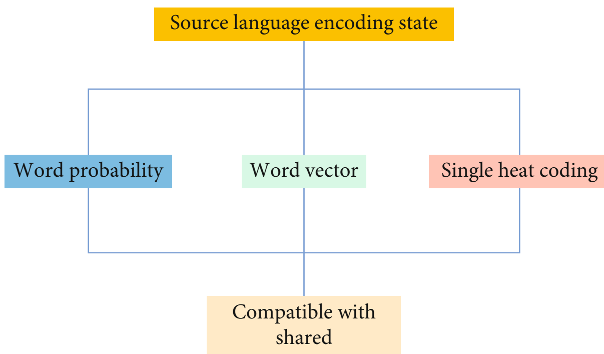

Figure 3: Translate system coding state.

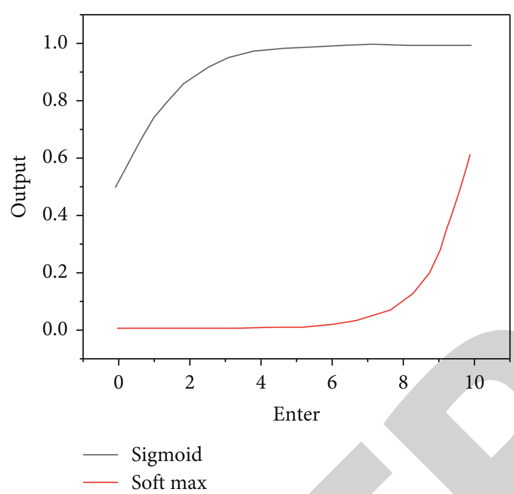

Figure 4: The activation function of Softmax and Sigmoid.

bilingual encoders: during the training, the monolingual encoders were pretrained step by step, then the bilingual encoders were trained, and finally, the key of each link was balanced through joint training. The standard model can measure Chinese sentences equivalent to English input. The model is designed from data-driven deep training. It learns and predicts the translated word of each given word through a multilayer neural network, transforming the word into a vector representation [20]. After tokenization, the RNN model has an embedding layer, which is the first layer of the encoder and decoder. To measure the automatic speech ability, the performance of GRU and LSTM layers is compared. The results show that GRU is better than LSTM, so the next layer is GRU layer. Hyperbolic tangent activation function is used to evaluate the attention mechanism, and Sigmoid function is used for attention layer activation function to achieve the best Chinese translation effect. Both the encoder and decoder GRU layers use linear and hyperbolic tangent activation functions because they have the lowest loss. Use English and Chinese sentences as input, and the mapping of English and Chinese is marked as attention weight, which represents the attention of Chinese tokenized sequence to English tokenized sequence, as shown in the following formula:

$$\text{Score} = \text{Sigmoid}. \tag{7}$$

Both encoder and decoder GRU layers use linear and hyperbolic tangent activation functions because they have the shortest downtime. Use English and Chinese sentences as input formula as follows:

$$F(x) = \frac{\exp(2x) - 1}{\exp(2x) + 1}. \tag{8}$$

x is the linear activation formula (9) of the value of the sequence.

$$F(x_i) = \omega x_i + b. \tag{9}$$

The activation function Sigmoid is shown in the following formula:

$$F(x) = \frac{1}{1 + \exp(-x)}. \tag{10}$$

The activation function of Softmax and Sigmoid is shown in Figure 4.

Machine translation has many advantages; it saves time, can translate many languages, and so on. In this paper, a design scheme of machine translation is proposed and implemented. Compared with other implementation methods in various studies, the proposed recursive neural network method provides better results. It will make contribution to the disposal of natural language of machine learning. When dealing with a large number of vocabularies, performance can be improved. And increasing the number of epochs can improve the accuracy. However, solving these problems requires a lot of energy and memory, which will be mentioned in future work. By making machine self-learning and communicating directly with natural language through intermediate connections, the translation problem has been transformed into a constructive problem of how to describe a particular generated language. On the basis of the encoder, the source sequence with initial and final identifiers is input into a vector file, which is then transmitted to the neural network together with the instruction background vector. In order to compare the influence of semantic feature vectors on the performance of the translation model and the effectiveness of the neural network, the baseline system was selected, that is, no semantic feature baseline was added and no recursive modeling baseline was selected. Figure 5 shows the neural network test system. The latter implementation is the same as the recursive neural network English translation model, but the training does not need to consider the recursion of phrases or rules aligned to the target language side of the instruction source language. The semantic vector is constructed from left to right by source language and target language, and the baseline system of the latter also has bilingual semantic similarity. Experiments show that the machine online translation system based on deep neural network method can improve the translation quality and efficiency and meet the demand of large volume of translation.

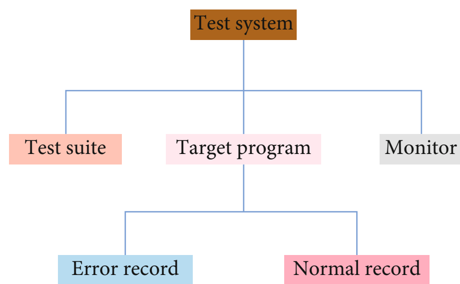

Figure 5: Neural network test system.

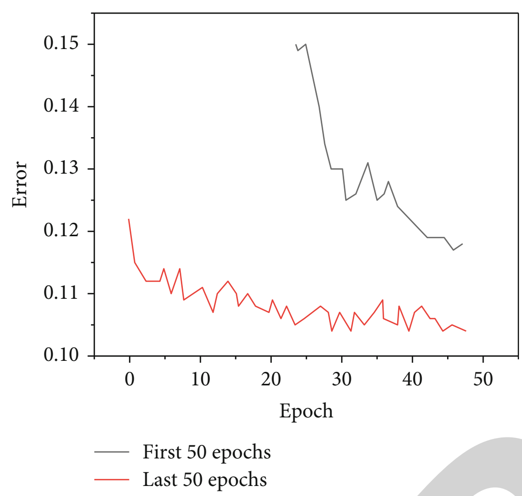

Figure 6: Performance improvement.

4. Result and Analysis

Machine translation is not only the conversion of one language string to another language string. It is also the semantically equivalent representation of the semantics spoken in one language and the semantics spoken in another language. Routine testing usually depends on the complexity of the translation. Other evaluation methods integrate language knowledge base to improve the evaluation quality of translation. In essence, these comprehensive methods of integrating language knowledge increase the evaluation proportion of semantic knowledge and are more in line with the essence of translation evaluation. Word vector can express rich semantic and linguistic structure information, which is a relatively ideal semantic representation method. Abstract effective features with neural network or use neural network model for translation evaluation has become a hot research topic. The main feature of character-level neural machine translation is to take character subwords as the basic unit of translation, which can avoid the problem of unknown words to a certain extent. Therefore, there is no limit on the size of translation dictionary. The main feature of multi-language neural machine translation is to expand the one-to-one translation model into one-to-many, many-to-one, or many-to-many translation model. At present, it is mainly aimed at the translation between western pinyin characters. The basic unit of translation can be the word subword, etc. When the subword is adopted, the open dictionary translation can be realized. A total of 100 epochs were used to evaluate the minimum error of each epoch, which was divided into two parts, as shown in Figure 6. Most neural machine translation models were realized by cyclic neural networks.

Designing effective features plays an important role in machine translation evaluation. The adopted features range from simple language-independent basic features to higher-level features based on language structures. Such artificial features are domain-dependent, vary in application across different data sets and languages, and largely ignore contextual information. Features obtained by neural network training include continuous spatial language model features, word vector features obtained by large-scale monolingual corpus training, similarity between target language words and source language words calculated by word alignment and word representation, etc. These characteristics are obtained through unsupervised training; simple, effective, and adaptable translation evaluation plays a guiding role in the research of machine translation and is an important research direction of machine translation. How to combine the advantages of neural network to construct a new evaluation method and make the automatic evaluation results more consistent with the evaluation of translation quality by human experts is the important goal for machine translation evaluation.

5. Conclusion

To sum up, this paper constructs an English translation model based on recursive neural network, which conforms to translation requirements and processes. The neural network is guided by alignment to generate structural information attached to source language and target language, in which word vector with global information and bilingual alignment information is fully considered during training. The most representative bilingual corpus was selected for training, and the effectiveness of the model was proved by multiple test data. Based on the experimental results, it is concluded that the English translation model based on recursive neural network is highly effective and stable and improves the BLEU score by about 1.51-1.86 compared with the baseline system. It also makes a preliminary analysis of machine translation technology based on deep neural network learning and realizes the creation of prototype system through research ideas. Based on the case and experiment to verify the feasibility of the technical ideas, the use of this technology in translation can innovate the retrieval technology of cross-language information in China and has a wide range of industrial application value and social value to achieve barrier-free communication between different languages is the dream of the early invention of computer. After more than 60 years of development, from rule-based machine translation to statistically based machine translation, to the current neuromachine translation, on the whole, people's intervention in the translation process has been constantly reduced. In terms of translation effect, the translation quality of neural machine translation is better under the same conditions, and there is still a lot of room for improvement. Neural network can also efficiently deal with

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Retraction

Retracted: Multimedia Image Data Compression Based on Wavelet Analysis

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[1] R. Wang, Q. Zhu, and W. Bu, "Multimedia Image Data Compression Based on Wavelet Analysis," *Wireless Communications and Mobile Computing*, vol. 2022, Article ID 2773868, 7 pages, 2022.

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Research Article

Multimedia Image Data Compression Based on Wavelet Analysis

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In order to improve the compression technology of multimedia image data, a compression method of multimedia image data based on wavelet analysis was proposed. By combining Fourier transform and wavelet packet multithreshold denoising method, the image data was denoised and compressed through the transform of wavelet analysis and multithreshold processing, so as to realize the compression of image data with high quality. The experimental results showed that it was effective to analyze signal singularity, singularity position, and singularity degree by using wavelet analysis. And the signal mutation position near $t = 0$ could be seen clearly from the wavelet coefficient diagram, while the Fourier transform diagram did not provide any information about when the frequency mutation occurred. It was concluded that the method of multimedia image data compression based on wavelet analysis could promote the development of multimedia image data compression technology effectively.

1. Introduction

The amount of multimedia image data is very large after digital processing. If the data is not compressed, the computer system cannot store and exchange it. Therefore, how to effectively store and transmit the image data in the multimedia system becomes one of the biggest problems faced by the multimedia personal computer (MPC). Data compression is an important way to solve this problem.

Wavelet analysis is an applied mathematical theory developed in the 1980s. It has obtained many important applications in many fields of surveying and mapping. An automatic cartographic synthesis model based on wavelet analysis is established to test the river network data [1]. These researches have achieved good results, but the depth and breadth of the research are not enough, and there are still many problems to be further investigated, but it is undeniable that wavelet analysis is an ideal mathematical tool for signal processing. As a means of signal processing, wavelet analysis has been more and more important for theoretical workers and engineers. And it has obtained the remarkable effect in many applications. Compared with the traditional processing method, there is a qualitative leap. It proves that the wavelet analysis technology, as a harmonic analysis method, has the huge vitality and broad application prospects, as shown in Figure 1.

2. Literature Review

Data compression refers to the technology of reencoding the original data to remove the redundancy in the original data and represent the original data with a small amount of data, which is the premise of processing image, audio, video, and other media data on the computer. With the development of computer network and computer communication technology, the data compression technology has received unprecedented attention and popularized and developed rapidly.

The compressed coding theory was first proposed in 1948. Oliver proposed the PCM (pulse code modulation) coding theory [2, 3]. From the perspective of the development of data compression technology, it could be divided into two important stages. The first stage was before 1984, in which the main theory was to study the basis of data compression. The second phase was from 1985 to now, and it walked into the practical phase of data compression technology. In 1988, the data

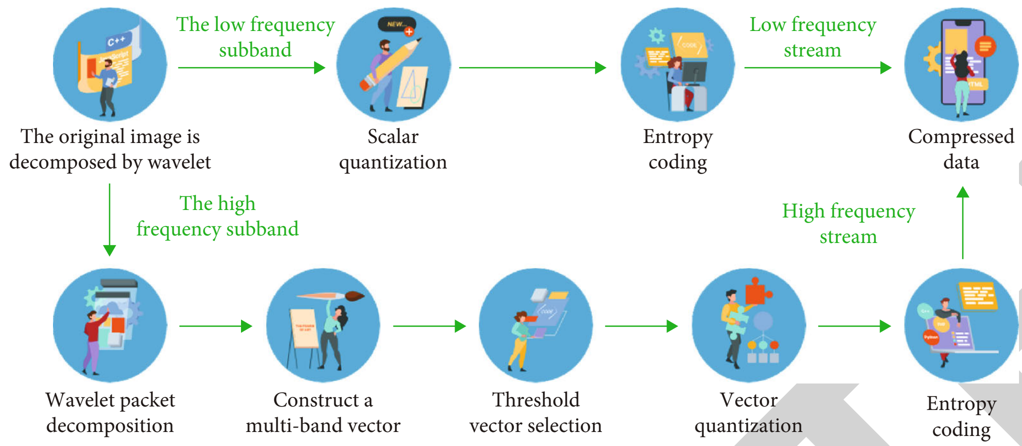

Figure 1: Multimedia image data compression.

compression technology had a breakthrough, and the suitable chip structure was made.

Transform coding is a kind of lossy coding. The so-called transform refers to the mathematical transform of the original time or space domain of the original data to highlight important parts of the original data after transform, so as to focus on processing [4]. At present, it is widely used in monochrome image, color image, still image, moving image, and multimedia computer technology in TV image compression within frames and between frames.

Transform coding refers to the transform of a given image to another data domain (transform domain or frequency domain) in order to represent a large amount of information with less data. In other words, it does not directly encode spatial domain image signals but first maps the currently expressed spatial domain image signals to another orthogonal vector space through transform to obtain a series of transform coefficients which are encoded then [5]. The coding accuracy of the important coefficients in the transform domain is higher than that of the second important coefficients. Transform itself is a lossless and reversible technology, but in order to obtain better coding effect, some unimportant coefficients are ignored; so, it becomes a lossy technology. Commonly used transform coding schemes include discrete cosine transform (DCT) and Fourier transform coding [6, 7].

In the DCT transform coding algorithm, the original image is usually divided into subblocks of 8×8 size, and each subblock performs DCT forward transform in sequence, quantizes the DCT transform coefficient, and then carries out coding. The decoding process is the opposite of the coding process; that is, the first is decoding and then dequantization. DCT inverse transform is performed on each subblock to obtain subblock image, and each subblock is carried out in sequence to obtain the image restored after decoding. DCT is widely used in image compression.

After DCT forward transform, most of the energy is concentrated in the upper left corner of Y matrix, which means that the correlation of the image decreases after DCT transform, so that fewer bits can be used to encode the upper left corner element of matrix D, thus achieving the purpose of data compression.

Wavelet analysis is a new field which is rapidly developing in current mathematics. It has both profound theory and extensive application. Compared with Fourier transform and Gabor transform, it is a local transform of time and frequency. So, it can effectively extract information from signals and perform multiscale analysis on functions or signals by scaling and shifting operations. Wavelet transform has solved many problems that Fourier transform could not solve; so, it is known as the "mathematical microscope" and is a landmark progress in the development history of harmonic analysis [8].

In the research, data compression of multimedia image was processed based on wavelet analysis. Wavelet analysis could achieve higher compression ratio and higher reproducibility image compression in image data compression. Therefore, wavelet analysis could be used to compress multimedia image data more efficiently and achieve better results.

3. Research Methods

3.1. Fourier Transform. Fourier transform (FT) is one of the important application tools in many scientific fields. Mathematically, it is the conversion of a complex operation on one function into a simpler operation on another function. Fourier transform transforms one function $F(t)(-\infty<t<\infty)$ into another function $F(\omega)(-\infty<\omega<\infty)$ by means of integration, as shown in Formula (1).

$$\mathrm{FT}: f(t) \longrightarrow F(\omega) = \int_{-\infty}^{\infty} f(t) e^{i\omega t}\, dt. \tag{1}$$

When $f(t)$ meets the appropriate conditions, it has the contravariant transform (FT^{-1}), as shown in Formula (2).

$$\mathrm{FT}^{-1}: F(\omega) \longrightarrow f(t) = \frac{1}{2\pi} \int_{-\infty}^{\infty} F(\omega) e^{i\omega t}\, d\omega. \tag{2}$$

The FT transform transforms the derivative of $f(t)$ into the multiplication of $F(\omega)$, $(d/dt)f(t) \longrightarrow i\omega F(\omega)$ and transforms the two functions the convolution of two functions $f(t)$ with $g(t)$ into the multiplication of $F(\omega)$ with $g(t)$. Most of the analysis and processing of signals uses linear constant coefficient differential operators or convolution operators to describe the relationship between the inputs and outputs. It is much simpler to study the relationship between the input and output spectrum of such signals than to directly study the signal itself, that is, from the frequency domain characteristics [9]. Fourier transform is the time domain and frequency domain mutual conversion tool. From a physical sense, the essence of the Fourier transform is to decompose this waveform in the time domain into a superposition of many sine waves of different frequencies. So, the study of the function $f(t)$ can be translated into the study of its weight, namely, Fourier transform $F(\omega)$.

By the definition of the Fourier transform, $F(\omega)$ depends on the global properties of $f(t)$ along the real axis $(-\infty, \infty)$; so, it does not reflect the local time range of the signal, that is, for a particular frequency in the Fourier spectrum, when that frequency is generated cannot be known. And in many practical problems, what people are interested in is the characteristics of the signal in the local time range. To address this weakness, Gabor puts forward the concept of "window Fourier transform" in 1946, also known as short-time Fourier transform (STFT) [10]. The basic idea of window Fourier transform is to divide the signal into many small time intervals and analyze each time interval with Fourier transform in order to determine the frequency existing in this time interval. The approach is to introduce a smooth function $g(t)$, called the window function, which is identical to 1 on the interval $(-\Delta+\delta, \Delta-\delta)$ and rapidly decreases smoothly from 1 to 0 on the interval $(-\Delta-\delta, -\Delta+\delta)$ and $(\Delta-\delta, \Delta+\delta)$ (δ is a suitably small positive number). Multiplying $f(t)$ by $g(t-\tau)$ is equivalent to opening a 2Δ window centered on $t=\tau$.

The window Fourier transform formula of function $f(t)$ on window function $g(t-\tau)$ is Formula (3).

$$G_f(\omega, \tau) = \int_{-\infty}^{\infty} F(t) g(t-\tau) e^{-i\omega t}\, \mathrm{d}t. \quad (3)$$

$G(\omega, \tau)$ reflects the spectral characteristics of signal $f(t)$ near $t=\tau$, and its inversion formula is Formula (4).

$$f(t) = \frac{1}{2\pi} \int_{-\infty}^{\infty} \mathrm{d}\omega \int_{-\infty}^{\infty} e^{i\omega t} g(t-\tau) G_f(\omega, t)\, \mathrm{d}\tau. \quad (4)$$

The window position of STFT changes with τ, which meets the requirements of studying the local nature of different positions of signals. However, the size and shape of its window function remain unchanged regardless of time and frequency, which cannot meet the requirements of variable window processing when processing time-varying signals. In order to solve this problem, a new time-frequency analysis theory, the wavelet transform, was developed in the late 1980s on the basis of inheriting and developing the localization idea of STFT.

The so-called wavelet transform is to obtain a subwavelet (also known as wavelet base) $\psi_{ab}(t) = (1/\sqrt{a})\psi(1-b/a)$ after the independent variable t of a function $\psi(t)$ is shifted (b) and stretched (a) [11]. The $W_f(a, b)$, a function with double parameters a and b, was obtained by the inner product of the function $f(t)$, as shown in Formula (5).

$$W_f(a, b) = \frac{1}{\sqrt{|a|}} \int_{-\infty}^{+\infty} f(t) \psi\left(\frac{(t-b)}{a}\right) \mathrm{d}t, a > 0. \quad (5)$$

The mother wavelet $\psi(t)$ has a compact support set [12]. That is, $\psi(t)$ is equal to 0 or rapidly approaches 0 outside the finite interval (making it play the role of a window). It is ensured that $\int_{-\infty}^{\infty} \psi(t) \mathrm{d}t = 0$ (so that its function values alternate with positive and negative fluctuations). The position of the window moves with $\int_{-\infty}^{\infty} \psi(t) \mathrm{d}t = 0$, and the window shrinks with a. Integral Formula (5) can be transformed into convolution form; so, the wavelet transform is to filter the $f(t)$ in the window, and this filtering is a band-pass filtering. The larger a is, the narrower the band is and the lower the average frequency is. It is as if a man was watching a scene, and the farther he stood, the greater the window, and the more obscure the scene. Conversely, the smaller a is, the higher the resolution is. This is multiresolution analysis, known as the "mathematical microscope" [13].

The data quality of wavelet transform is to project the signal onto a series of wavelet basis (a series of wavelet basis functions are used to approximate the signal), which is generally divided into continuous (CWT) and discrete (DWT) wavelet transform [14, 15].

The process of continuous wavelet transform (CWT) can be understood as follows. The wavelet with a certain scale a is selected, and it is compared with the left end alignment of the original signal. According to the continuous wavelet transform formula, see Formula (6).

$$\mathrm{CWT} = \int_{-\infty}^{\infty} f(t) \psi_{ab}(t) \mathrm{d}t. \quad (6)$$

Calculate the similarity coefficient of the two functions and then move the wavelet function to the right one wavelet function distance for comparison and calculation, until the whole signal operation is completed. The wavelet scale parameter a is changed to repeat the above process. This results in wavelet coefficients at a range of scales. Finally, the gray scale of wavelet coefficients can be made by taking time as abscissa and scale as ordinate. Taking Morlet wavelet as an example to transform the function $f(t)$, when $-1 < t < 0$ and $f(t) = \sin(50t)$. When $0 < t < 1$, $f = \sin(100t)$. It can be clearly seen from the wavelet coefficient diagram that the position of signal mutation is near $t = 0$, while the Fourier transform diagram does not provide any information about when the frequency mutation occurs.

3.2. Key Technologies of Wavelet Packet Multithreshold Denoising Method. Image denoising refers to the process of reducing the noise in digital images. In the process of digitalization and transmission, the digital image in reality is often affected by the noise interference of imaging equipment and external environment, which is called noise-containing image or noise image. Noise is an important cause of image

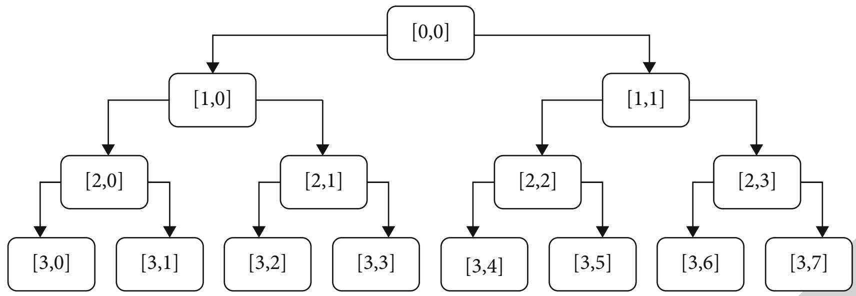

Figure 2: Node number of wavelet packet three layer decomposition.

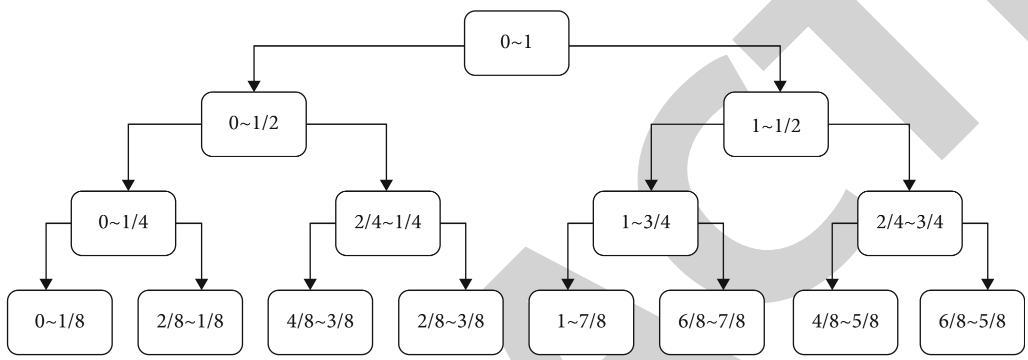

Figure 3: Frequency decomposition of wavelet packet three layers (unit: Hz).

interference. So, in order to better compress the digital image, it is necessary to carry out the denoising processing. Wavelet packet multithreshold denoising method is a good denoising method [16]. The mathematical expressions of the decomposition algorithm and reconstruction algorithm of wavelet packet theory are as follows.

The decomposition algorithm of wavelet packet is that $\{d_t^{j,2k}\}$ and $\{d_t^{j,2k+1}\}$ are solved through $\{d_t^{j+1,k}\}$, as shown in Formula (7).

$$\left.\begin{aligned} d_t^{j,2k} &= \sum_p h_{p-2t} d_p^{j+1,2k} \\ d_t^{j,2k+1} &= \sum_p g_{p-2t} d_p^{j+1} \end{aligned}\right\}. \tag{7}$$

The reconstruction algorithm of wavelet packet is that $\{d_t^{j+1,k}\}$ is solved by $\{d_t^{j,2k}\}$ and $\{d_t^{j,2k+1}\}$.

$$d_t^{j+1,k} = \sum_p \left(h_{t-2p} d_p^{j,2k} + g_{t-2p} d_p^{j,2k+1} \right). \tag{8}$$

In Formula (8), h and g are the filter coefficient. d is the wavelet packet decomposition coefficient. p and t are the decomposition layer number, and j and k are the node number of the wavelet packet.

The distribution of noise in the frequency domain is mainly concentrated in the higher frequency part. Therefore, when using wavelet packet to denoise, if the same threshold processing method is adopted in different frequency band information, or different threshold processing methods are adopted in the same frequency band information, the denoising accuracy will be affected. So, how to divide frequency band accurately is the key problem of multithreshold denoising. In the research, a classification method is proposed, which is based on frequency order and information type reorganization. According to the theory of wavelet packet transform, it can extract useful information hidden in low frequency, medium frequency, and high frequency. Taking three layers as an example, signal decomposition is shown in Figure 2. The GPS deformation monitoring data with sampling frequency of 2 Hz is taken as an example, and Nyquist sampling theorem is applied [17]. The signal is divided into wavelet packets as shown in Figure 3. Then, each node of the wavelet packet tree at the third layer is corresponding to Figure 2 one by one, and Table 1 is obtained.

Table 1 shows that the natural order and frequency order of nodes in wavelet packet tree are inconsistent. The lowest frequency part corresponds to the first node, and the highest frequency part corresponds to the fifth node. The reason for this phenomenon is that the high-pass filter will carry out a “flip” operation when the wavelet packet is decomposed. It can be proved by the properties of wavelet packet that the decomposition of any wavelet packet will produce the phenomenon of inconsistency between natural order and frequency order, and the situation of inconsistency is the same. Therefore, when the wavelet packet decomposes each layer, the low-frequency decomposition part is arranged in ascending order of frequency, and the high-frequency part

Table 1: The correspondence table of the third layer node number of wavelet packet tree and the decomposition frequency of wavelet packet.

The serial number	1	2	3	4
Wavelet packet tree node number	[3, 0]	[1, 3]	[2, 3]	[3]
Decomposition frequency/Hz	0/8 ~ 1/8	2/8 ~ 1/8	4/8 ~ 3/8	2/8 ~ 3/8
The serial number	5	6	7	8
Wavelet packet tree node number	[3, 4]	[3, 5]	[3, 6]	[3, 7]
Decomposition frequency/Hz	8/8 ~ 7/8	6/8 ~ 7/8	4/8 ~ 5/8	6/8 ~ 5/8

Table 2: Multithreshold criteria selection table.

Low frequency	Middle frequency	High frequency
Rigrsure	Rigrsure	Sqtwolog
Minimaxi	Minimaxi	Heursure

is arranged in ascending order of frequency. In the field of deformation monitoring, because noise distribution is closely related to frequency order, frequency order rather than natural order is needed.

In the deformation analysis, there are often frequency bands that need to be preserved and denoised centrally, if the vibration frequency information of the building owner mode of 0.15 Hz needs to be monitored; according to the calculation, [3, 0] and [1, 3] are the concentrated frequency band of useful information, namely, the low frequency band. However, noise pollution is general. [3 and 4] are the frequency band of useless information concentration, that is, the high frequency band. The other nodes are transitional frequency band, that is, middle frequency band. Therefore, the wavelet packet decomposition coefficients can be grouped according to the frequency bands to be monitored and the situation of noise pollution, which is the method of reorganization according to the information type. Specifically, according to the distribution of signal and noise, taking three layers as an example, α is the proportion coefficient of low frequency band, β is the proportion coefficient of high frequency band, and n is the number of signal decomposition layers. Then, there is a wavelet packet tree node grouping. It should be pointed out that in some special cases, the frequency band can be further subdivided into low frequency, sublow frequency, intermediate frequency, subhigh frequency, and high frequency, but the basic principle remains the same.

In Table 1, wavelet packet tree nodes $[n, m_0]$, $[n, m_1]$, …, $[n, m_{2^n-1}]$, … are arranged in order of frequency from smallest to largest.

3.3. Multithreshold Processing of Wavelet Packet Decomposition Coefficients. Because the distribution of signal and noise is not fully considered in the single threshold criterion, it is easy to have insignificant or excessive denoising effect in denoising, while the multithreshold criterion can overcome the above shortcomings well [18]. The basic idea of multithreshold criterion is to flexibly select different threshold criteria for each wavelet packet decomposition coefficient according to certain rules, so as to retain useful information to the maximum extent and remove useless information. The four threshold criterion commonly used in wavelet packet analysis includes fixed-form threshold criteria (sqtwolog), adaptive threshold criteria (rigrsure), heuristic threshold criteria (heursure), and minimaxi [19]. Due to the different selection rules, the denoising effect is different. Therefore, each wavelet packet decomposition coefficient has its most appropriate threshold criteria [20].

The four threshold criterion has their own characteristics. Among them, sqtwolog threshold criteria and heursure threshold criteria are similar in that all coefficients are processed; so, noise can be strongly removed. Correspondingly, it is easy to over-denoise; so, it can be called “radical” denoising criteria, which is suitable for processing the high frequency part of GPS signal [21, 22]. Rigrsure threshold criteria and minimaxi threshold criteria deal with part of the coefficient, which is a relatively compromise processing method. Therefore, it can prevent excessive denoising. Correspondingly, it is prone to the phenomenon of not obvious denoising; so, it can be called “conservative” denoising criteria, suitable for dealing with the low-frequency part. Among them, rigrsure threshold criteria and minimaxi threshold criteria are more suitable for middle frequency band. Therefore, the selection table of multithreshold criteria as shown in Table 2 is established for threshold processing of wavelet packet decomposition coefficients [23].

4. Result Analysis

A signal can be decomposed by the wavelet transform, and then the original signal can be obtained through the reconstruction. Figure 4 is a schematic diagram of a fault signal decomposed and reconstructed by algorithm. From the low-frequency coefficients in the figure, it can be clearly seen in the “approximate signals” of the original signal at different scales. The rough outline of the signal is preserved, while the high frequencies reflect the turning points of the signal clearly. Singular value detection is carried out on the basis of the algorithm. The singular point and irregular mutation part of the signal often carry important information, which is an important part of the signal. Image compression processing is of great significance [24]. For a long time, the Fourier transform is the main tool to study the singularity of functions. Its method is to study the attenuation of functions in the Fourier transform domain to infer whether the function has the singularity and the magnitude of the singularity. However, Fourier transform lacks spatial locality. It can only determine the global properties of the singularity of a function, but it is

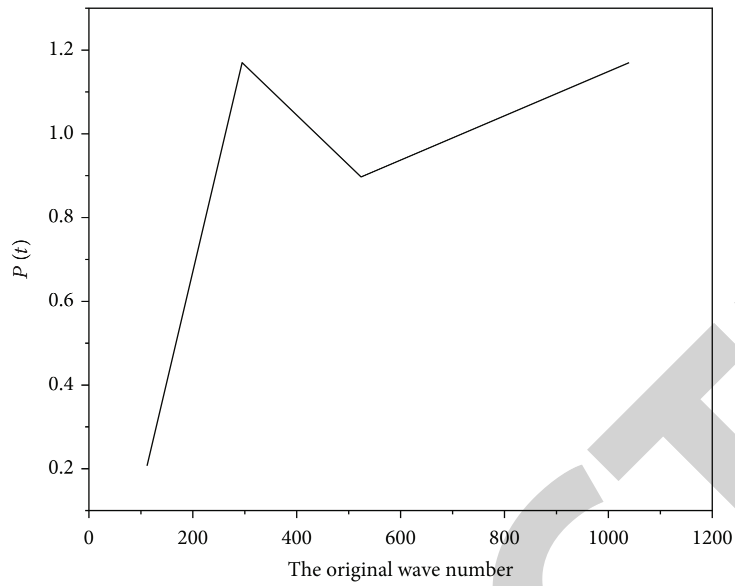

FIGURE 4: Signal decomposition and reconstruction.

difficult to determine the position and distribution of the singularity in space. However, the wavelet transform has the property of spatial localization, and the wavelet coefficient diagram can clearly reflect that the location of signal mutation near $t = 0$, while the Fourier transform diagram does not provide any information about when the frequency mutation occurs. Therefore, it is effective to use wavelet to analyze signal singularity, singularity position, and singularity degree [25].

5. Conclusions

In the research, the multimedia data image compression method based on wavelet analysis is used for compression processing. When using the wavelet analysis method to compress data image, the compression ratio is high, the compression speed is fast, and the basic characteristics of signal and image can be kept unchanged after compression and can be anti-interference in the transmission process. The wavelet packet multithreshold denoising method is better than traditional wavelet, wavelet packet denoising method, and other improved wavelet packet denoising method. It provides an optimization method for the compression of multimedia image data.

Data Availability

The data used to support the findings of this study are available from the corresponding author upon request.

Conflicts of Interest

The authors declare that they have no conflicts of interest.

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Retraction

Retracted: 5G Edge Computing Access Node Selection Algorithm Based on Energy Efficiency and Delay

Wireless Communications and Mobile Computing

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This article has been retracted by Hindawi following an investigation undertaken by the publisher [1]. This investigation has uncovered evidence of one or more of the following indicators of systematic manipulation of the publication process:

(1) Discrepancies in scope
(2) Discrepancies in the description of the research reported
(3) Discrepancies between the availability of data and the research described
(4) Inappropriate citations
(5) Incoherent, meaningless and/or irrelevant content included in the article
(6) Peer-review manipulation

The presence of these indicators undermines our confidence in the integrity of the article's content and we cannot, therefore, vouch for its reliability. Please note that this notice is intended solely to alert readers that the content of this article is unreliable. We have not investigated whether authors were aware of or involved in the systematic manipulation of the publication process.

Wiley and Hindawi regrets that the usual quality checks did not identify these issues before publication and have since put additional measures in place to safeguard research integrity.

We wish to credit our own Research Integrity and Research Publishing teams and anonymous and named external researchers and research integrity experts for contributing to this investigation.

The corresponding author, as the representative of all authors, has been given the opportunity to register their agreement or disagreement to this retraction. We have kept a record of any response received.

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Research Article

5G Edge Computing Access Node Selection Algorithm Based on Energy Efficiency and Delay

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In order to address the dissipation of energy efficiency in 5G edge computing, and the problem of network delay, better improve the quality of user service, considering the data aggregation delay while improving the network energy efficiency. The author proposes a 5G edge computing access node selection algorithm based on energy efficiency and delay; through the energy efficiency and delay balanced data collection mechanism (EEDBDG), a new dynamic tree is used to organize the network topology, eliminating the hot zone problem; nodes dynamically choose routes and take turns acting as the root of the tree, which collects data and communicates directly with the base station. At the same time, three data collection strategies are proposed for different latency and energy efficiency requirements: delay optimal algorithm (EEDBDG-D), energy efficiency optimal algorithm (EEDBDG-E), and energy efficiency delay balance algorithm (EEDBDG-M). Experimental results show that, when the communication radius of nodes is limited, EEDBDG balances the energy consumption of nodes, prolongs the network life time, and shows outstanding performance in energy saving and time saving. Compared with GSEN, in the best case, the network lifetime of EEDBDG-E is increased by 72%, and the convergence delay of EEDBDG-D is reduced by 74%. *Conclusion*. The algorithm can effectively reduce the energy dissipation and delay of edge computing.

1. Introduction

In recent years, with the wide application and popularization of IoT access devices, as well as the rapid development of mobile data networks, the 5G (The 5th Generation Mobile Communication) era of Internet of Everything has provided a good environmental foundation [1]. At the same time, in order to cater to the rapidly developing mobile Internet of Things information technology, the 5G communication era needs to carry larger data services, making the information transmission between "people" and "things," "things," and "things" more smooth and convenient [2]. The wireless communication technology has undergone a complex and huge evolution process from the initial 2G, to the mature 4G, and now the hot 5G. There are more and more emerging applications such as deep learning, face recognition, and natural language processing. Obviously, smart terminals have gradually become an indispensable part of people's daily life [3]. It is predicted that there will be up to 4 billion Internet users in the future, with as many as 10 million users. By then, 8 billion terminal devices will be connected to the Internet, the number of IoT connections will be 100 billion, and the number of virtual connections will even reach trillions. The study found that the innovation of enterprises is closely related to 5G, artificial intelligence, and the Internet of Things and also generates a large amount of application data [4]. The large-scale access of heterogeneous devices makes the applications of terminal devices more and more complex, not only demanding more and more wireless and computing resources, but also causing excessive delay and high energy consumption during data transmission or execution, moreover, the limited resources, low battery capacity, and task execution capability of intelligent terminals are difficult to match with intensive task execution requirements. For end users, the low computing power will seriously affect the response speed of the application, and the poor battery life will cause the interruption of the computing-intensive task program and affect the task execution process. Therefore, how to improve user service quality while meeting application processing requirements has become the focus and research focus of many scholars [5].

Therefore, the author proposes a food packaging design based on green ecology, through the discussion of the theoretical framework of ecological design and the research on ecological materials of food packaging; the author summarizes the ecological design principles of green ecological food packaging, so as to better guide packaging design.

2. Literature Review

Regarding the research on 5G edge computing (Figure 1) optimization, Li et al. proposed to design a spatiotemporal offloading decision algorithm for heterogeneous networks in edge cloud scenarios. According to the energy consumption and wireless channel model, a threshold-based task scheduling strategy is derived. Each timeslot user offloads some data tasks to the MEC server for execution based on the channel quality, local energy consumption and fairness among users, and an optimal resource allocation scheme is given [6]. Wang et al. proposed a computational offloading scheme in multiuser and multismall cell scenarios and proposed an energy-efficiency optimized offloading scheme based on artificial fish swarm algorithm [7]. Iwagami et al. proposed the optimal task offloading strategy and resource allocation problem under user MEC network; aiming at minimizing the weighted sum of wireless device energy consumption and task execution time, a reduced-complexity Gibbs sampling algorithm is proposed to obtain optimal offloading decisions, and the research is extended to multiuser scenarios [8]. Wang et al. proposed to transform the objective function into convex optimization; a computational offloading and resource scheduling scheme based on the multiplier method is presented. In order to minimize the network system delay, the problem of computational offloading in ultra-dense networks is studied; according to the NP-hard property of the objective function, it is transformed into two subproblems of task allocation and resource allocation, and an efficient offloading strategy is proposed. In the case that the execution completion time is constrained by a strict deadline and the task offloading occurs in the Markov wireless channel, considering the multidecision problem, an online energy optimization calculation offloading algorithm is proposed [9]. Moore et al. proposed the use of computational unloading technology to optimize the objective function. By formulating an appropriate unloading strategy and designing a reasonable unloading algorithm, the solution problem of the function to be optimized is completed [10]. For the calculation offloading decision-making strategy in the MEC system network, it is generally under the condition that the acceptable execution delay limit of the terminal is satisfied, aims to minimize energy consumption for smart end users, or seeks and analyzes a compromise between the two.

Based on the current research, the author proposes a 5G edge computing access node selection algorithm based on energy efficiency and delay. Through the data collection mechanism of energy efficiency and delay balance (EEDBDG), it is compared with the traditional algorithm GSEN, so as to demonstrate the superiority of the algorithm in reducing energy efficiency dissipation and delay reduction.

3. Research Methods

3.1. 5G Edge Computing Network Architecture. 5G edge computing is mainly composed of 5GUPF (userplane function) and edge computing platform system; the network architecture is shown in Figure 2.

3.1.1. 5GUPF. The 5G core network adopts an architecture in which the control plane and user plane are separated; UPF is the user plane network element in the 5G core network; it mainly implements functions such as service data routing and forwarding, data and service identification, and policy execution and is directly controlled by the control plane network element, control, and management of SMF (session management function) and executes business flow processing according to the policies issued by SMF [11]. UPF can be flexibly deployed to the edge of the network, while control plane network elements such as SMF are usually deployed centrally in the network cloud. In the edge computing business scenario, SMF selects the UPF close to the user to provide services to achieve local route establishment and data offloading [12].

3.1.2. Edge Computing Platform System. The edge computing platform system consists of the MEC host and the edge computing management system.

MEC host includes edge computing platform (MEP) (providing the app running environment and calling edge computing services: load balancing, security functions, traffic management, user metering, etc.), virtualized infrastructure (providing the computing required for running edge computing applications, storage, and network resources), and various edge computing applications and services (edge computing App) running on it [13].

Edge computing management system includes host-level management and system-level management. Host-level management mainly includes edge computing platform management (MEPM) and virtualized infrastructure management (VIM). System-level management mainly includes edge computing operation management platform, edge orchestrator (MEO), operation management subsystem (BSS) and operation management system, and dimension management subsystem (OSS) [14].

3.2. 5G Edge Computing Deployment Architecture. The overall deployment of edge computing mainly includes computer room infrastructure, IaaS facilities, PaaS platforms, and SaaS applications from the bottom to the top.

The equipment room infrastructure mainly includes the equipment room, cabinet, power supply, transmission, environmental monitoring, and other supporting resources

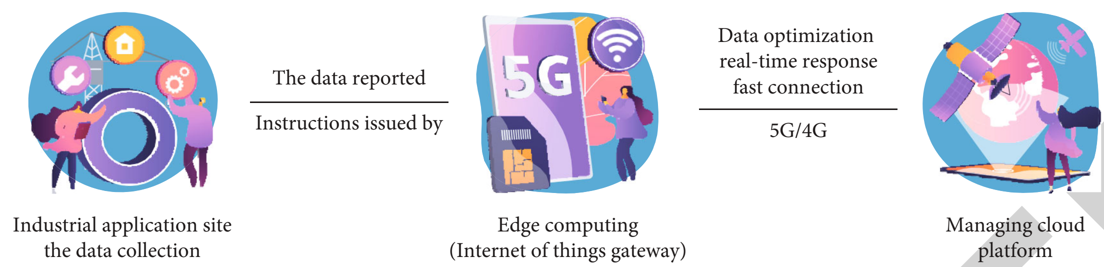

FIGURE 1: 5G edge computing.

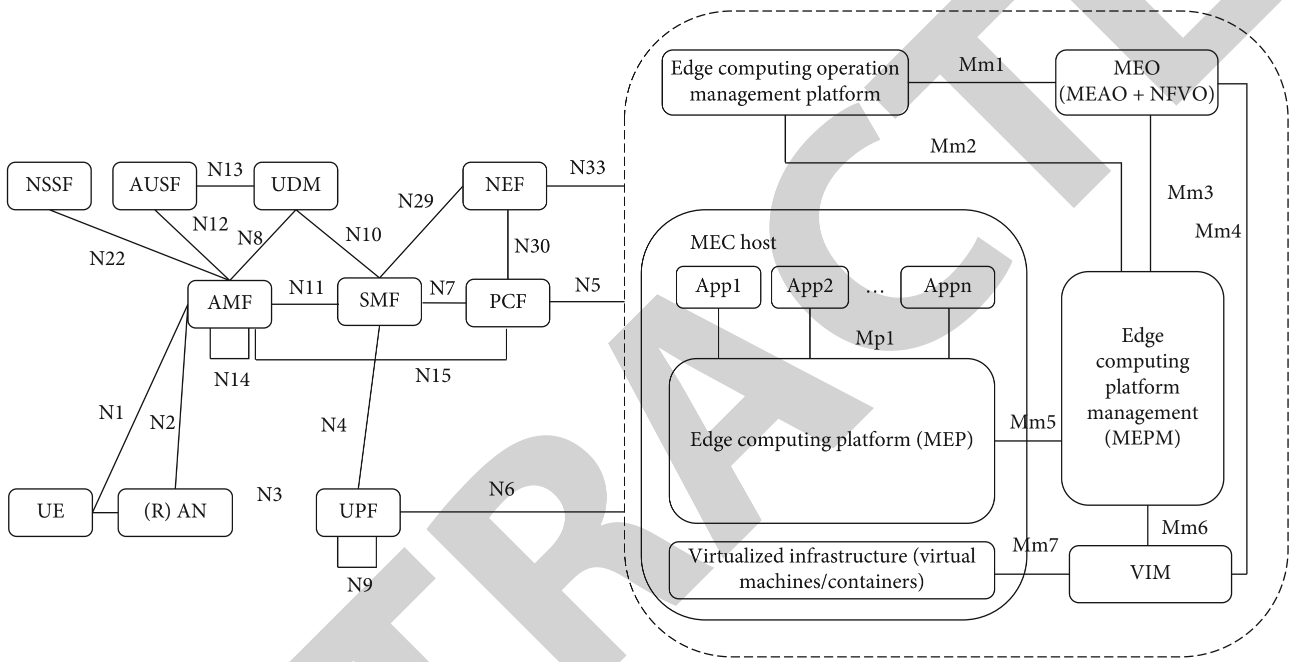

FIGURE 2: 5G edge computing network architecture.

required for the installation of edge computing equipment; IaaS facilities include hardware physical resources and virtual resources including servers, network equipment, and accelerators, which are used to deploy and Cloud infrastructure for running edge computing services and related network element functions [15]. The PaaS platform is a key enabling module in the full stack of edge computing, providing platform capabilities and network capabilities for upper-layer SaaS applications, including operators' basic PaaS platforms and third-party PaaS platforms. The SaaS application layer includes various applications developed and run for all walks of life based on the PaaS layer.

3.3. Energy Consumption Model. The energy consumption model and its parameters affect the energy efficiency of the protocol and the network lifetime [16]. The author adopts the first or der radio model to calculate the node energy consumption and use it for performance evaluation; the energy consumption of transmitting k bits data to the distance d is

$$E_{Tx}(k, d) = kE_{\text{Elec}} + k\xi_{fs}d^2. \quad (1)$$

The receiving energy consumption is

$$E_{Rx}(k) = kE_{\text{Elec}}. \quad (2)$$

In the formula, $E_{\text{Elec}} = 50nj/bit$ is the power consumption of the module circuit, and $\xi_{fs} = 100pj/(bit * m^2)$ is the power consumption of the transmission amplifier. In addition, data fusion also consumes energy $E_{\text{da}} = 5nj(bit * signal)$.

3.3.1. Delay Optimal Algorithm (EEDBDG-D). After the nodes are placed, the initial establishment phase begins, and the EEDBDG-D initial establishment phase consists of four steps [17]:

(1) Neighbor discovery: All nodes broadcast information to their neighbors with a default size of power (communication radius dcr) so that the neighbor node obtains the ID of the node and the distance to the node and stores it in the neighbor table

(2) Base station discovery: The base station sends hello information with a known power that can cover the entire network so that the node can estimate

the distance to the base station so that it can directly communicate with the base station when it is the root node [18]

(3) Initial tree establishment: A similar controlled flooding is initiated from the node whose ID is 1 to surrounding nodes. Each node has a height value H, which is initially a large integer. Set the H value of node 1 to 0, and the initial tree establishment message broadcast by node 1 contains its H value of 0. After receiving it, the neighbor node sets its own H value to 1 and modifies the H value of the establishment message to 1 and broadcasts it to its neighbors, and so on. Each node only sends a setup message once when it receives it for the first time, but it will monitor the change of the H value of the neighbor node and adjust its neighbor table accordingly. Since the channel is bidirectional, a tree with node 1 as the root is established according to the order of sending and receiving messages and the level of H value

(4) Tree topology adjustment: The tree topology in Step (3) is already the best in terms of delay, but the energy consumption still needs to be optimized to save energy. The algorithm is as follows: The node selects the nearest neighbor from the neighbor node with the lowest H value as the parent node

The data collection phase occupies most of the network lifetime. Data is periodically sent to the root node; then to the base station, the tree topology is being adjusted every round. Data aggregation starts from the leaf nodes; the leaf node selects the nearest neighbor among the neighbor nodes with the lowest H value as the parent node and packages the collected data and sends it to its parent node. After the parent node receives the data of all child nodes, perform data fusion compression, then select its own parent node and send it, and so on, until the root node receives the data of all child nodes; after the same fusion, it is sent to the base station. After the root node has sent the data, it selects the tree root with the largest energy among the neighbors as the root of the next round and notifies the node; the new root node changes its own H value to the H value of the original root node minus 1. In this way, the height value of the root node is always the lowest in the entire network, which ensures the effectiveness of routing and avoids loops.

3.3.2. Energy Efficiency Optimal Algorithm (EEDBDG-E). EEDBDG-E tree topology adjustment steps are completely different from EEDBDG-D; it needs to be adjusted to the minimum distance spanning tree to save energy. In order to reduce the complexity, the author proposes an approximate minimum spanning tree algorithm (PMSTA), which only uses the information in the neighbor table, and the packet complexity is very low. PMSTA algorithm is a search mark algorithm, there are two ways [19]:

(1) Passive marking: initiated by node 1 of the initial tree root. Node 1 finds its nearest neighbor k and sends the marking information; after k receives it, it changes its own H value to the value of node 1 plus 1 and establishes that after the link k node is marked, it can send the marking information to its nearest child node, and so on

(2) Active marking: When a node receives or overhears the change of the H value of the neighbor node, it re-compares the neighbor distance and H value, selects the neighbor with a low H value, and is closest to itself as the parent node, and changes its own H value [20]. After a certain period of time, the marking process is completed. Except for individual links, each node selects the nearest sending link so that an approximate minimum spanning tree is established

Since the minimum distance spanning tree is unique (assuming that all links are of unequal length), the dynamic topology adjustment based on the minimum spanning tree is relatively easy. And since the energy consumption is mainly related to the transmission distance, see Equation (1); therefore, the minimum distance spanning tree topology is the most energy efficient; similar to EEDBDG-D, the data is aggregated from the leaf node to the root node, and the root node is rotated, but the selection of the parent node of EEDBDG-E is based on the following formula:

$$w_{ij}(\mathrm{T}) = \frac{\left(2k_{ij}E_{\mathrm{Elec}} + k_{ij}\xi_{fs}d_{ij}^{2}\right)}{E_{j}(\mathrm{T})}. \tag{3}$$

$w_{ij}(\mathrm{T})$ is the link weight from node i to node j, which is related to the sending and receiving distance d_{ij}^{1} and the remaining energy Ej(S) of the receiving node at the current moment S. On the basis of the closest link distance, considering the remaining energy of the node, prevent some nodes from dying prematurely due to heavy traffic [21]. When the node receives the data of all sub-nodes, it performs data fusion and compresses it into fixed-length data packets and then, using the neighbor Table information, calculates the link weight corresponding to the neighbor whose H value is lower than its own and selects the neighbor of the link with the smallest weight as parent node and send data and, at the same time, changes its own H value according to the H value of the parent node (guaranteed to be 1 lower than the H value of the parent node).

3.3.3. Energy Efficiency Delay Balance Algorithm (EEDBDG-M). EEDBDG-M is an energy-efficiency-delay tradeoff algorithm, and its topology control is the same as EEDBDG-E. The data establishment phase is the same as EEDBDG-E, creating a minimum distance spanning tree. In EEDBDG-E, the data aggregation path is consistent with topology control, but the data aggregation path in EEDBDG-M adopts/false path 0, that is, the data is not sent to its own parent node; it may be a grandfather node or other A node with a low H value. The routing strategy of EEDBDG-M is as follows: The node first sorts the neighbor nodes lower than its own height by height value. Then, it selects the neighbor

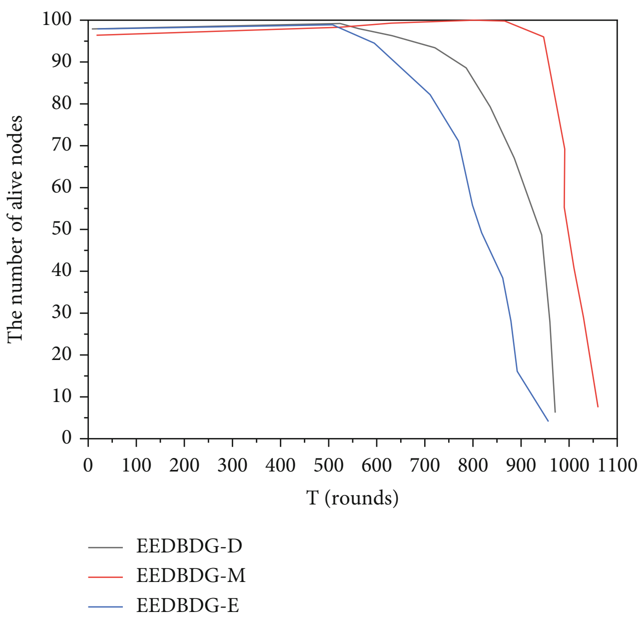

Figure 3: Network life cycle under different protocols.

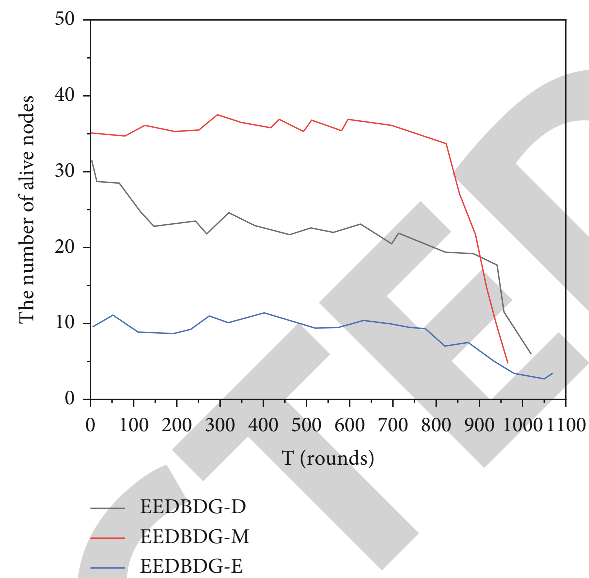

Figure 4: Data aggregation delay under different protocols.

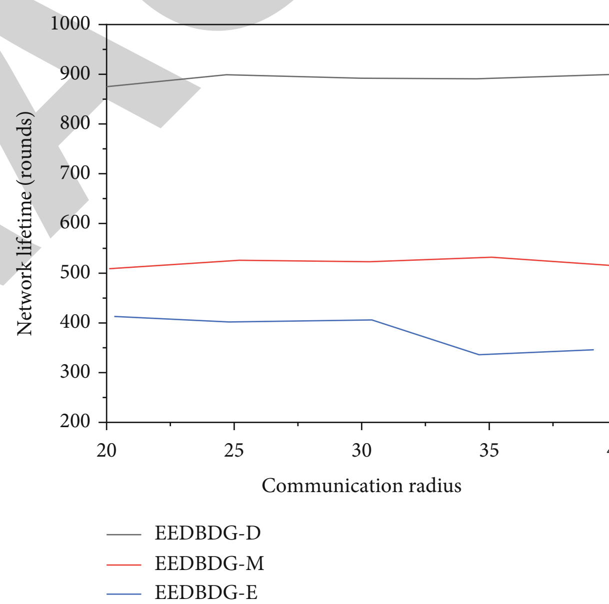

Figure 5: Communication radius and protocol performance.

node corresponding to the median of the height value sequence as the data receiving node. In addition, nodes also need to perform topology adjustment on the basis of information update, including the rotation process of the root node and the selection process of the parent node based on H value and routing weight.

At the end of the network's life, the EEDBDG adopts the following measures to maintain the network. When a node dies, its neighbor nodes will learn after a certain period of time (without periodic broadcast) and then delete it from the neighbor Table. When all the neighbor nodes of the node are dead, the node will increase the transmit power to find neighbors or communicate directly with the base station. Since the communication between nodes is local, EEDBDG can effectively deal with the joining and failure of nodes, the joining node can run the EEDBDG algorithm as long as it builds its own neighbor table, and the failed node will be deleted from its neighbor table by its neighbors after a certain period of time.

4. Analysis of Results

Write a simulation program in C++ to analyze and evaluate the performance of the EEDBDG protocol. The EEDBDG protocol belongs to the network layer protocol; for simplicity, the MAC layer protocol is assumed to be ideal, and channel errors are ignored. In order to demonstrate the advantages of the protocol proposed in this paper, we compare EEDBDG with the latest data collection protocol GSEN, which is an energy-efficient and low-latency algorithm that uses a two-layer chain structure for data aggregation, thereby improving the latency of PEGASIS performance. It has been verified that the energy efficiency of the GSEN algorithm is better than that of PEGASIS and LEACH and the average data aggregation delay of GSEN is only 40% of that of PEGASIS. The simulation program obtains the average sampling results by performing 200 experiments on random node distribution scenarios. Each node in the simulation program has parameter attributes such as position, energy, and neighbor table. At the beginning of each round, the queue is first updated according to the information recorded in the previous round, and the parameters of each node are updated, and then each node performs algorithm calculation according to its own parameters and generates a new information update queue. The simulation program counts the energy consumption of nodes in each round, calculates the data aggregation delay, and finally records the network lifetime.

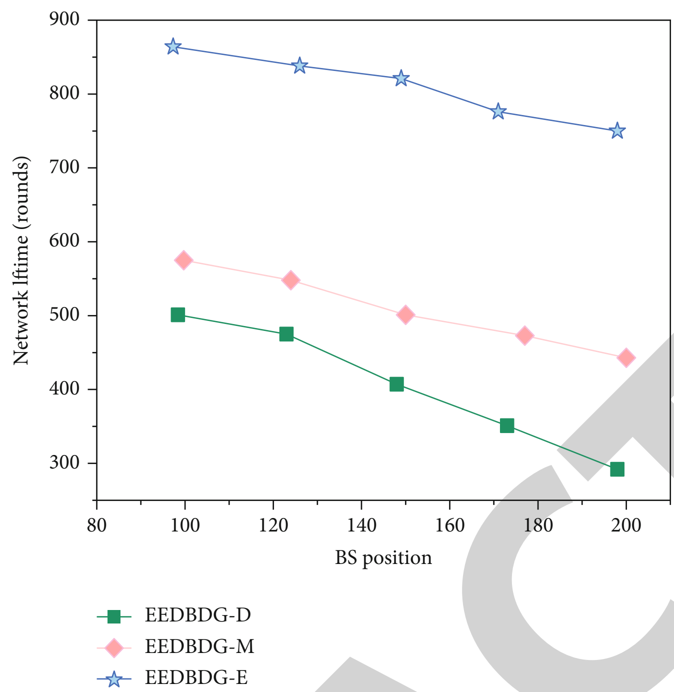

Figure 6: Base station location and protocol performance.

The author analyzes the scenarios where the base station is located at (50, 150), and 100 nodes are randomly distributed in the (100 m@100 m) area, perform multiple simulations (set the communication radius of the EEDBDG protocol to 20 m), and obtain the average network lifetime and convergence delay by statistics, as shown in Figures 3 and 4.

Figure 3 describes the relationship between the number of surviving nodes and time for the four protocols. As can be seen from the Figure 4, EEDBDG-D nodes die first, followed by GSEN, while EEDBDG-M and EEDBDG-E nodes start to die very late. Their network lifetimes are sequentially: 409 rounds, 513 rounds, 831 rounds, and 883 rounds. The average network lifetimes of EDBDG-M and EEDBDG-E are 62% and 72% higher than GSEN, respectively. In addition, the node death time of these two algorithms is concentrated in the last 200 rounds, and the GSEN node death lasts for 500 rounds. This is because the greedy algorithm adopted by the chain protocol has defects. This shows that EEDBDG better balances the energy consumption of all nodes and describes the variation of data aggregation delay under the four protocols. The GSEN algorithm is regrouped every 25 rounds, and the delay in the 25 rounds is unchanged, which is convenient for comparison; the author averages the corresponding delay sampling of EEDBDG every 25 rounds; it is easy to see that the delay of EEDBDG-D is the lowest, which is only 74% of GSEN; the average delay values of are as follows: 9, 15, 23, and 35; the average delay of EEDBDG-E with the worst delay in the EEDBDG protocol is only 66% of that of GSEN. The performance relationship of the three algorithms of EEDBDG is that the energy consumption is related to the square of the communication distance; EEDBDG-E has the shortest average communication distance and is the most energy-efficient, while the long communication distance reduces the number of hops to the root, so the EEDBDG-D algorithm has the smallest delay. The advantage of the EEDBDG protocol in delay is mainly because it is more suitable for the random distribution of nodes, that is, the distance between nodes is quite different, and the delay of the dynamic tree algorithm only depends on the depth of the tree. The chain algorithm GSEN is more suitable for the case where the nodes are evenly distributed; otherwise, it cannot reduce the number of members of the maximum group, resulting in high latency.

In the experiment, the influence of the parameters on the performance of the protocol is also studied by changing the simulation parameters for simulation, as shown in Figures 5 and 6.

Summarizing the experimental results, whether the communication radius, base station location, node density, or area size changes, the performance of EEDBDG algorithm is better than GSEN in both energy saving and time saving, which can reduce energy consumption and time delay more effectively.

5. Conclusion

The author proposes a 5G edge computing intervention point selection algorithm based on energy efficiency and delay, through the data collection protocol algorithm EEDBDG; it consists of three sub-strategies, which, respectively, achieve optimal delay (EEDBDG-D) and optimal energy efficiency (EEDBDG-E) and energy efficiency delay balance (EEDBDG-M). Experiments show that under different parameters and scenarios, the EEDBDG-D algorithm maintains the lowest delay, the average delay is reduced by 70% compared with GSEN, the average network life is only

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Retraction

Retracted: Application of Computer Technology in VR Digital Media

Wireless Communications and Mobile Computing

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This article has been retracted by Hindawi following an investigation undertaken by the publisher [1]. This investigation has uncovered evidence of one or more of the following indicators of systematic manipulation of the publication process:

(1) Discrepancies in scope
(2) Discrepancies in the description of the research reported
(3) Discrepancies between the availability of data and the research described
(4) Inappropriate citations
(5) Incoherent, meaningless and/or irrelevant content included in the article
(6) Peer-review manipulation

The presence of these indicators undermines our confidence in the integrity of the article's content and we cannot, therefore, vouch for its reliability. Please note that this notice is intended solely to alert readers that the content of this article is unreliable. We have not investigated whether authors were aware of or involved in the systematic manipulation of the publication process.

Wiley and Hindawi regrets that the usual quality checks did not identify these issues before publication and have since put additional measures in place to safeguard research integrity.

We wish to credit our own Research Integrity and Research Publishing teams and anonymous and named external researchers and research integrity experts for contributing to this investigation.

The corresponding author, as the representative of all authors, has been given the opportunity to register their agreement or disagreement to this retraction. We have kept a record of any response received.

References

[1] W. Zhang, J. Wang, and H. Wang, "Application of Computer Technology in VR Digital Media," *Wireless Communications and Mobile Computing*, vol. 2022, Article ID 6433852, 8 pages, 2022.

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Research Article

Application of Computer Technology in VR Digital Media

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In order to make up for the defects of traditional digital media system design, continuously strengthen the user's sense of experience, and further improve the digital media system design through diversified digital media forms, this paper proposes an application method of computer technology in VR digital media. Through the introduction and research of human-computer interaction interface, the usability of human-computer interaction interface evaluation and testing is analyzed, and combined with GOMS model to optimize and improve the model, a new optimized GOMS layered quantitative model is proposed. The experimental results show that when the system is running, the trend of video cache rate in WiFi and 4G environments is basically the same. The playback start rate is fast and then tends to be stable. During the playback process, the video frame rate is stable at about 60 FPS, which meets the needs of human eyes to watch without Caton. After the playback starts, the GPU occupancy rate remains about 20% and stable. Computer technology can realize the effective combination of multiscreen interaction and digital media in VR digital media, creating a better prospect interactive experience for the future development of digital media mobile terminal.

1. Introduction

Computer VR technology is a new digital information technology emerging in recent years. It is the product of the integration of science and information technology. The emergence of this technology depends on the generation of computer technology. The full name of VR technology virtual reality, and the Chinese name is virtual reality technology. According to the Chinese literal meaning of VR technology, VR technology cannot let users truly experience a certain scenario, but it is a technology that creates a virtual environment for users to experience in the virtual environment. Computer VR technology is a simulation technology to create a virtual environment with the help of computers [1, 2]. The main principle is to create a dynamic three-dimensional simulation world through computers, so that users can get a sense of immersion and experience in the three-dimensional world and experience the virtual world and environment.

To establish a virtual space with VR technology, we need to combine a variety of technologies. VR technology combines three-dimensional modeling technology, image processing technology, and sensor technology. VR technology can be applied to many fields, such as computer image technology, network technology, media information communication technology, and intelligent database technology. These different technical fields have a common feature. Their birth is due to the information communication between machines and users. The main difference is that the forms of information communication are different. In the content category of VR technology, information expression is a major information technology, and it is also the main medium for information exchange between mechanical equipment and users [3, 4]. The information communication of VR technology enables users to further create a more immersive experience of the three-dimensional simulation world. Virtual reality technology is not a simple virtual multimedia information technology. Users can get a real feeling in the virtual environment under the action of sensors, so that users can get visual, auditory, and tactile experience in the three-dimensional simulation world and gain the same experience as the real world. In the follow-up development, virtual reality technology has been applied to high-level multimedia applications because of its own application characteristics. As a technology integrating computer technology, graphic technology, psychological technology, visual technology, stereo display technology, and other technologies, virtual reality technology has obvious fidelity and interactivity, and it can provide strong support for system simulation. At present, virtual reality technology has the following three characteristics.

2. Literature Review

Digital media system is an information carrier mode with the functions of recording, generation, dissemination, processing, and intelligent acquisition, specifically including digital animation, text information, communication network, and other diversified media forms [5, 6]. The application of computer VR technology in the design of digital media system can enable the cross-border integration and development of information expression, which is conducive to further optimizing the design of digital media system and further strengthening the sense of user experience. In the design of digital media system, computer VR technology can generate computer simulation according to the diversified needs of different users and bring users into a virtual environment [7]. This communication method can make users feel immersive. Compared with other information communication methods, it has outstanding advantages in timeliness, because when users enter the virtual environment, the whole person is like being integrated into the scene, which can not only continuously obtain information but also freely control objects in the virtual world through sensors and controllers in the virtual world, so as to obtain the same feeling as the real world [8].

Different information expression methods are adopted in the design of digital media system to strengthen the user experience [9]. The biggest difference between traditional media and digital media is the interaction between users. Generally speaking, the degree of information received and participation of users are often determined by the degree of interaction. The application of computer VR technology in the design of digital media system can show the rich amount of information in a simple way according to the diversified needs of users, so that users can easily understand and obtain this information on the basis of meeting the real needs of users. Driven by the rapid development of science, technology, and society, people have officially entered the era of big data. With the emergence and further development of artificial intelligence information technology, the whole society has gradually entered the digital era. The media industry has also achieved a leap forward development from traditional media such as newspapers and television to digital media. In this process, it has experienced the stage from quantitative change accumulation to qualitative change. From mutual integration to innovative development, it can be found that the future informatization development presents significant ecological characteristics [10].

In the digital media ecosystem, the relationship between various media forms is close, and they do not exist in an independent way but are interactive. Even with the support of VR technology, media technology innovation can be realized to further expand the breadth and depth of virtual technology [11]. In the diversified virtual environment established by VR technology, the digital media ecosystem can establish user information and transmit it. Combined with the characteristics of resources and data, the digital media ecology can have a new connotation. In the design practice, to build a digital media ecosystem based on computer VR technology, the following work should be done well. First, further improve the information transmission mode; that is, organically integrate the digital media system design and computer VR technology. The integration of computer VR technology not only realizes the transmission of video, image, and other information but also further optimizes the way things are expressed in the virtual world according to the characteristics of users, so that users can get a better virtual experience in the virtual world, so that digital image technology is no longer simply building a simulation world but is endowed with richer and new significance. Second, paying attention to the full integration of users' practical experience and image information, guiding users, and designing interactive digital media based on experience are the key to establishing a digital media ecosystem and an important measure to enhance users' interaction, which is conducive to improving users' participation [12]. Third, further improve the experience equipment related to computer VR technology. The research and development of innovative ecological sensors can not only promote the high integration of the user's body and mind and the virtual environment but also fully integrate the user's senses with the virtual environment, which is conducive to further strengthening the user's sense of experience and promoting the integrated development of mobile media and intelligent data. Therefore, this paper proposes the application of computer technology in VR digital media.

3. Research Methods

3.1. Overview of Relevant Technologies

3.1.1. Overview of Stereoscopic Vision Perception. Because the human stereoscopic algorithm is relatively independent of its neural implementation, the study of human stereoscopic calculation model is helpful for engineering application and design using stereoscopic method [13]. When viewing an object, at the same time, two different images enter your left and right eyes through different angles. The human brain obtains the feeling of distance and depth by analyzing and synthesizing the two images. When we watch, we always have a three-dimensional feeling; that is, we can feel the distance between objects and also the distance between objects and us. The parallax effect can be observed only when two images are generated according to the left and right viewpoints of the human eye. When observing, the left eye and the right eye must see the graph generated according to the left and right viewpoints, respectively. Suppose that the coordinates of a point in the space are the right viewpoint, its coordinates are the left viewpoint, its coordinates are (x_l, y_l, z_l), and the equation of the viewing plane is

$$Ax + By + cZ + D = 0. \quad (1)$$

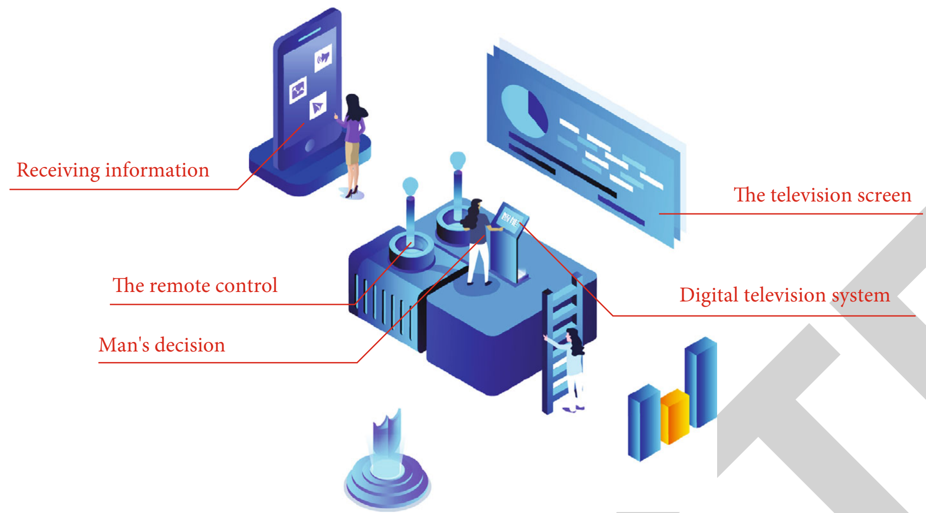

Figure 1: Human-computer interaction interface of digital media.

Then, the intersection point S_R^0 of the line between the point I and the right viewpoint S_R and the viewing plane is the drawing point when the right eye views I, and its coordinate is (x_r^0, y_r^0, z_r^0). The intersection point s_l between the line of point I and the left viewpoint S_l^0 and the viewing plane is the drawing point when the left eye views I, and its coordinate is (x_l^0, y_l^0, z_l^0). To synthesize point parallax map, the coordinates of point $S_k{}^0, S_l^0$ must be obtained.

The equation for the left line of sight is

$$\frac{x_l{}^0 - x_l}{x_1 - x_l} = \frac{y_l{}^0 - y_l}{y_1 - y_l} = \frac{z_l{}^0 - z_l}{z_1 - z_l} = t_l. \tag{2}$$

The equation for the right line of sight is

$$\frac{x_r^0 - x_r}{x_t - x_l} = \frac{y_r^0 - y_r}{y_t - y_l} = \frac{z_r^0 - z_r}{z_t - z_t{}^1} = t_r. \tag{3}$$

According to the algorithm of calculating the parallax transmission of points, we can deduce the parallax transmission algorithm of lines and planes. When generating the parallax projection of points, volumes, and planes on the computer, it is more accurate and faster than using the traditional method.

3.1.2. Human Computer Interface. Human-computer interaction interface (HMI) mainly refers to the main media interface that can realize information transmission and exchange between people and computers and can meet the general interface of various equipment and be used for the equipment software connection of computer terminals [14]. The design of human-computer interaction interface usually refers to the user visible page in the human-computer interaction operation, and the human-computer interaction interface realizes the communication and operation between human and system. The human-computer interface mainly includes two parts: hardware and software. Human-computer interface, also known as machine, is not only the output object of information reaction but also an important carrier of information interaction between human and system. Software is the form of graphic information finally displayed based on hardware.

3.1.3. Human Computer Interface of Digital Media. For digital media, the realization of human-computer interaction interface can fully transmit information between TV users and digital media. As shown in Figure 1, the human-computer interface of digital media can transmit information. People can obtain and process the content information of digital media through the TV screen, make corresponding decisions in combination with specific needs, and feed back to the digital media system [5].

In the design of human-computer interaction interface of digital media, the friendly operation between human and machine can be directly realized for the information display, operation, and specific response in the digital media page [15]. In human-computer interaction design, how to achieve rapid and efficient interactive operation of digital media pages and whether the human-computer interaction interface design is consistent with people's own cognitive laws, physiological reactions, etc. are very important for human-computer interaction experience. Therefore, the design of human-computer interactive digital media interface needs to ensure that the structure is reasonable, easy to operate, and consistent with the public aesthetic, so as to improve the digital media interaction experience.

3.2. Multiscreen Digital Media Interactive Interface Information Display. When designing the digital media interface, it is necessary to input the corresponding final design task results, complete the corresponding logic module design, add the corresponding access mechanism, and then organize these modules as the main interface structure modules. Establish the access mechanism as a network and layered direct mechanism, directly determine the mechanism

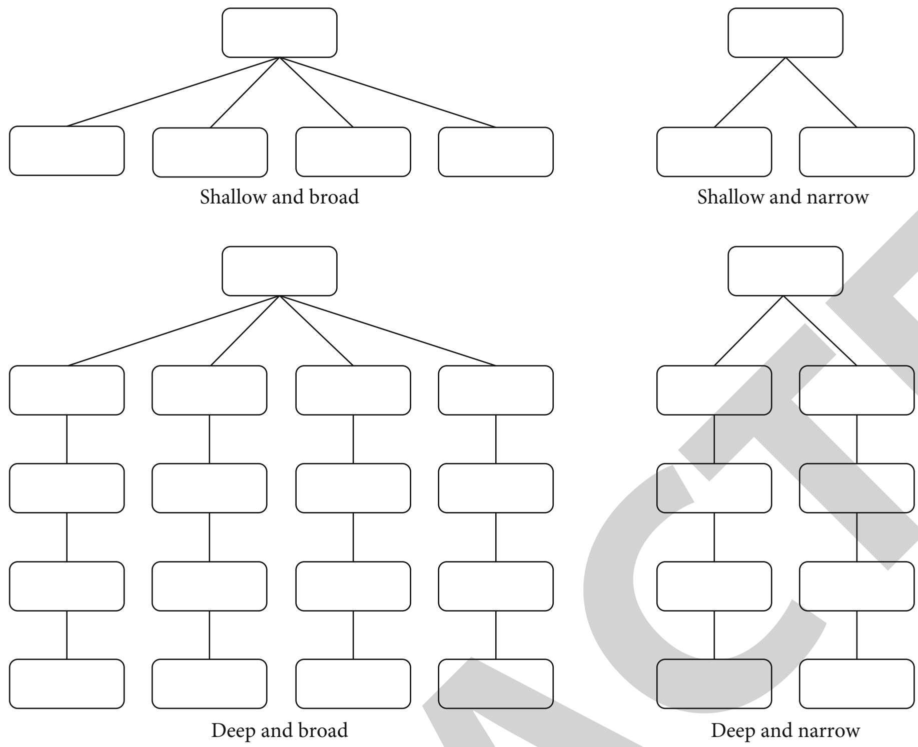

Figure 2: Information architecture type.

type through the task structure, and affect the final design style [16]. For example, the menu can provide the corresponding hierarchy, as well as direct access to charts and hierarchical operations. When designing the interface language, it also meets the direct network access mechanism, and then, it is divided into several design steps in the second part to refine each subpackaging step of the design. In the human-computer interaction information display interface, the navigation function needs to be designed to facilitate the selection of jump information and the completion of target tasks. The navigation mode will be affected by the information content, system structure, and hardware facilities to a certain extent.

Based on the information architecture, an interactive information architecture can be formed, including navigation, classification, and organization, and this kind of information architecture will also affect the consulting availability of end users [17]. For the human-computer interface, a good information architecture can meet the needs of users to quickly find the information they need. Figure 2 mainly includes four types of simple operation architectures, which are affected by factors such as screen size, different operation modes, and distance. The content of information architecture will also lead to visual loss of users and inability to find the required information.

Different human-computer interaction interfaces of terminal equipment also have different layout modes, which can be used as a reference for the design of digital TV interaction interface. The layout mode of Jiugongge human-computer interaction interface can bring regular and tidy visual experience to users and can form a very regular function jump and finally quickly switch to optional content [18].

3.3. Design and Implementation of Digital Media Human-Computer Interaction Interface

3.3.1. System Information Architecture. Figure 3 shows the functional architecture of human-computer interactive digital media interface in this design, including two information architectures: TV terminal and mobile terminal.

In formulating the information framework, it is necessary to comprehensively consider the system functions and combine the characteristics of differentiated terminals. Therefore, the differentiated information architecture is designed this time. Based on the information interaction design rules, the traditional remote control focus jump and the complex secondary page classification content are considered. In order to ensure the design flexibility of the mobile phone system, you can directly switch functions in the label bar and enter the remote control interface.

3.3.2. Grid System Page Layout. In this system page layout design, it is necessary to comprehensively consider the physical size, resolution, and other relevant information of the page; reasonably layout, tile and column; and introduce the grid system into it [19]. As a graphic design style, the design grid system uses the fixed grid to design the overall layout and designs the regular web page layout to form an accurate and readable block. In consideration of the interface

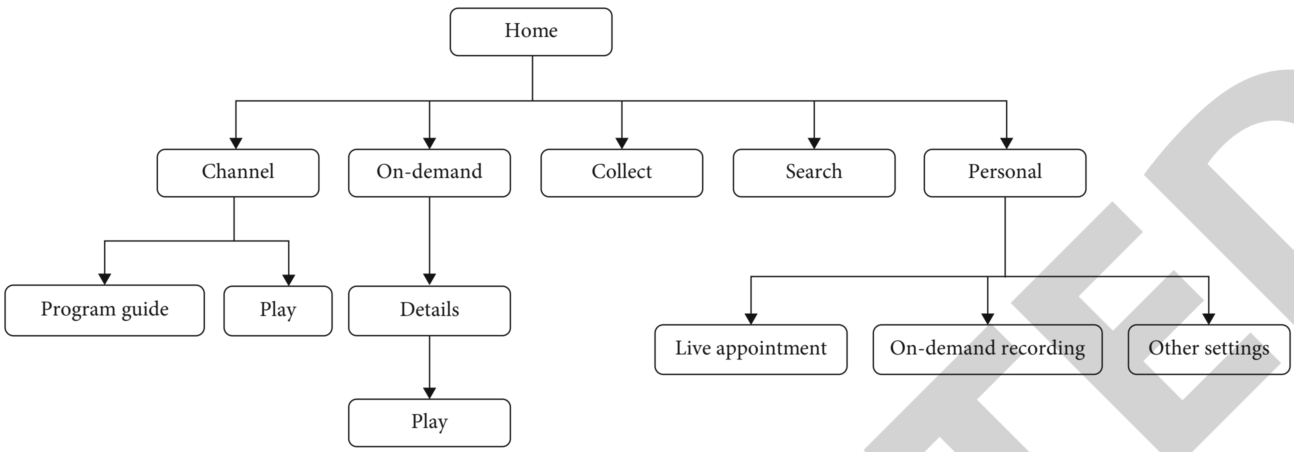

Figure 3: Human computer interface information architecture of digital media.

compatibility of the TV terminal, the system display rate is modified, such as solving the TV replay problem through technology, and the built-in rather than external input of the TV system interface.

3.3.3. Drawing Interface Block Diagram. This design is based on the prototype block diagram and adopts the Axure drawing interface. The software can draw wireframes and generate HTML prototype drawings to complete the demonstration interaction. Take TV as an example to draw wireframe and design page layout when designing information architecture. As a combination of the functions, information, and contents of the system design, the grid system is designed to combine with the differentiated function page, refine the navigation layout, and design two types of layout: regional and column.

3.3.4. Dual Screen Interaction Model. In the use of TV and mobile terminals to watch programs, the interaction process is used to design the information architecture and design the system dual screen interaction. After analyzing the user's prototype operation process, the mobile terminal is used to search the TV channel and push it to the TV terminal. The user can directly make an appointment for late viewable programs through the mobile terminal, so as to make an appointment in advance. In addition, the user can also turn off the TV after watching the TV program and directly use the mobile phone to select the history for dial-up viewing.

3.4. Interactive Visual Design of Digital Media System Interface. When designing the human-computer interaction interface, first of all, it is necessary to determine the visual and color style of the interface. For setting the color, it is necessary to ensure that the digital media system can bring people a pleasant experience and select the yellow border of the media platform based on the dark purple background, so as to achieve the state of highlighting the focus. When designing the overall style of the interface, it is necessary to define the digital media system interface as a flat visual style, focusing on color blocks and lines, so as to achieve a more prominent visual style, which is consistent with the needs of digital TV users. At present, when designing interactive

Table 1: System test environment configuration.

System	Android 9.2
Processor	Qualcomm Snapdragon 845
Memory	8 GB
Network	WiFi/4G
Video protocol	HTTP
Video resolution	1080P

visual style of interactive software, it is necessary to ensure consistent design style as far as possible based on the consistency of different terminal characteristics of mobile phones and TVs. In the design of interface details, PS software is used to draw interface details. Since the interface style is flat visual style, it is necessary to simplify the layout as much as possible, including the system interface composed of pictures and lines. For example, when designing the TV terminal interface, if you want to achieve obvious block and background differentiation effect, you can obtain clearer interface character recognition effect by applying fine projection to the entry text part. In the design background details, the interface background design needs to make targeted shading adjustments for different pages. It is necessary to ensure that the user navigation is concise and intuitive and adopt a clear text description method to realize the text matching with the icon use case, so that the user can quickly think of and perform the corresponding functions while seeing the buttons.

In the process of icon design, based on the iOS 7 system interface, a special linear chart is developed, which is consistent with the system interface style. In order to make it easier for users to operate and identify, the mobile phone icon is drawn. The remote control function icon is designed in Volume I, and the system interface navigation bar is designed in Volume II. In the process of TV terminal design, because the iOS 7 chart lines will have a great impact on the recognition when users watch, it is necessary to redesign the TV terminal icons and draw different styles according to different icons, which can also meet the design needs of users in the process of use. When designing the

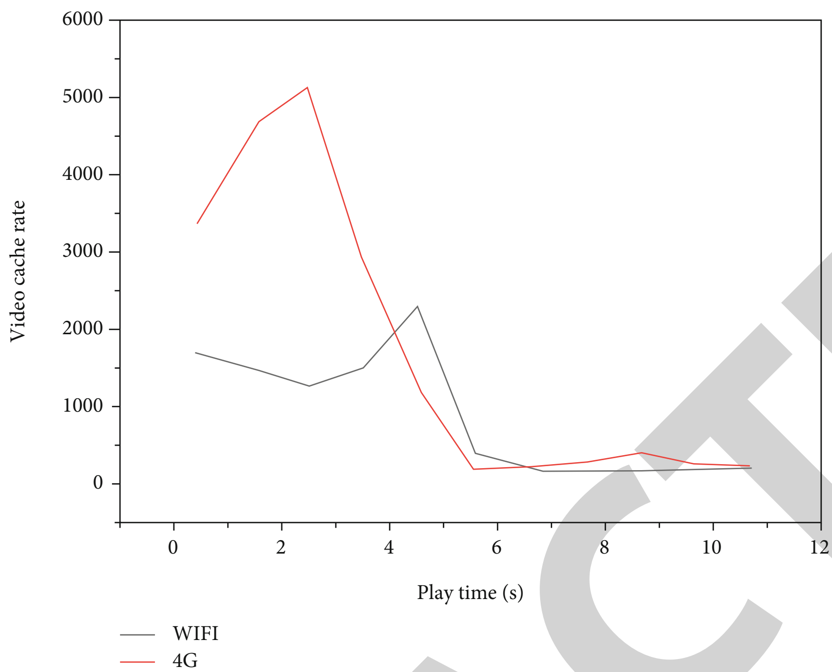

FIGURE 4: Video cache rate in WiFi/4G environment.

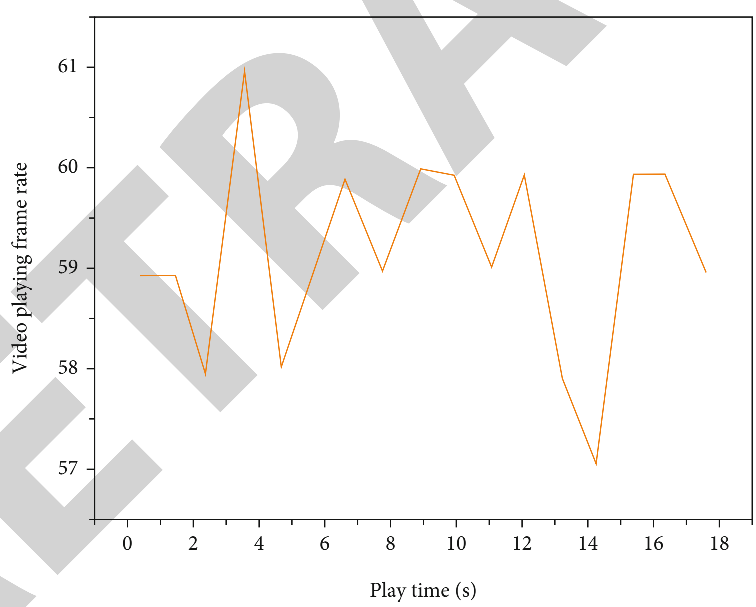

FIGURE 5: Video playback frame rate.

focus status bar, the differentiated focus status of the primary and secondary navigation is designed by selecting the red and white reverse color method, and the same standard is adopted for the mobile terminal and the TV terminal, respectively. The first level navigation selection turns from white to red, and the second level navigation selection turns from white to red. Through this differentiated design, the first and second level navigation can be satisfied. For the mobile terminal, this method should also be used in the focus design process. The upper and lower labels are designed as level 1 and level 2 navigation, respectively, so that the consistency of the status navigation bar interface of the mobile terminal and the TV terminal can be seen. In addition, for TV, mobile phone, and other terminal operations, it is still necessary to use the direction key for remote control, set the focus box at the focus position, and select the focus position to confirm; then, the subsystem interface in the focus state can be successfully activated.

4. Results and Discussion

4.1. System Test. As the system is applied to VR media, the network fluency during VR playback is the most key indicator. Therefore, the combination test is mainly conducted for

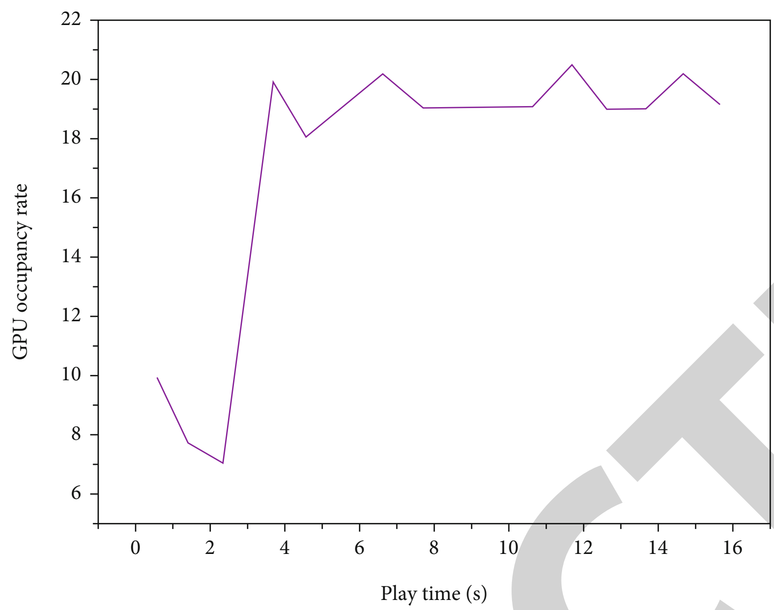

FIGURE 6: GPU occupancy in video playback.

the cache rate and frame rate during the playback process. The configuration of the test environment is shown in Table 1. Write code, output logs in real time, and record test results. Sort out the data obtained from statistics, and take the average value of multiple tests. The specific results are shown in Figures 4–6.

As can be seen from Figure 4, the trend of video cache rate in WiFi and 4G environments is basically the same. The playback start rate is fast and then tends to be stable. As can be seen from Figure 5, the video frame rate is stable at about 60 FPS during playback, which meets the demand of human eyes to watch without jamming. As can be seen from Figure 6, the GPU occupancy rate remains around 20% and stable after playback.

The test shows that under the normal network environment, the system has a stable and good playing effect for VR video streams with ultraclear image quality, basically without jamming, and users can experience high-quality VR effects, which meets the requirements.

5. Conclusion

This paper presents an application method of computer technology in VR digital media. By combining the functional characteristics of digital media, this paper analyzes the necessity of studying the interactive interface of multiscreen interactive digital media. The software data designed in this interface supports users to store locally and upload relevant information to the server successfully during operation. Due to other network speeds and other reasons, local operation is required when it is not convenient for the server to read data, so as to fully enhance the running speed. It not only meets the diversified needs of users when using the interface but also enriches the interactive design content of digital media interface.

Data Availability

The data used to support the findings of this study are available from the corresponding author upon request.

Conflicts of Interest

The authors declare that they have no conflicts of interest.

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Retraction

Retracted: Three-Dimensional Simulation Garden Landscape Design Method Based on Virtual Simulation Technology

Wireless Communications and Mobile Computing

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This article has been retracted by Hindawi following an investigation undertaken by the publisher [1]. This investigation has uncovered evidence of one or more of the following indicators of systematic manipulation of the publication process:

(1) Discrepancies in scope
(2) Discrepancies in the description of the research reported
(3) Discrepancies between the availability of data and the research described
(4) Inappropriate citations
(5) Incoherent, meaningless and/or irrelevant content included in the article
(6) Peer-review manipulation

The presence of these indicators undermines our confidence in the integrity of the article's content and we cannot, therefore, vouch for its reliability. Please note that this notice is intended solely to alert readers that the content of this article is unreliable. We have not investigated whether authors were aware of or involved in the systematic manipulation of the publication process.

Wiley and Hindawi regrets that the usual quality checks did not identify these issues before publication and have since put additional measures in place to safeguard research integrity.

We wish to credit our own Research Integrity and Research Publishing teams and anonymous and named external researchers and research integrity experts for contributing to this investigation.

The corresponding author, as the representative of all authors, has been given the opportunity to register their agreement or disagreement to this retraction. We have kept a record of any response received.

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[1] S. Chen and X. Wang, "Three-Dimensional Simulation Garden Landscape Design Method Based on Virtual Simulation Technology," *Wireless Communications and Mobile Computing*, vol. 2022, Article ID 4804256, 7 pages, 2022.

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Research Article

Three-Dimensional Simulation Garden Landscape Design Method Based on Virtual Simulation Technology

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In order to further promote the design and development of 3D simulated garden landscape, the author proposes a method of 3D simulated garden landscape design based on virtual simulation technology. By combining virtual simulation technology and traditional 3D simulation garden landscape design method, a 3D garden landscape simulation system is constructed, thereby realizing the improvement of 3D simulation garden landscape design method and further promoting the development of 3D simulation garden landscape design. Experimental results show that with the gradual expansion of the scope, the accuracy of the method used by the author gradually improved, reaching a maximum of about 89%, while the traditional method was always maintained at about 40%, and the judgment rate was doubled compared with the traditional method. *Conclusion*. By combining virtual simulation technology and traditional 3D simulation garden landscape design method, the development of 3D simulation garden landscape design can be effectively promoted.

1. Introduction

Garden landscape design requires the use of landscape architectural design concepts based on park planning and the integration of the use of scientific, technological, and artistic tools to design and protect outdoor environment [1]. The work design should not only look good but also be in harmony with the environment. It includes urban development, community development, site development, environmental development, and building construction and refers to the integration of gardens, landscape with life, environment, and culture, as well as sustainable development, protection, conservation, and natural use. Capital layer: how to show the design in detail, realistically and uniformly, because the landscape design of the park, regardless of the scale, wants to show the effect of an event in a time, and the scene moves at every step of the spatial organization? This approach is very important for designers and it helps to have a clear design idea of the garden designer.

Most existing building designs use AutoCAD software to draw two houses [2]. Local specialized software has started late and is often responsible for planting trees by building software. For example, HCAD software in Hangzhou and Hongye software is all kinds of planning software. Since most software is developed by a third-party platform, such as AutoCAD, in addition to protecting the right software, it only uses the platform features to easily draw the house and has little bit degree of 3D modeling or statistical data automation [3]. It is only used as a "pen" but not as a design tool. This software only needs to be classified as professional planning and software development, and it is difficult to get approved by the kindergarten industry due to the lack of technical know-how in the garden. Virtual simulation technology is a product that combines digital technology with the use of digital technology based on the rapid development of information technology such as multimedia technology, virtual reality technology, and network communication technology and are better design models [4]. A unique feature of virtual simulation technology is the creation of integrated, complete virtual environments for all systems, as well as the integration and management of multiple organizations of the virtual environment.

Therefore, in order to better audit the 3D simulated garden landscape, the author introduces the virtual simulation technology into it, by combining the virtual simulation technology and the traditional garden landscape design method, a 3D garden landscape simulation system is constructed to realize the design of the 3D simulated garden landscape.

2. Literature Review

With the acceleration of urbanization in China, people are paying more and more attention to the garden landscape environment. Influenced by urban landscape design and national history, the integration of traditional cultural connotations has played a very important role. Landscape is an important part of environmental greening and aesthetics, and the rationality of spatial distribution is restricted by various aspects; in this case, it is of great significance to study a reasonable method of garden landscape simulation and judgment [5]. There are several methods for judging the rationality of garden distribution in China. Judgment method based on weighted average theory, this method can effectively describe the geometric parameters of garden landscape and perform accurate calculation, but there is a problem that it is difficult to accurately judge whether the distribution is reasonable. Based on the network projection judgment method, this method has a high accurate judgment effect, but there is a problem of poor evaluation stability [6]. At present, people most often use the deep estimation judgment method, which has problems such as large judgment error and low speed and cannot meet the needs of high-precision judgment. Simulation technology, or simulation technology, is the technology of imitating another real system with one system [7, 8].

Based on the above theoretical research, the author proposes a 3D simulation garden landscape design method based on virtual simulation technology, by combining virtual simulation technology and traditional 3D simulation garden landscape design method; a 3D garden landscape simulation system is constructed to realize 3D simulation, improvements in garden landscape design methods, further promote the development of 3D simulation garden landscape design.

3. Research Methods

3.1. 3D Garden Landscape Simulation System

3.1.1. System Overview

(1) System Architecture. The 3D landscape design simulation system is first of all a computer-aided design system, which has comprehensive functions and can help designers to quickly complete the preliminary design and the later result display [9]. The system is based on garden landscape design, with terrain design, planning design, and planting design as the main content, integrating architectural modeling and road design; while completing the graphic design, the scene can be dynamically browsed with OpenGL, and the real-time rendering and 3D simulation animation can be produced in real time, and the scene can be displayed in multiple directions and all angles [10]. The system can be roughly divided into several modules: modeling and editing, terrain design, planning and design, planting design, sprinkler irrigation design, data statistics, construction drawing production, and rendering and animation production; the overall architecture of the system is shown in Figure 1.

(2) Drawing Technology Based on Virtual Simulation Technology. In landscape animation, a very important technique is the drawing technique [11]. Due to the large amount of model data in the garden design industry, the system has high requirements for display speed and rendering effect. The system adopts the contour line technology to improve the drawing effect, deeply researches the OpenGL related content, and optimizes the specific realization algorithm of the drawing. The content is as follows.

Although computer graphics hardware has developed quite rapidly, large-scale fine meshes are not suitable in all cases, and coarse meshes still play an important role in some cases [12]. In the drawing of rough meshes, the contour line needs special treatment; here, a contour line smoothing technology is proposed, optimizing the outline drawing of rough meshes, solving the problem of how to make rough mesh outlines draw more natural and smoother without a finer model. The algorithm assumes that only coarse meshes exist and mainly consists of six parts. (1) Calculate the visible silhouette edges and associated triangles of the mesh at a certain viewing angle. (2) Project these silhouettes onto a 2D viewing plane to obtain a series of 2D line segments. (3) Use Hermite interpolation to replace line segments with smooth curves. (4) It is assumed that these smooth curves are the projections of the three-dimensional smooth contour lines on the viewing plane, so the curves are projected to three dimensions to obtain smooth contour lines. (5) Resample on the three-dimensional curve, and calculate the texture coordinates of the sampling points. (6) Retriangulate the mesh, map the texture, and draw the final model. The algorithm proposed here requires only coarse meshes, and no fine meshes exist [13, 14]. Second, during the run phase, only the silhouette edges of the rough mesh are extracted, which is much faster. Experiments show that this optimization process takes 80% more time than drawing the original mesh, but much less time than drawing one that gives an approximate mapping effect on the boundaries.

Flow field visualization is a classic research direction in scientific computing visualization research, and it is widely used in fluid mechanics, weather forecasting, and detonation data simulation [15]. A new method for visualizing 2D flow fields with semiregular textures is presented, extending the state-of-the-art texture synthesis algorithms and discussing how to strike a balance in maintaining continuity between frames and the texture structure of samples, and proposes two features via deformation matrices: a method to measure the degree of texture deformation [16]. Compared with the

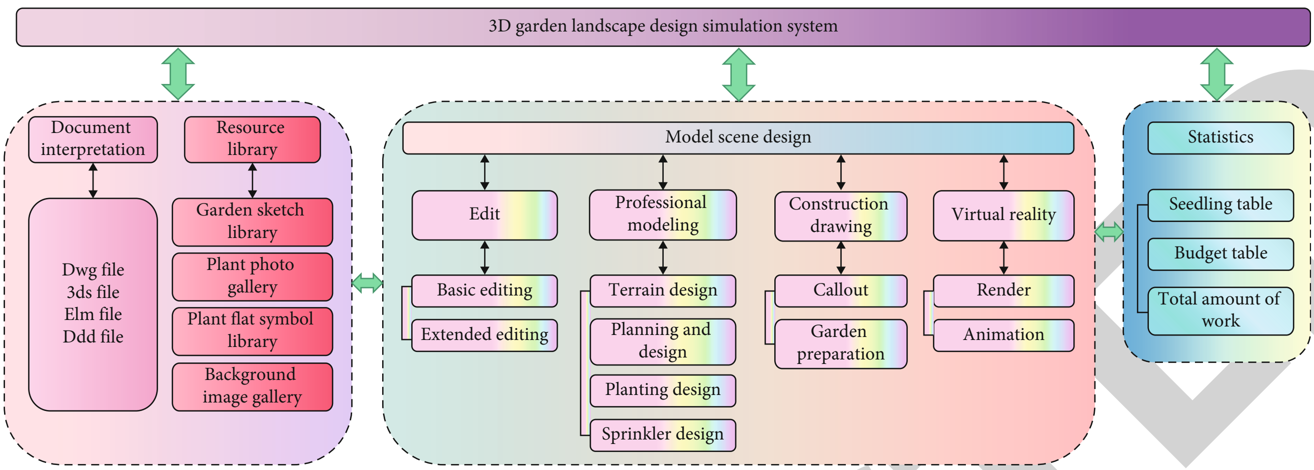

Figure 1: System architecture.

existing texture-based flow field visualization technology, the algorithm is a brand-new method; it does not use noise texture as input, but reinterprets the flow field with sample texture containing structure and direction information; it is also very different from the original method, but still expresses the internal characteristics of the flow field well [17]. Since many semiregular textures in nature can be used as input sample textures, the algorithm not only provides a new flow field visualization algorithm but also greatly enriches the variety of visualization results. Different from the traditional method based on noise texture, the method proposed here directly uses the directional information contained in the semiregular texture itself to visualize the flow field, the results are intuitive and effective, and the applicable texture range is wide, which enriches the means of flow field visualization. In the previous algorithm, after synthesizing the first frame, all pixels in each small block move forward at the same average speed. When each small block moves to a new position, if the original speed direction of a certain point and the current position are direction is not correct, then this point is the invalid point [18]. It can be seen that the previous algorithm only considers the translation mode of the texture block, while ignoring its reasonable rotational motion; therefore, when the flow field is complex, simple translation will often cause too many invalid points, prolonging the synthesis time; at the same time, too many newly introduced small blocks also reduce the continuity between frames, making the algorithm unsuitable for the visualization of unsteady flow fields [19]. The new algorithm proposed here overcomes these difficulties, allowing the rotation of texture patches, resulting in enhanced frame continuity and reduced composition time. Experiments show that the new method is only about half of the previous algorithm (all times are measured on a PC with 2 GHz CPU and 512 M memory).

In order to improve the drawing effect, it is necessary to study OpenGL technology in depth. In the new version of OpenGL (1.3 specification), OpenGL provides new techniques for drawing. The HPBUFFERARB PBuffer object provides a mechanism for off-screen drawing of target objects, which is an extended form of wgl. The background pixel buffer sets a 24-bit color buffer and a 32-bit depth buffer; the relationship between the pixel buffer size and video memory can be expressed as memory = width $*$ height $*$ $(24 + 32)$. Since the application also needs to be displayed, the storage capacity of the graphics card must be much larger than this result. Using OpenGL PBuffer off-screen rendering to determine the visibility of large-scale mesh models, it mainly includes the following five steps. The first step is to create the background window, define the window pixel format specification, set the pixel format of the device description table, create the drawing description table, and activate the device description table and the drawing description table. The second step is to use wgl Choose Pixel Format ARB to obtain a list of pixel formats with specified attribute characteristics, use wgl Create PBuffer ARB to create a pBuffer object, obtain the associated DC of the PBuffer, and create an Open Context, that is, the environment associated with the PBuffer (including GL frame buffer initialization, setting GL viewport, setting GL transformation matrix, and graphics card hardware programming settings). The third step is to enter the OpenGL context of the PBuffer and draw the mesh triangle data. The fourth step is for each triangular patch in the mesh model, take the coordinates of the midpoint of the triangle to transform the coordinates from the model space to the viewport space, use gl Read Pixels to read the depth data of the PBuffer, compare the depth value corresponding to the viewport coordinates, and set the visibility flag of the patch [20]. Step 5 is to restore the settings of the background pixel buffer, delete the draw description table, release the device description table of the window, and destroy the window.

3.2. System Calculation Principle, Method, and Calculation Formula

3.2.1. 3D Simulation Terrain Design. 3D simulation garden landscape design simulation system uses integrated modeling (RSG) to complete the line area modeling and design. The system uses a basic interpolation algorithm to model the constraint height measurement points or ground contour data to model a three-dimensional area with a triangle, which is then transformed to the data network always, for example, digital upgrade models (DEM). Using local interpolation algorithms, it can convert altitude sampling or contour line data to modern network DEM data. After a simple change of the calculation result and the accuracy of the result, the proposed return weight is finally used in the calculation to create a 3D network environment. The accuracy of the location simulation depends on the accuracy of the natural model, which is the reality of the original location in 3D model based on the ground data, which can make the designer focus data analysis. In order to avoid sampling point accuracy and various factors affected by modeling, the system uses manual sampling point control, which achieves the desired results. The application of the DEM model in the design space can not only be site-based but also complete the analysis, site-level and refinement [21].

3.2.2. Discrete Point Terrain Elevation Calculation Principle and Formula. The system adopts the principle of inverse distance weight method elevation interpolation calculation to realize the elevation calculation of discrete point terrain.

Shepard's method is the simplest "inverse distance weight" interpolation method.

$$F(x, y) = \sum_{i=1}^{n} w_i f_i. \quad (1)$$

n is the number of points around (x, y) to define its z value.

$$w_i = \frac{h_i^{-p}}{\sum_{j=1}^{n} h_j^{-p}}, \quad (2)$$

$$Z = \frac{\sum_{i=1}^{n} \left(1/(D_i)^p\right) Z_i}{\sum_{i=1}^{n} 1/(D_i)^p}. \quad (3)$$

P is the exponent, usually set to 2.

h_i is the distance between the interpolation point and the known point i.

$$h_i = \sqrt{(x - x_i)^2 + (y - y_i)^2}$$
$$\text{or } h_i = \sqrt{(x - x_i)^2 + (y - y_i)^2 + (z - z_i)^2}. \quad (4)$$

The U.S. Department of Defense Groundwater Model (GMS) uses the following weighting formula.

$$w_i = \frac{\left[(R - h_i)/Rh_i\right]^2}{\sum_{j=1}^{n} \left[(R - h_j)/Rh_j\right]^2}. \quad (5)$$

h_i is the distance between the interpolation point and the known point i.

R is the distance between the interpolation point and the farthest point.

3.3. Research on the Rationality Judgment Method of 3D Landscape Simulation System

3.3.1. 3D Image Data Acquisition. In daily life, due to the influence of weather factors, architectural factors, etc., the reasonable distribution of garden landscape design cannot be guaranteed. To this end, a three-dimensional image garden landscape data collection process is designed, and the analysis and judgment of this process is shown in Figure 2.

It can be seen from Figure 2 that the 3D image garden landscape data collection first collects the implicit data and normal data of the landscape distribution, then enters the data into the database for classification, and makes reasonable judgments based on the landscape design data [22].

3.3.2. 3D Image Rationality Judgment Model Based on Virtual Simulation Technology. According to the data characteristics obtained above, a 3D image garden landscape design rationality judgment model based on virtual simulation technology is constructed, and the 3D visualization method is used to display the rationality judgment results of landscape design. Taking the garden landscape design data as the input, the simulation characteristic parameters are determined, and finally, the rationality judgment result is obtained; the construction of the model is shown in Figure 3.

As can be seen from Figure 3, the model for judging the rationality of landscape design based on 3D image simulation mainly includes two parts. One part is a computer simulation model of garden landscape. The other part is a computer simulation model of three-dimensional characteristics, through which the inertia factor of simulation judgment can be obtained.

Using this model, by introducing the dynamic forward judgment and reverse judgment methods, the obtained inertia factor is judged positively, and then, the reverse judgment of each characteristic structure is obtained; by judging whether the garden landscape design is reasonable, the rationality of the three-dimensional garden landscape simulation system is judged [23].

In order to prove the validity of the proposed three-dimensional image simulation judgment method for the rationality of garden landscape design, it is necessary to design experiments to verify. A three-dimensional image model analysis platform for the rationality of garden landscape distribution is constructed under Windows 8 environment. Reasonable collection, identification, and analysis are carried out through 3D images, and the objective function values of different matrices are calculated; if the function value is large, the judgment and analysis of garden landscape are more accurate. If the function value is small, it means that the judgment of the rationality of garden landscape design is not accurate.

4. Results and Discussion

The following is an experimental analysis of the rationality of the three-dimensional garden landscape simulation system.

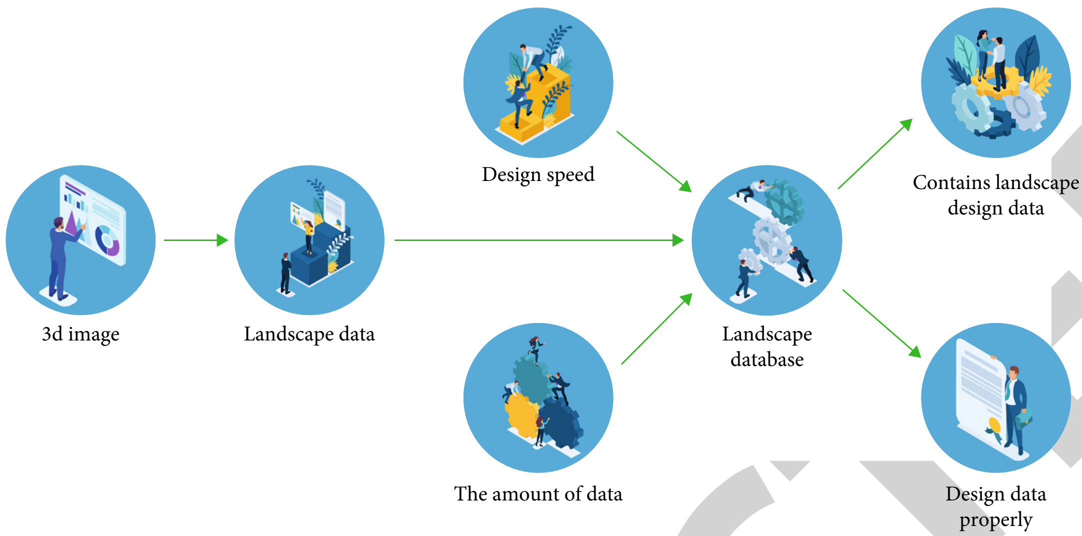

FIGURE 2: 3D image garden landscape data collection process.

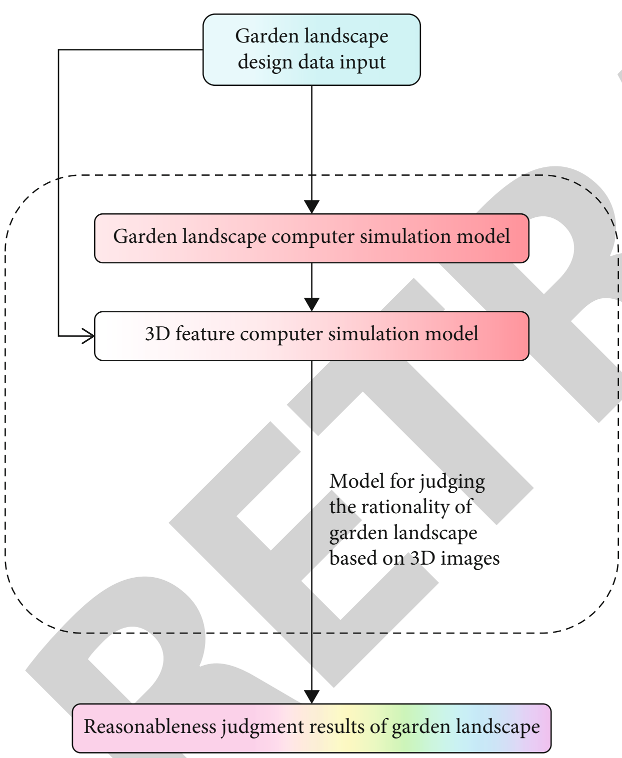

FIGURE 3: 3D image simulation judgment model.

4.1. Image Feature Point Matching Number and Matching Rate Results and Analysis. The 3D image simulation judgment method and the traditional deep estimation judgment method are used to compare the rationality of the garden landscape design; whether the number of image feature points can be used to judge the accuracy of the 3D image simulation of the garden landscape, the key factor is how to accurately match the corresponding attributes of the landscape garden image feature points [24]. At the same time, these two judgment methods are used to compare the matching number and matching rate of landscape feature points, and the results are shown in Table 1.

It can be seen from Table 1 that the matching number and matching rate of garden landscape feature points obtained by traditional deep evaluation judgment method are all lower than the three-dimensional image simulation method used by the author, and the number of image feature points in the matching process is simpler. The 3D image simulation method has a high feature point matching rate, which fully proves the rationality of using this method.

4.2. Judgment Rate and Accuracy Comparison Results and Analysis. The data was collected in the landscape environment, and the judgment rate analysis was carried out between the traditional method and the author's method, as shown in Figure 4.

During the period between 0 and 10, the visual value of the process always increases gradually, but is always lower than that of the three-dimensional simulation method, as shown in Figure 4. It has been determined that the process usually begins to depreciate at intervals of between 10 and 15. In real time, the process always shows up and down, with the fastest being only about 1/2 of the fastest for simulating 3D images. It can be seen that the traditional process used to measure the quality of a garden landscape is slow and tedious; 3D image modeling process based on virtual simulation technology is faster. The comparative results of filtration are shown in Figure 5. As shown in Figure 5, when the filtering range is less than 20%, the traditional method and the authorization method are slightly different in the fact they assess the landscape. Designs and procedures are always more detailed than the author's method. When the filtration volume is 20%-45%, the accuracy of the filtration standard is higher than that of the collection method. However, as the expansion expands, the accuracy of the method used by the writer gradually increases to a maximum of 89%, while the standard is always around 40%. This shows that the 3D landscape simulation system based on virtual

Table 1: The matching number and matching rate of three-dimensional image feature points of the two methods.

Group	Traditional method		3D garden landscape simulation system	
	Number of matches (piece)	Match rate (%)	Number of matches (piece)	Match rate (%)
A	540	30.25	680	75.28
B	350	25.61	460	63.16
C	360	24.32	400	50.12
D	320	27.02	390	44.32
E	280	21.34	340	30.15
F	256	30.16	303	29.38

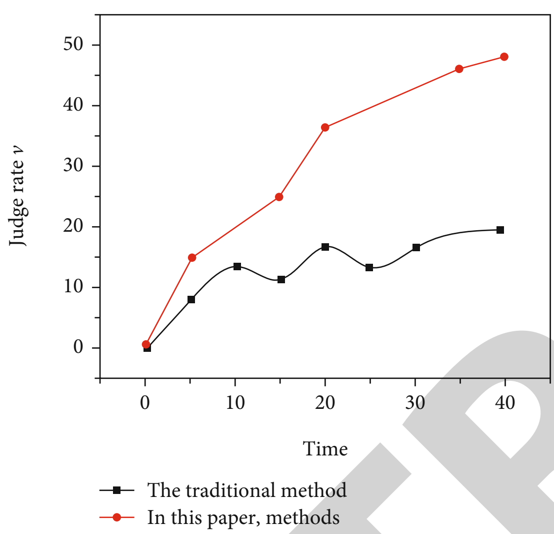

Figure 4: Comparison results of two methods to judge the rate.

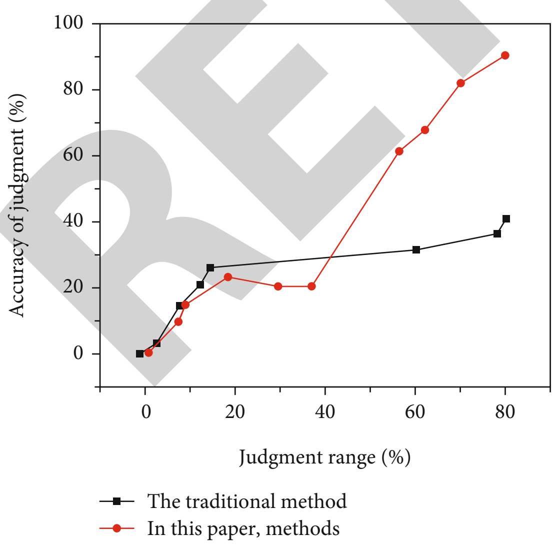

Figure 5: Comparison results of the two methods to judge the accuracy.

simulation technology is more accurate than the traditional methods used to measure the quality of landscape design [25].

5. Conclusion

The author proposes a 3D simulation garden landscape design method based on virtual simulation technology; by combining virtual simulation technology and traditional 3D simulation garden landscape design method, a 3D garden landscape simulation system is constructed, and then, the 3D simulation garden landscape design method is realized, improved, and further promoted the development of 3D simulation garden landscape design. The experimental results show that as the scope gradually expands, the accuracy of the method used by the author gradually increases, while the traditional method always maintains around 40%, describing the 3D simulation garden landscape design method based on virtual simulation technology and further promoting the development of 3D simulation garden landscape design.

Data Availability

The data used to support the findings of this study are available from the corresponding author upon request.

Conflicts of Interest

The authors declare that they have no conflicts of interest.

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Retraction

Retracted: Optimization of Plane Image Color Enhancement Based on Computer Vision

Wireless Communications and Mobile Computing

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(5) Incoherent, meaningless and/or irrelevant content included in the article
(6) Peer-review manipulation

The presence of these indicators undermines our confidence in the integrity of the article's content and we cannot, therefore, vouch for its reliability. Please note that this notice is intended solely to alert readers that the content of this article is unreliable. We have not investigated whether authors were aware of or involved in the systematic manipulation of the publication process.

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[1] M. Cao, "Optimization of Plane Image Color Enhancement Based on Computer Vision," *Wireless Communications and Mobile Computing*, vol. 2022, Article ID 3463222, 8 pages, 2022.

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Research Article

Optimization of Plane Image Color Enhancement Based on Computer Vision

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In order to enhance the color effect of plane image, this paper presents a method of optimization of color enhancement processing of plane image based on computer vision technology. This method combines Retinex algorithm with adaptive two-dimensional empirical decomposition and decomposes the image to achieve the effect of image color enhancement. The experimental results show that the average value of the image processed by this method is increased by about 0.3. The variance increased by about 0.13. Information entropy increased by about 0.3. The definition is improved by about 0.02. *Conclusion*. The optimization method of color enhancement processing of plane graphics based on computer vision technology can effectively improve the color of plane images, which is of great significance for image processing.

1. Introduction

Image color enhancement is the most basic and key image information processing technology [1]. Traffic monitoring, medical imaging, criminal investigation technology, and military fields have their applications. The unprocessed original plane image may have noise interference, including lighting conditions, weather reasons, the reflection properties of the object itself, and other factors, which will make the image not clear enough, the color saturation is not enough, and the details are missing, resulting in small gray value, high brightness, blurred image, and other problems.

Computer vision is an important part of the intellectual field. The aim of the study was to enable computers to recognize three-dimensional environmental data through two-dimensional imaging [2]. Computer vision is based on computer graphics, signal processing technology, and validation results, including geometry, neural networks, machine learning theory, computer data, and paper production technology. It analyzes and processes computer-generated data [3]. Try to create a device that receives information from various images and information based on scientific research, computer vision, scientific research, and technology. Computer vision is a broad field that involves scientists in many fields, including computer science, engineering, architecture, physics, mathematics, statistics, neurophysiology, and cognition [4–6]. Computer vision is also a very active field in the current computer science. The field of computer vision is closely related to image processing, pattern recognition, projection geometry, statistical inference, statistical learning, and other disciplines. In recent years, it also has a strong connection with computer graphics, three-dimensional representation, and other disciplines [7]. With the rapid development of information technology, the development of computer vision image technology is advancing by leaps and bounds. Under normal circumstances, these technologies will be applied in the process of image data acquisition and detection image processing of human internal vision system. Highly integrated with visual technology, it can be applied to the image processing of industrial testing instruments and equipment and parts. Some technologies will also be applied to the deep multilevel image processing of the part image data to be collected. In this environment, using computer vision technology to enhance and optimize the color of plane image can greatly improve the quality of plane image, so as to better use plane image for problem processing.

2. Literature Review

Image color enhancement is the most basic and key image information processing technology. Traffic monitoring, medical imaging, criminal investigation technology, and military fields have their applications. The unprocessed original plane image may have noise interference, including lighting conditions, weather reasons, and the reflection properties of the object itself, which will make the image not clear enough, the color saturation is not enough, and the details are missing, resulting in small gray value, high brightness, blurred image, and other problems. In order to solve these problems, relevant professionals have done a lot of exploration and research. For example, Tao proposed the fundus color image enhancement method. Although it can enhance the color and effectively improve the color and brightness, it needs to manually set parameters during calculation, resulting in cumbersome calculation and no adaptability [8]. Huang et al. explored the use of histogram to enhance the image. This method has strong adaptability. However, when the original image has a small gray dynamic range and uneven distribution, the image details will be lost, and even the noise will be amplified [9].

Computer vision technology refers to the visual process of simulating human visual observation and analysis of images through computers. It requires computers to have the ability to use images to perceive the surrounding environment in the process of artificial intelligence, simulate the specific process of human visual function, and then realize intelligent processing of relevant images. Computer vision technology is an artificial intelligence technology, which simulates the process of human perception of the environment. Therefore, this technology integrates multiple disciplines and technologies, including image processing, artificial intelligence, and digital technology [10, 11]. This technology plays a very important role in the development of computers. Especially in modern society, people need computers to complete more intelligent behaviors to replace human beings to solve some work in special environments. In addition to the application of computer vision technology in the development of computer, it also has certain applications in mechanized production. In the future mechanical automation production, this technology can be used to extract the image of objective things and then used for the detection and control in the production process. Compared with the traditional automation control, this technology can realize the control function of faster speed, greater amount of information, and more functions.

Computer vision began with the introduction of the 1950 model. At the time, the work focused only on two-dimensional analysis and identification, such as knowledge of optical behavior, analysis and interpretation of work surface, micrography, and aerial photography. In the mid-1970s, the laboratory opened a "car vision" class. Since the 1980s, blind computer research has shifted from advanced experiments to practical applications. The rapid development of computer manufacturing and the development of intelligent, functional, and neural network technologies have helped to improve the performance of computer vision systems and to participate in research into various techniques of visual processing. Currently, computer visual technology is widely used in geometry, computer graphics, graphic design, and robotics, as shown in Figure 1.

The concept of machine vision was introduced into China at the beginning of the 21st century. Up to now, the technology is still in the stage of popularization. As China's development ability in machine vision hardware and software is not very strong, there is a certain gap between domestic MVT and foreign MVT, resulting in high development cost and low efficiency of related products [12]. In recent years, domestic research institutes, universities, and related enterprises have increased their research on MVT and applied the technology to industrial sites, such as electronic manufacturing, semiconductor industry, and pharmaceutical industry. Some experts and scholars have developed product defect detection equipment based on MVT, which can sort unqualified products. With the gradual improvement of MVT, it has also been applied in the domestic automobile manufacturing industry and new energy industry. At present, MVT in China is extending to many fields and industries. The technological process of viewing information in a computer visual system depends only on the method of image processing. These include image enhancement, data encoding, transmission, smoothing, edge sharpening, segmentation, feature unpacking, image recognition, and understanding. After this process, the quality of the output image is improved to a certain extent, which not only improves the appearance of the image but also allows the computer to recognize, process, and recognize the photos. Based on the above research, this paper proposes an optimization method for color enhancement of planar images based on computer vision technology. This method uses Retinex algorithm, adaptive two-dimensional empirical decomposition, and computer vision technology to decompose it, so as to achieve the purpose of enhancing and optimizing the color of plane image [13, 14].

3. Research Methods

3.1. Principles of Computer Vision Technology. Computer vision is the use of computers to transform many organ systems and the brain into a complete, explanatory environment, according to the technique of comprehension. The ultimate goal of computer vision research is to enable computers to control, understand, and adapt to the world through human-like vision. Only with long-term efforts can we achieve our goals. Therefore, before achieving the ultimate goal, the main goal of human activity is to create a vision that can do certain tasks based on certain perceptual and feedback skills. For example, an important area of computer visual application is visual vehicle navigation. There is no system that recognizes and understands the environment and regulates itself like a human being. Therefore, the goal of human research is to identify visionary drivers who are able to control the highway and avoid collisions with oncoming vehicles. What is being said here is that the computer plays an important role in changing the human brain's computer vision, but this does not mean that the computer must be

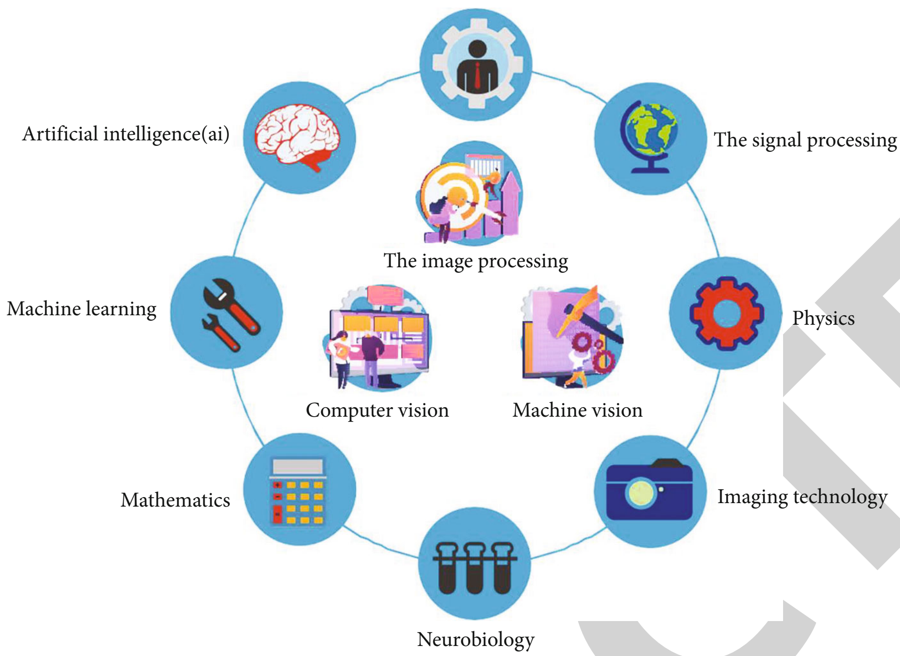

Figure 1: Domain relationship of computer vision.

able to complete the data it sees as a model of human vision. The computer's vision must be visible and in accordance with the characteristics of the computer. However, the human visual system is the most robust and perfect visual system.

As we will see in the following chapters, the study of human vision will provide inspiration and guidance for the study of computer vision. Therefore, computer information processing is used to study the mechanisms of human vision and to develop the sensory perception of human vision. This study is called vision counting and can be considered as a computer vision survey [15]. Figure 2 shows the scope of a computer vision system.

3.2. Retinex Algorithm. The Retinex algorithm is based on visual perception of brightness and color and automatically adjusts the perceived color and brightness to ensure color persistence. The reason for distinguishing the illumination change and surface change of a plane image is that the color change caused by the brightness of the incident light is slower than that caused by the reflection of the object surface. Thus, a plane image composed of the interaction between the incoming and outgoing light and the reflector can be obtained.

In the Retinex algorithm, the incident light and reflection attributes can be expressed by the following mathematical expressions, as shown in the following formula:

$$f(x, y) = l(x, y) \times r(x, y). \tag{1}$$

The original image is $f(x, y)$, and the incident light and reflected light images are $l(x, y)$ and $r(x, y)$, respectively.

The reflected light image can be calculated from the following formula:

$$R = F - L, \tag{2}$$

where $R = \log(r)$, $F = \log(f)$, and $L = \log(l)$, respectively, represent the reflected light image, and the result of logarithm between the original image and the incident light image is the R exponential function [16].

3.3. Adaptive Two-Dimensional Empirical Decomposition. Adaptive two-dimensional empirical decomposition (ABEMD) converts one-dimensional signals into two-dimensional signals through the optimization method of multiscale architecture and then combines the two-dimensional intrinsic mode function to collect the image extreme points, interpolate the surface of the extreme points, and calculate the average value on the envelope surface. Then, the two-dimensional intrinsic mode function is used to subtract the two-dimensional signal, and the obtained value is the trend function. Finally, the iteration is performed [17]. $f(x, y)(x = 1, \cdots, M, y = 1, \cdots, N)$ refers to the image signal of $M \times N$ size. To divide the original image into two-dimensional intrinsic mode functions of high frequency and low frequency, adaptive two-dimensional empirical mode decomposition can be used. The frequency corresponding to the decomposed image scale is sorted in ascending order, that is, the detail mode is built. When decomposing, it is necessary to ensure that the two-dimensional intrinsic mode function is commensurate with the initial two-dimensional signal whose mean value is 0, and that the maximum point and minimum point are positive and negative, respectively. The following formula represents the decomposition result:

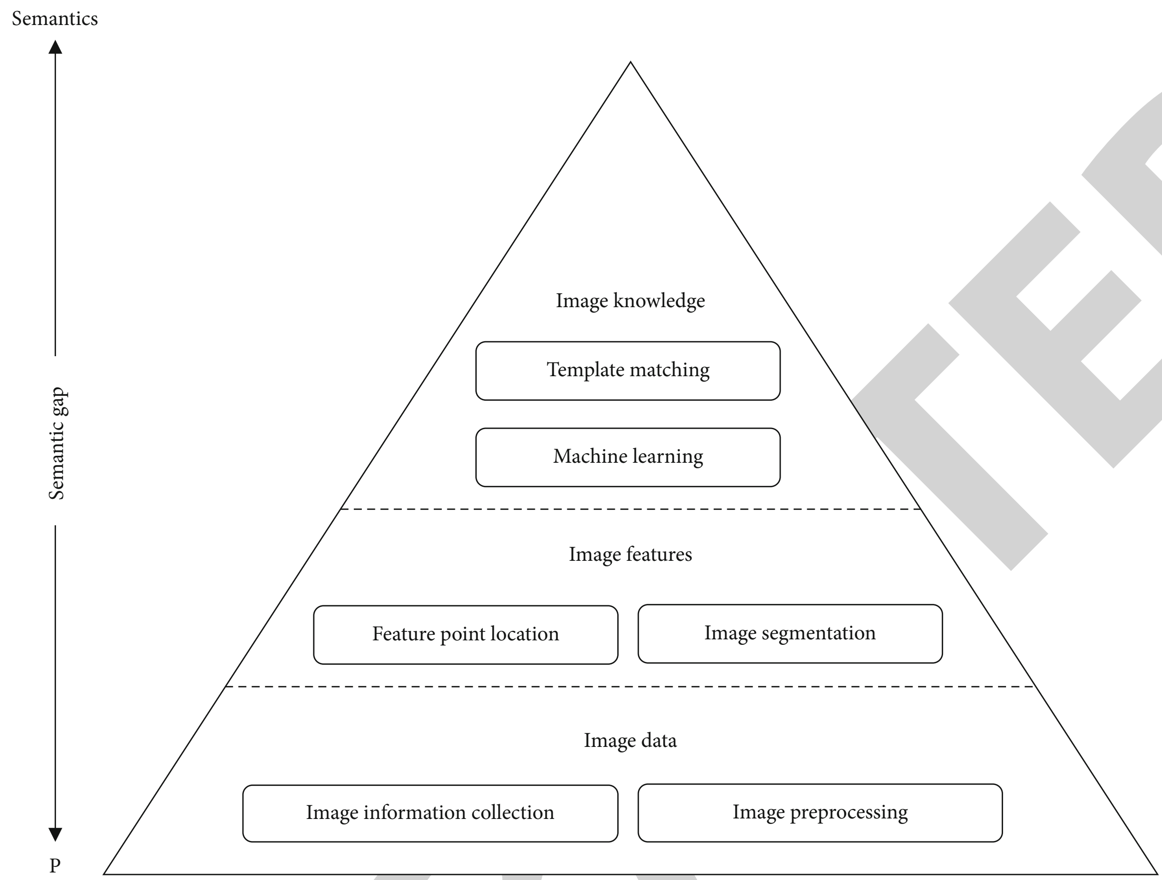

Figure 2: Computer vision recognition system framework.

$$f(x, y) = \sum_{k=1}^{N} \mathrm{bim}f_k(x, y) + r_N(x, y), \quad (3)$$

where $\mathrm{bim}f_k(x, y)$ is used to describe the two-dimensional intrinsic mode function image of layer K, and the trend image is obtained through n-layer division [18].

3.4. Combination of Retinex Algorithm and Adaptive Two-Dimensional Empirical Mode Decomposition. Gaussian convolution is used to calculate the incident light component of the original plane image, and the center surround Retinex algorithm is used [19]. The selection of scale should be considered in this process. If a single scale Retinex algorithm is adopted, it will focus on the local. If a multiscale Retinex algorithm is adopted, the efficiency will be reduced due to the increase of the amount of computation. In addition, when setting single scale and multiscale, the results will be different due to different environments. When the incident light component is collected by the adaptive two-dimensional empirical mode decomposition method in this paper, the scale will be matched independently according to the original characteristics of the image, and the operation method is very simple.

After adaptive two-dimensional empirical mode decomposition, several two-dimensional intrinsic mode function images and trend images with different scales are obtained, and different frequency characteristics are summarized, respectively [20]. When estimating the incident light component, the adaptive two-dimensional empirical mode decomposition can match the scale independently, which can maximize the acquisition area of details. Therefore, the detail information, such as image noise, is deleted, which is the high-frequency component. The reason why "halo" will not appear in the calculation process of Retinex algorithm is that the illumination component can directly reflect the illumination information in this process.

3.5. Algorithm Flow. The best way to realize planar image processing is to effectively ensure that the subsequent processing of planar images is less complicated and the image enhancement effect is good. The method proposed in this paper is a planar image color enhancement method based on computer vision technology, and its specific framework is shown in Figure 3.

The RGB space of the image is transformed into HSV space, and then, each component is decomposed by the Retinex algorithm. Finally, the Retinex algorithm is used to correct and adapt the incident light and reflected light components. Weighted acquisition of the brightness component after enhancement can simplify the three channels of R, G, and B into single channel calculation. The saturation component S is corrected based on the enhanced brightness component V', and the chrominance component should be

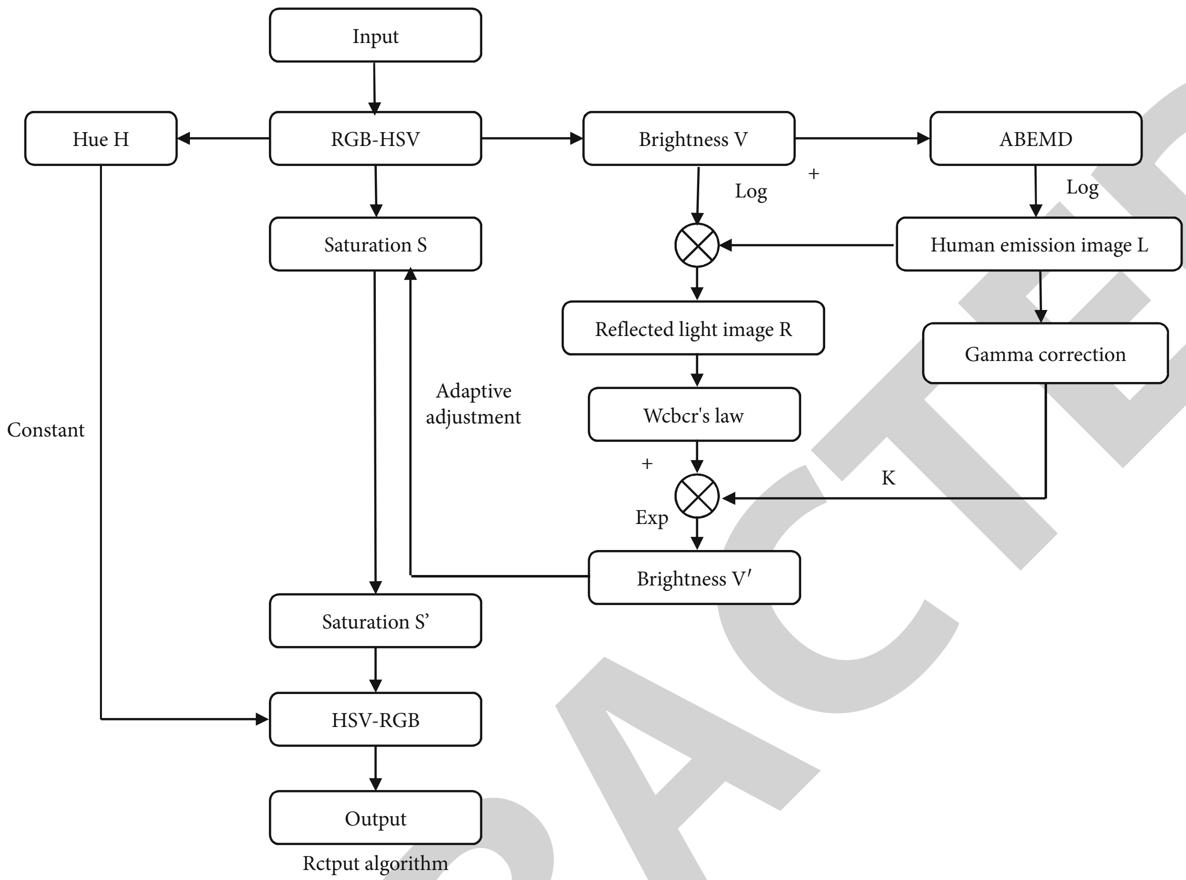

Figure 3: Specific framework of this method.

consistent with the previous one. In this way, the color of the color image can be kept undistorted, and finally it can be converted into RGB domain.

3.5.1. Area Retinex Incident Light Image Acquisition. Regional Retinex incident light image acquisition is the core of image color enhancement. Here, adaptive two-dimensional empirical mode decomposition is applied to decompose the image into k layers to obtain the regional Retinex incident light component. The specific steps are as follows.

(1) The histogram of the original image $f(x, y)$ is averaged, and the color space is converted to obtain three quantities: chromaticity H_{org}, saturation S_{org}, and brightness V_{org}

(2) Under different illumination conditions, the brightness component V_{org} is increased to obtain $n_1, n_2, \cdots, n_m$ illumination coefficient and M images $V_{\mathrm{org1}}(x, y), V_{\mathrm{org2}}(x, y), \cdots, V_{\mathrm{org}m}(x, y)$

(3) The plane image V_{org} is decomposed by adaptive two-dimensional empirical mode, and the $V_{\mathrm{org1}}(x, y), V_{\mathrm{org2}}(x, y), \cdots, V_{\mathrm{org}m}(x, y)$ is divided into k layers, where the high-frequency component is $\mathrm{imf}f_{ij}$ and the low-frequency component is $p_{ih}(x, y)$, that is, the area Retinex incident light component obtained by decomposition

3.5.2. Calibration Based on Retinex Algorithm. For the incident light, reflected images, and output results obtained by Retinex algorithm, in order to obtain high-quality results adapted to visual features, the following steps can be used for correction.

(1) Correction of Incident Light Image. Gamma correction of incident light image is used to solve the problem of uneven brightness caused by uneven illumination. In order to enhance its self-adaptability, the following formula is used for transformation to obtain and correct the incident light image,

$$y(i) = i^{a \cdot i + a}, \tag{4}$$

where the pixel value is i, the pixel is a, and the range is {0-1}. After the transformation, the effect of low brightness area can be enhanced and the severe exposure of high brightness area can be controlled at the same time, so as to achieve the goal of global enhancement.

(2) Correcting Reflected Light Images. If the critical visible deviation is met, the reflected light image can be corrected by using Weber's law in order to improve the regional clarity of the contrast of the reflected light p image. The ratio between the difference of two brightness values and the background can be identified visually, that is, the light intensity I is 1-1000 cd, expressed by the following formula:

$$\frac{\Delta R}{R} = \text{constant}, \tag{5}$$

where R is the reflected light image and is the critical visible deviation of the reflected light image.

Optimize the calculation amount to better match the edge and surface of the object, which is expressed by the following formula:

$$\frac{\Delta R}{R} = 0.002216 \times R^{-1.09} + 0.05943 \times R^{-0.2645}. \tag{6}$$

The modified reflected light map can well coordinate the local details of the image and increase the brightness and contrast of the global image. At the same time, because it has adaptive characteristics, it is not necessary to consider setting data in advance.

(3) Retinex Algorithm Output Correction. In order to truly present the objective image, the center surround Retinex algorithm is improved. The enhanced image only has a narrow brightness range. The improved formula is as follows:

$$\begin{cases} \log\left(V'\right) = R + KL, \\ K = \dfrac{L}{246}. \end{cases} \tag{7}$$

The luminance component V' is used to describe the image after enhancement processing. The weighting coefficient is K, and the pixel mean value is L. After improvement, it can increase the real lighting and enhance the enhancement effect.

3.5.3. Global HSV Color Space Correction. The brightness component of the enhanced planar image will change the matching degree between saturation and brightness to a certain extent and affect the color sense of the image. To ensure the global color idealization, the saturation component should have the following adaptive adjustment. The adjustment method is shown in the following formula:

$$s'(x, y) = s(x, y) + t\left(v'(x, y) - v(x, y)\right) \times \lambda(x, y)$$

$$v_W(x, y) = \frac{1}{n \times n_{(i,j)\in W}} \sum_{W} u(i, j), s_W(x, y) = \frac{1}{n \times n_{(i,j)\in W}} \sum_{(i,j)},$$

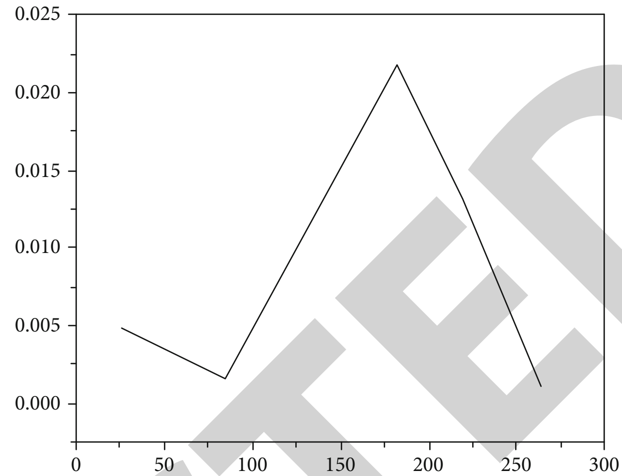

Figure 4: Before enhancement.

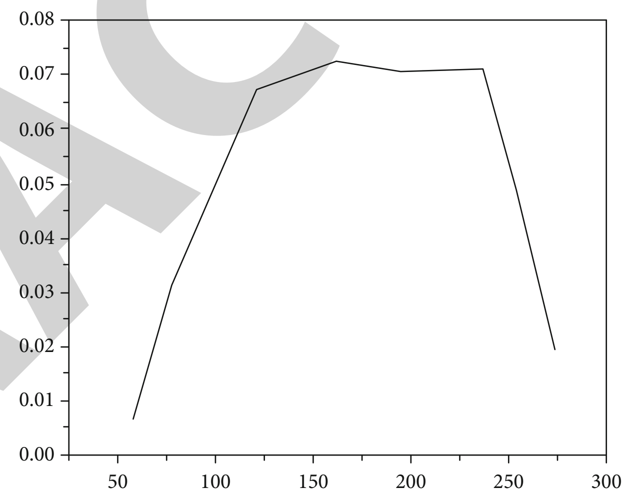

Figure 5: After enhancement.

$$\begin{aligned} \delta_V(x, y) &= \sum_{(i,j)\in W} \left[v(i, j) - v_W(x, y)\right]^2, \delta_s(x, y) \\ &= \sum_{(i,j)\in W} \left[s(i, j) - s_W(x, y)\right]^2, \end{aligned}$$

$$\begin{aligned} \lambda(x, y) = \sum_{(i,j)\in W} &\left|v(i, j) - v_W(x, y)\right| \\ &\times \left|s(i, j) - s_W(x, y)\right| / \sqrt{\delta_V(x, y) \times \delta_s(x, y)}. \end{aligned} \tag{8}$$

The brightness values before and after enhancement are $v(x, y)$ and $v'(x, y)$, respectively, and the saturation values before and after change are $s(x, y)$ and $s'(x, y)$, respectively. The constant ratio is t. In this paper, the luminance and saturation values of $t = 0.35$ and (x, y) in the domain window W are $v_W(x, y)$ and $s_W(x, y)$, respectively, and the variances of luminance and saturation are $\delta_V(x, y)$ and $\delta_s(x, y)$, respectively.

The change result of the λ, V component of the addition coefficient will affect the S component. The greater the value

Table 1: Image enhancement performance analysis of three methods.

Image	Contrast	Mean value	Variance	Information entropy	Definition
Street	Original drawing	0.2758	0.1215	0.4688	0.0141
	Method 1	0.386	0.2092	0.6602	0.0296
	Method 2	0.5783	0.1965	0.6411	0.0301
	Paper method	0.5816	0.2635	0.7091	0.0309
Flower	Original drawing	0.1631	0.0691	0.3063	0.0131
	Method 1	0.1536	0.1563	0.5571	0.0141
	Method 2	0.4514	0.1692	0.5322	0.0174
	Paper method	0.4612	0.1921	0.6638	0.0201

of λ, the greater the influence of the V component on the S component.

4. Results and Discussion

4.1. Image Enhancement Effect Analysis. Randomly select a plane image from the experimental database, and use this method to enhance the image. See Figures 4 and 5 for the histogram equalization effect before and after image enhancement.

The results of the image processed by the method proposed in this paper not only achieve the effect of plane image enhancement but also highlight the details of the image background and reduce the image noise. In the gray histogram, each pixel is distributed within a reasonable range without reducing the gray level, and the image equalization effect is good [21].

4.2. Image Color Enhancement Performance Analysis. The experiment measures the image enhancement effect of this method through four evaluation indexes: mean, variance, information entropy, and sharpness of plane image. The larger the evaluation index value, the better the image enhancement effect. The experimental images are the floor and street real scene plane images randomly selected from the image database [22, 23]. When using the formula to calculate the mean, variance, information entropy, and definition of image subblocks, divide the plane image into 10×10 pixel blocks, calculate the mean value of each subblock of each channel in the RGB color space, and then calculate the average value. Normalize the calculation results in the range of 0-1, and the results are shown in Table 1.

It can be judged from the objective evaluation criteria that the average value of the image processed by this method is increased by about 0.3. The variance increased by about 0.13. Information entropy increased by about 0.3. The definition is improved by about 0.02. Its lifting effect is good [24, 25].

5. Conclusion

This paper studies the method of color enhancement of plane image based on computer vision frequency decomposition. When using this method to enhance the color of plane image, it has achieved the effect of universal application and simplicity of calculation, from the estimation of illuminance to the optimization of incident light component and reflected light component and then to the correction of HSV color space. From the objective evaluation criteria, it can be judged that the average, variance, information entropy, and clarity of the image processed by this method are better than those of the other two methods, which accurately reflects that this method has more advantages in image enhancement processing through enhanced visual observation and objective index evaluation. It can be verified that the image enhanced by this method has moderate brightness, full color, and clear details and can be widely used in the color enhancement of planar images.

Data Availability

The data used to support the findings of this study are available from the corresponding author upon request.

Conflicts of Interest

The author declares no conflicts of interest.

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Retraction

Retracted: Application of Road Extraction from High-Resolution Remote Sensing Images in Tourism Navigation and GIS

Wireless Communications and Mobile Computing

Received 18 July 2023; Accepted 18 July 2023; Published 19 July 2023

This article has been retracted by Hindawi following an investigation undertaken by the publisher [1]. This investigation has uncovered evidence of one or more of the following indicators of systematic manipulation of the publication process:

(1) Discrepancies in scope
(2) Discrepancies in the description of the research reported
(3) Discrepancies between the availability of data and the research described
(4) Inappropriate citations
(5) Incoherent, meaningless and/or irrelevant content included in the article
(6) Peer-review manipulation

The presence of these indicators undermines our confidence in the integrity of the article's content and we cannot, therefore, vouch for its reliability. Please note that this notice is intended solely to alert readers that the content of this article is unreliable. We have not investigated whether authors were aware of or involved in the systematic manipulation of the publication process.

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[1] G. Wang, C. Ma, and X. Liang, "Application of Road Extraction from High-Resolution Remote Sensing Images in Tourism Navigation and GIS," *Wireless Communications and Mobile Computing*, vol. 2022, Article ID 2422030, 8 pages, 2022.

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Research Article

Application of Road Extraction from High-Resolution Remote Sensing Images in Tourism Navigation and GIS

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In order to quickly and accurately obtain and process road information and its damage information, to obtain better tourism navigation experience and accurate geographic information, this paper proposes a road extraction method based on high-resolution remote sensing images. Based on the known road width information and the analysis of the gray-scale characteristics of the road surface, the method takes the road center line and straight line in the image as the center line and then deduces the road edge line information, so as to extract the edge information. Then, through the image de redundancy information processing, the final obtained road width parameters are compared to verify the accuracy and reliability of the method. The experiment shows that the road information can be extracted accurately, and the extraction accuracy and efficiency have been significantly improved, reaching more than 90%, and can directly reflect the road edge line, median line, and width information. *Conclusion.* The road extraction method based on high-resolution remote sensing images can effectively and accurately extract road information, obtain better tourism navigation experience, and accurate geographic information.

1. Introduction

With the rapid development of information technology and sensor technology, the resolution of satellite remote sensing images (including spatial resolution, spectral resolution, and temporal resolution) has been greatly improved. Since the first earth observation satellite with a resolution of was launched in, it has been developed into a high-resolution remote sensing satellite with an order of magnitude or below, and the resolution is getting higher and higher [1]. With the application of high-resolution remote sensing images, we can obtain more accurate, richer, and more comprehensive information. Extracting information from remote sensing images, obtaining information by identifying interested targets and completing image understanding are the fundamental goals of remote sensing applications [2]. Road information is a very important part of the information that remote sensing images can provide. Transportation-related industries play an important role in the national economy and people's lives. In geographic information science, roads have always been an important research direction of related disciplines because of their obvious regional characteristics. With the development of remote sensing and its related technologies, they have been inseparable with electronic technology, communication technology, computer technology, and information science, making the research on road traffic more automatic and intelligent. From urban road planning to road congestion detection, tourism navigation, and geographic information application, all reflect the great role of road information. However, with the continuous updating of road information, the traditional manual operation has been unable to meet the demand. Therefore, combining remote sensing technology with electronic technology and image recognition technology to study the extraction of roads from remote sensing images can improve efficiency, which is of great significance for road monitoring, navigation, and timely updating of maps. At present, the diversity of information sources and the explosive growth of the amount of information have led to great changes in our research methods and means [3]. Now people increasingly rely on the unified research level, large professional databases, and the efficient retrieval and organization of a large amount of information. The use of computer technology to extract and sort out the data information of massive literature and establish a professional database with specific standards can provide effective means for information extraction, processing, and organization [4]. Therefore, it is very important to extract roads from high-resolution remote sensing images. How to quickly and accurately obtain and process road information and its damage information is the top priority. This paper makes an in-depth study on road vector extraction from high-resolution remote sensing images.

2. Literature Review

As for the research on road extraction from high-resolution remote sensing images, Kang et al. proposed a method based on polyphase time, which is to compare the photos at different time points before and after the road damage and analyze and extract the road damage information. Using the correlation coefficient method, through the correlation analysis of the image road information before and after the road damage, the geometric information and attribute information of the road damage are obtained [5]. Ma et al. proposed an interpolation method to compare road extraction [6]. The difference method is to extract the road from the registered image of the same area, then perform the difference operation to obtain a difference change image, and then analyze, judge, and extract the change information. However, this method is vulnerable to the noise and pixel gray value changes when obtaining the image. Li et al. proposed a single-phase change detection method. For the change detection of object features, first use professional software to segment the image, then extract the spectral features, texture features, and shape features of the segmented target object, respectively, use the difference method for change detection, and finally fuse the change detection results of different object feature levels to obtain the final results [7]. Jones and Renwick proposed a road classification and comparison method. The postclassification comparison method is a very intuitive change detection method. It requires that each image be classified separately, and then, the classification result images of multitemporal images are compared to detect the change information of the ground objects of interest and can also provide the change type information [8]. Ajay et al. proposed to use relatively parallel edges to select seed points and connect them according to the similarity of edge strength and length. At the same time, they made use of the system of opportunity rules. This method simply assumes that there is no noise in the image, and the road has a high contrast with the background, so its adaptability is not high [9]. Guo et al. proposed and designed a relatively complex system for road extraction on textured aerial images. This is a multilevel structure, so that low-level processing and high-level processing can cooperate with each other [10]. The low-level processing uses the method of section matching. The high-level processing can obtain the vehicle information of intersection, gland, width change, and road surface. If there is an interruption, a new model can be generated to continue the road tracking.

On the basis of current research, this paper proposes a road extraction method based on high-resolution remote sensing images. Based on the known road width information and the analysis of the gray-scale characteristics of the road surface, the method takes the road center line and straight line in the image as the center line and then deduces the road edge line information, so as to extract the edge information. Then, through the image de redundancy information processing, the final obtained road width parameters are compared to verify the accuracy and reliability of the road extraction.

3. Research Methods

3.1. Basic Framework of Road Information Extraction. Road damage information extraction is a comprehensive method of road extraction and road damage detection. The knowledge involved in the research of road information extraction is not only the extraction and positioning of high score image targets, but also the analysis and interpretation of the extracted targets and the comprehensive understanding of road knowledge information. Road information extraction is to select appropriate methods to extract accurate road information based on the full analysis of road feature information. Road damage information is based on road information extraction to deeply analyze road targets. Road damage information extraction is the change of corresponding information on high score images before and after road damage, and it is the change detection of specific targets [11, 12].

3.1.1. Road Feature Analysis. The road in the remote sensing image presents bright or dark strip features that are obviously different from the geometric shape of the background. Asphalt roads generally show a dark strip shape in high-resolution remote sensing images. Concrete, gravel, and soil pavements generally show a bright strip shape. Intersections are generally shown as light and dark areas with different shapes, such as cross, T-shaped, circular, and butterfly. The pavement marking lines are generally bright short lines and long lines. The urban road presents the complex network characteristics of horizontal and vertical staggered and cross connected in its topological characteristics; But the nonurban road presents a simple network feature. The background of urban roads is generally complex background such as buildings, roadside trees, and isolation belt between roads [13]. The background of nonurban roads, especially expressways, is generally simple background such as farmland, mountain forest, or river, and there is a linear isolation belt in the middle of the road. Through the analysis of the characteristics of roads in high-resolution remote sensing images, combined with the characteristics of roads in the real world, road pavement materials, and image performance, and through the analysis of road attributes to connect the characteristics of roads in all levels, scholars have established classic road models, as shown in Figure 1 below.

The model summarizes the characteristics and corresponding relationships of roads in the three levels. It highlights the characteristics, existing forms, and material characteristics of roads in different levels and provides clear guidance and strong support for road idea extraction in remote sensing images. Image features are composed of physical features, geometric features, and gray-scale change features of local areas. The region with features contains a large amount of information, while the region without features should only contain a small amount of information [14]. Roads have the following characteristics in remote sensing images:

(1) *Geometric Features*. Roads appear in the image in the form of long strips with little change in curvature. The width of the road changes little and is far less than its length. The intersections and overpasses of roads are polygonal areas with certain characteristics in a large area.

(2) *Radiation Characteristics*. The gray value of the road image is relatively single within the two edge lines, has certain texture characteristics, and has a large difference with the pixel gray value of its adjacent areas, forming a clear contrast.

(3) *Topology Features*. Generally, roads do not exist alone. They are usually connected with other roads to form a road network and will not be disconnected in the middle. In the image, one end of the road is either connected with other roads or extends beyond the image.

(4) *Context Characteristics*. It is the image feature information of the areas closely related to the road, such as the roadside trees and buildings on both sides of the road, the lane, zebra crossing, and various driving signs on the road on the high-resolution image, as well as the material properties of the road, which are all the context information of the road [15].

As the resolution of remote sensing image is getting higher and higher, the details provided by the image are becoming richer and richer. For example, narrow roads that could not be distinguished in the previous medium and low-resolution images can now be clearly distinguished [16]. However, while improving the resolution brings rich detail features, it also brings a large number of noise information of nontarget objects, which also causes two main problems in the process of extracting the road network: first, the buildings around the road and the road have very similar light reflection characteristics, resulting in similar strip and gray-scale features in the image. Even after the region segmentation, the two cannot be clearly separated. Second, the high-resolution image not only enriches other details of the image but also enriches the detailed features of the road surface, making the vehicles, pedestrians, and trees on the road surface clearly visible, resulting in the road surface becoming mottled and fractured fragments in the image, so that the extraction method based solely on the road texture feature is no longer applicable to those urban roads and roads with rich road information, increasing the difficulty of road network extraction [17].

3.1.2. Characteristic Analysis of Road Damage Information

(1) Changes in Geometric Characteristics. Because the roadbed and pavement are damaged or covered by a large amount of deposits, the regular geometric features of the road image on the high-resolution image change or even disappear. The spatial continuity is damaged, and the intact road and the damaged road are spaced. The edge line characteristics of the road are damaged. The complete road is two continuous and clear edge lines, while the damaged road has only one discontinuous edge line or both edge lines disappear. The structural structure of the road is damaged by the strong earthquake, which will cause the fluctuation of the road surface, change the width of the road surface, partially narrow or completely covered, and change the extension direction of the road [18], as shown in Table 1.

(2) Spectral Characteristic (Gray Scale) Change. The material and reflectivity of pavement determine the spectral characteristics of pavement. The damage of the pavement caused by strong earthquakes will change the smoothness of the road surface or produce large cracks or be covered by rocks, trees, snow, and other debris, resulting in changes in the light reflection characteristics of the pavement, thus changing the characteristics of the road in the high-resolution image. The changes are mainly reflected in the following aspects: first, the characteristics of the uniform gray scale and texture of the road are changed, becoming disordered or even disappearing. Second, the physical structure of the pavement and subgrade is damaged, which reduces the image gray of the road. However, the pavement accumulation caused by secondary disasters such as landslides and debris flows makes the gray and texture of the road image closer to the spectral characteristics around the road [18].

(3) Topology Characteristic Change. Strong earthquakes will cause "broken roads" and "isolated roads" and destroy the topological characteristics of the original intact road network-connectivity and connectivity.

(4) Contextual Characteristics. Landslide and debris flow caused by secondary disasters can provide reference information for road damage information extraction. The break and disappearance caused by the shadow and occlusion of buildings, trees, and viaducts can also be used as reference information for road extraction.

3.2. Road Extraction Based on Vector Template. To extract the road image, we need to do some pretreatment to make it meet the requirements of the road extraction method.

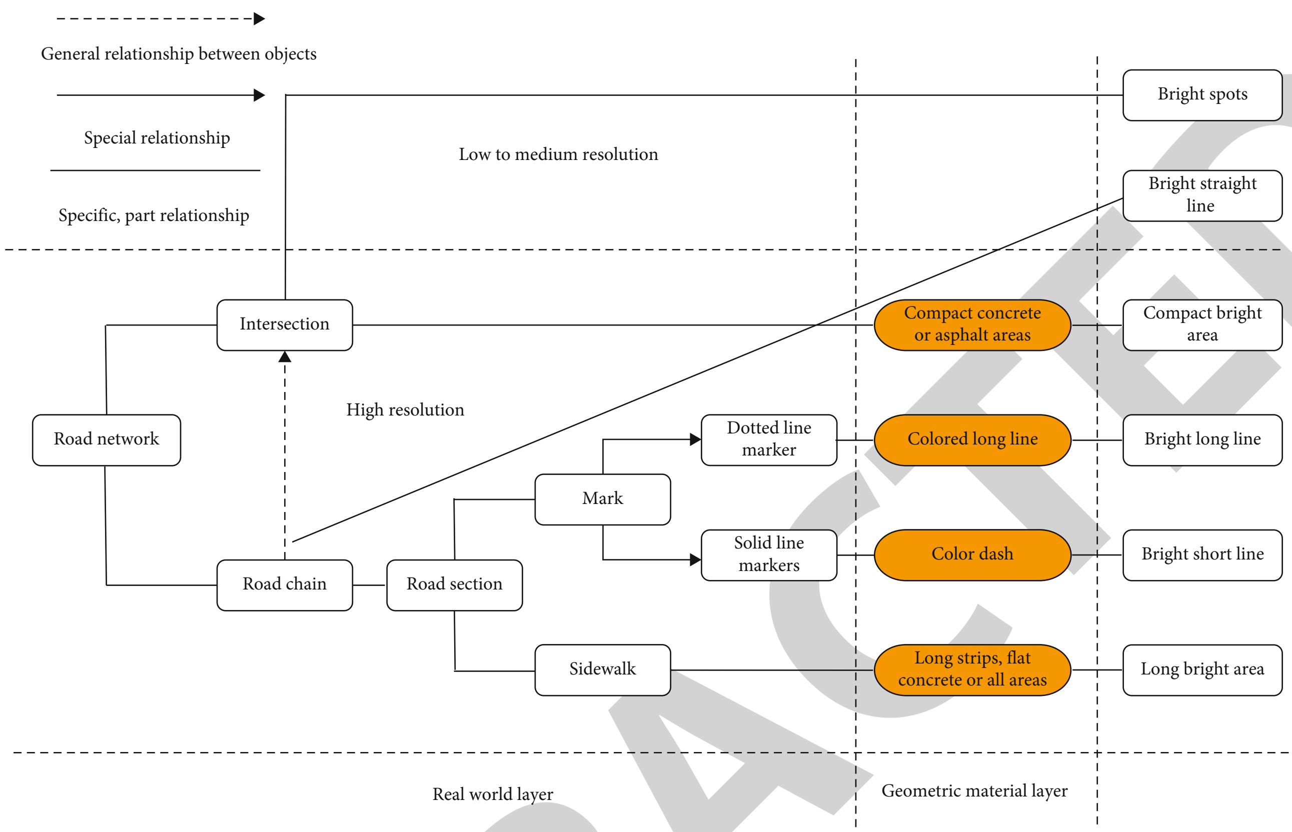


Figure 1: Classic road model in optical image.

Table 1: Disaster change of geometric characteristics of road boundary.

Geometric features	Preearthquake road	Postearthquake road
Continuity	The edge has good continuity without interruption	Edge line intermittent
Parallelism	The road has two parallel side lines, and the lane or separation zone of the high-grade road is also parallel to the road side line	The edge lines of the damaged road are not parallel, and one or two of the edge lines change or even disappear
Width	The width change along the road is very small. The width is related to the grade of the road. The higher the grade, the greater the width	The structural damage and the covering of deposits will cause sudden changes in width

The technical scheme of pretreatment process is shown in Figure 2 below.

Image correction: during image acquisition, the image cannot be kept strictly horizontal, and the ground is not completely horizontal, so the image will produce deformation errors such as image point displacement, graphic deformation, and inconsistent scale. Therefore, in order to extract accurate road information, it is necessary to correct the images obtained by remote sensing. Because the road information extraction we are going to carry out has higher requirements for the accuracy of the image, we need to carry out necessary image correction so that the road information on the image can accurately reflect the real data information of the road, including road direction, width, length, edge line, and other information. Image registration: because the extraction of road damage information we need to do is based on high-score images of the same area at different time points, we need to do some registration work to make the two (more) images match completely, so as to extract different road information before and after the road damage, and then compare and extract the road damage information. As the methods used for image registration and correction are not the main research content of this paper, the existing mature registration and correction methods are used to ensure the accuracy and reliability of road damage information extraction [19].

On the basis of image information enhancement, we remove the redundant information, mainly the nonroad objects in the image. After binarization and mathematical morphology processing, the road information can be clearly displayed on the image, but there are still some noise effects in some areas. Let us solve this problem by opening and closing operations. First, we set a strip operator with the same width as the road span. This operator can simply rotate around the center of the strip operator, and the rotation is

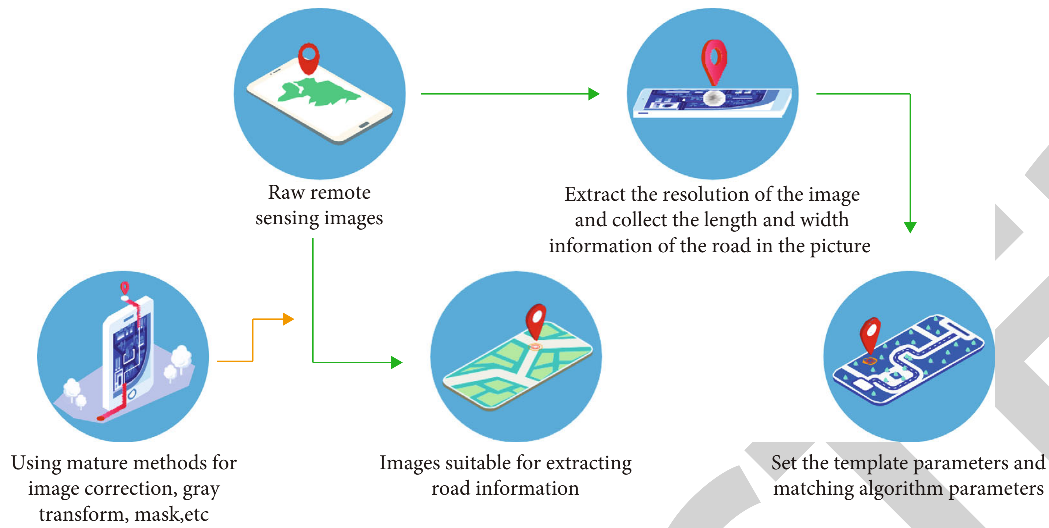
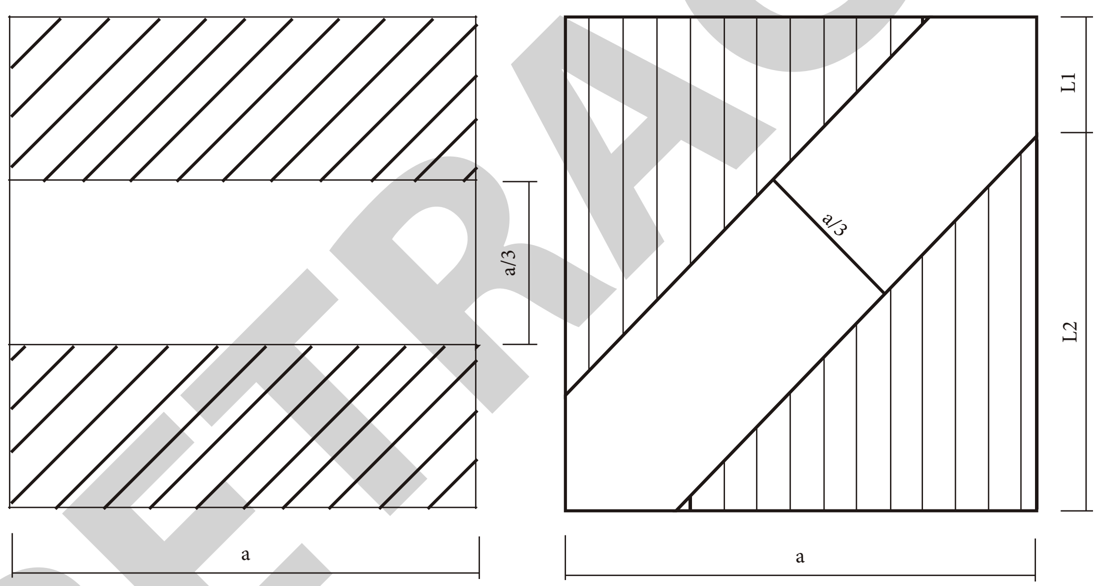


FIGURE 2: Pretreatment process technology scheme gap.



(a) The smallest proportion

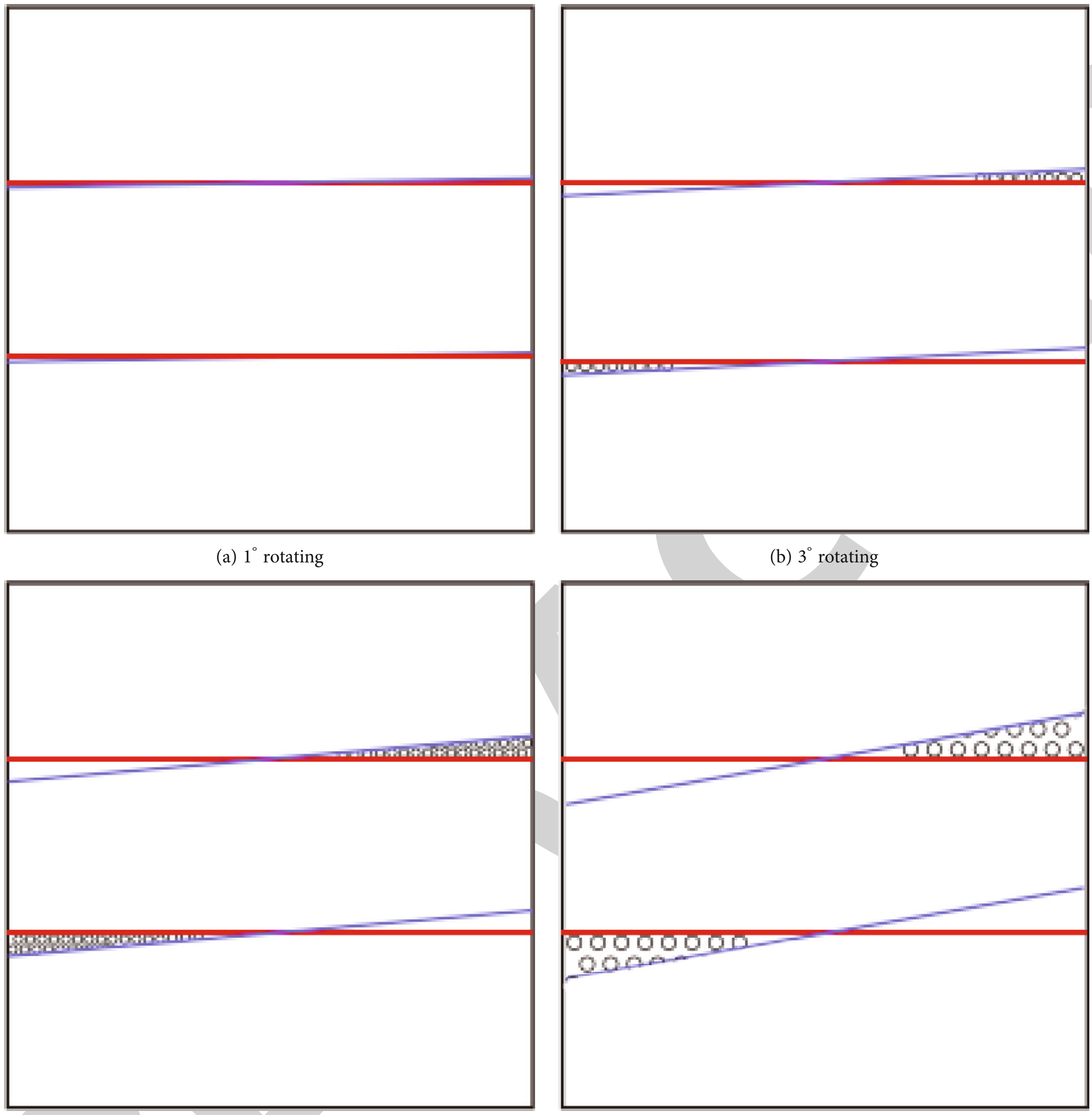
(b) The largest proportion

FIGURE 3: Scale analysis.

limited to 90°, that is, rotate 45° left and right in the vertical direction, so as to find out the area where the "vertical" road exists. Then, we set a horizontal strip operator, which can rotate 45° up and down in the horizontal direction, so as to find out the area where the "horizontal" road exists. In this way, adding the road existence regions in the two directions can obtain the road existence regions in the "all directions," so that the next step of vector template matching can be done to extract road information [20].

In the actual operation, the road vector template is built in the search box, its rotation is completed within the boundary of the search box, and its movement is carried out with the movement of the search box. The feature analysis of pixels in the search box is the basic analysis of template matching. The following is an analysis of the characteristics of pixels inside the search box:

First of all, the search box is a square window three times the width of the Road W. Its internal points are composed of pixel points in the image, which can be regarded as a $3w * 3w$ matrix. The value of each point is the gray value of the pixel points, which requires us to analyze the data in the search box to see whether there are road segments, as shown in Figure 3 below. Suppose the width of the search box is a, then the road width in the search box is $a/3$. Calculate the proportion of the blank part in the figure to the total area of the search box, that is, the proportion of road pixels in the search box to the road pixels and the total pixels in the box [21].



(a) 1° rotating (b) 3° rotating (c) 5° rotating (d) 10° rotating

Figure 4: Simulation diagram of different rotation angles.

We assume that the area of the search box is s, the blank area is s, and the ratio of the blank area to the total area of the search box is Nmax, then

$$\begin{aligned} \eta_{\min} &= \frac{S_{1\text{空}}}{s} = 0.33, \\ \eta_{\max} &= \frac{S_{2\text{空}}}{s} = 0.4158. \end{aligned} \tag{1}$$

The result of the above two formulas is the area proportion relationship between the road section and the search box in the model. Because each pixel in the digital image is also closely connected, this proportion can also represent the proportion between the number of pixels in the road section and the number of all pixels in the search box. Therefore, we can conclude that only when the number of pixels of a certain gray value (gray value of road pixels) in the search box reaches a certain proportion, it can indicate that the search box may contain road segment information. In this way, the search matching range can be greatly reduced and the operation time can be greatly reduced. Due to the influence of noise in the actual high score image, the scale range should be adjusted appropriately. We set the threshold

Table 2: Comparison between experimental data and actual data.

Project	Actual specified width road length m	Road length m of specified width extracted by experiment	Extracted scale
All designated roads	5055.40	4550.41	90.1%
Specify the straight portion of the corridor	3341.7	3131.77	93.71%

value between 0.3 and 0.45 according to multiple checking calculations, which can eliminate part of the influence caused by noise and gray value setting error. Because the roads may exist at any angle in the image, the template must adapt to the road matching of each angle, which leads to the problem of the rotation angle gradient of the road template, as shown in Figure 4 below.

We analyze the extracted matrix to be analyzed (search box suspected of containing road information). Any point $o(x, y)$ in the matrix that meets the set road gray threshold, if $f_{L2}(x) < y < f_{L1}(x)$, means that the suspicious point is in the road template. After all the suspicious points are analyzed, we record the total number of suspicious points in the road template and then compare this value with the total number of pixels in the road template. If the ratio road is a large value (above 0.8), we can determine the angle, position, center line, edge line, and other information of the road in the search box. This completes the work in this search box. Carry out the remaining matrix to be analyzed in turn, and you can find all the roads that meet the requirements.

4. Result Analysis

Taking the high score image of the main road in an urban area as an example, the road extraction experiment is carried out. The image size is 4077×4092 pixels, and the resolution is 0.2 meters. There are two roads with known width in the area. We select a road with the same pavement gray and 12 m width as the extraction object, that is, the road width in the image is 60 pixels. In order to make the template better cover the road and adapt to the search box calculation, we set the extracted width value to 61 pixels. Based on the known road width information and the analysis of the gray-scale characteristics of the road surface, the center line and straight line in the closest image are taken as the center line, and then, the road edge line information is derived. In this way, the extracted edge information is more accurate than the center line information and can also provide more accurate basic information support for the extraction of road damage information, as shown in Table 2.

Through the experiment, we can see that it is feasible to extract the road information of the specified width in the high score image by using the vector template matching search method and can also get good results, which can meet the requirements of extracting the road damage information for line scanning. The road information can be extracted accurately; the accuracy and efficiency of extraction have been significantly improved and can directly reflect the information of road edge line, median line, and width.

5. Conclusion

In this paper, a road extraction method based on high-resolution remote sensing image is proposed. Based on the known road width information and the analysis of the gray characteristics of the road surface, the center line and straight line in the image are taken as the center line, and then, the road edge line information is derived to extract the edge information, and then, the final road width parameters are compared through image de redundancy information processing. The experiment shows that the road information can be extracted accurately; the extraction accuracy and efficiency have been significantly improved, reaching more than 90%, and can directly reflect the road edge line, median line, and width information. It can be verified that this method can effectively and accurately extract road information and can obtain better tourism navigation experience and accurate geographic information.

Data Availability

The data used to support the findings of this study are available from the corresponding author upon request.

Conflicts of Interest

The authors declare that they have no conflicts of interest.

Acknowledgments

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Retraction

Retracted: Application of Information Encryption Technology in Computer Network Communication Security

Wireless Communications and Mobile Computing

Received 18 July 2023; Accepted 18 July 2023; Published 19 July 2023

This article has been retracted by Hindawi following an investigation undertaken by the publisher [1]. This investigation has uncovered evidence of one or more of the following indicators of systematic manipulation of the publication process:

(1) Discrepancies in scope
(2) Discrepancies in the description of the research reported
(3) Discrepancies between the availability of data and the research described
(4) Inappropriate citations
(5) Incoherent, meaningless and/or irrelevant content included in the article
(6) Peer-review manipulation

The presence of these indicators undermines our confidence in the integrity of the article's content and we cannot, therefore, vouch for its reliability. Please note that this notice is intended solely to alert readers that the content of this article is unreliable. We have not investigated whether authors were aware of or involved in the systematic manipulation of the publication process.

Wiley and Hindawi regrets that the usual quality checks did not identify these issues before publication and have since put additional measures in place to safeguard research integrity.

We wish to credit our own Research Integrity and Research Publishing teams and anonymous and named external researchers and research integrity experts for contributing to this investigation.

The corresponding author, as the representative of all authors, has been given the opportunity to register their agreement or disagreement to this retraction. We have kept a record of any response received.

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[1] H. Zhang, "Application of Information Encryption Technology in Computer Network Communication Security," *Wireless Communications and Mobile Computing*, vol. 2022, Article ID 9354441, 7 pages, 2022.

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Research Article

Application of Information Encryption Technology in Computer Network Communication Security

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In order to improve the communication efficiency while ensuring the security of communication information, this paper proposes a design and research method of a computer information security communication method by introducing data encryption technology. A new communication method is proposed through the construction of computer information security communication transmission model, computer information communication user identity authentication, communication information data encryption and decryption processing based on data encryption technology, and computer secondary communication key update. The experimental results show that the new communication method and ZigBee-based communication method are applied to the same communication environment through comparative experiments. The addition of encryption time and decryption time of the experimental group can be basically controlled within 70 ms, while the addition of encryption time and decryption time of the control group exceeds 70 ms, which verifies that the new communication method has higher security and communication efficiency. The introduction of data encryption technology in the actual information communication process can provide guarantee conditions for information security.

1. Introduction

With the continuous progress of science and technology, information technology has also been rapidly developed. More and more viruses and hackers affect people's normal life and even bring economic losses to people. In this context, the computer has derived the data encryption technology to ensure the security of computer network communication and protect people's privacy. At the same time, as the global attention to the value of information is gradually increasing, people are increasingly influenced by science and technology. The greater the impact of information value on people, the more important network communication security is in the development of computers. In order to protect people's communication security and ensure that people's privacy is not infringed, computer practitioners must strengthen the research on computer network communication security and use corresponding data processing technology to ensure information security [1–3].

With the continuous development of the network age, the attacks, and intrusions of network hackers, criminals and viruses make the network information maliciously tampered and stolen, which poses a serious threat to the security of network information. If the data encryption technology is applied to the computer network communication security, it can not only avoid the tampering and stealing of the network information data and ensure the authenticity and integrity of the network information data but also protect the user's private information. Data encryption technology, as its name suggests, means that the transmitted network information data is securely converted by using encryption keys, so that the readable information data becomes a series of garbled codes (also known as ciphertext) [4, 5]. This kind of garbled code has no meaning and cannot be accurately read and understood by the thief. Only when the receiver uses the decryption key after receiving the garbled code can the garbled code be decrypted. Compared with other information technologies, data encryption technology not only has simple and clear logic but also has low technical difficulty, which reduces the learning cost of technicians in related fields and lays a solid foundation for the effective promotion and application of this technology. At the same time, data encryption technology plays an important role in the construction of the network security system [6, 7].

The computer network security protection architecture is shown in Figure 1. From the figure, it can be clearly seen that users strengthen the stability, reliability, and security of computer network communication from the two aspects of encryption cognition and key management [8]. At the same time, various functional modules such as security protocol, virus protection, attack protection, and access control should be effectively combined and connected, so as to comprehensively improve the security level of computer network communication and create good conditions for scientifically and effectively avoiding the attacks of hackers and criminals. Therefore, it is of great practical significance to strengthen the application of data encryption technology to improve the security, integrity, and confidentiality of network information data [9].

2. Literature Review

In recent years, the continuous progress of network technology has greatly promoted the development of e-commerce industry. The application of data encryption technology in this field can better meet the development needs of e-commerce [10]. The emergence of e-commerce has greatly changed people's production, life, and social production mode. People can buy goods without leaving home, and businesses can sell goods without leaving home. However, it should be pointed out that the stable development of e-commerce is based on a safe and reliable computer network environment. As a trading platform for consumers and merchants, e-commerce platform must ensure the security of transactions and avoid disclosing users' address information, telephone information, and payment password. The application of SSL, set and other security protocols, digital certificates, digital signatures, and other data encryption technologies in e-commerce can effectively guarantee the information of both parties to the transaction. Moreover, the application of data encryption technology is an important measure to protect LAN. The rapid development of the current market economy has brought huge development opportunities for small- and medium-sized enterprises. During the development of enterprises, a lot of data information will be generated. Enterprises should establish a dedicated LAN inside, which is an important target of viruses and hackers. Once the LAN is damaged, it will lead to data information leakage and cause huge losses to enterprises. Through the application of data encryption technology, we can realize the effective protection of LAN, avoid information leakage, and ensure the security of enterprise internal data and information. Even if there is a problem in the enterprise LAN, the source can be identified in time and the handling work can be done well to reduce losses [11].

In the process of data encryption, it is necessary to comprehensively check the integrity and security of the information content of secret files in the computer network system to ensure that they will not be threatened by viruses. The application of computer needs a lot of software, so it is very important to encrypt the software, which is the focus that

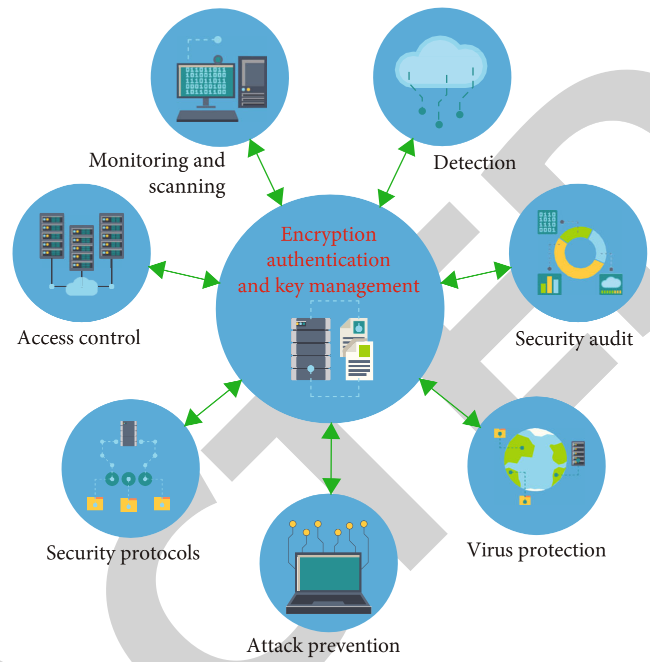

Figure 1: Computer network security protection architecture.

users have been paying attention to. At this stage, the emergence and application of microblog, WeChat, TikTok, and other software have greatly enriched people's interaction and entertainment methods. These software need to be encrypted in the application process to ensure the safe operation and application of the software. Another example is as follows: Currently, many mobile and computer games, such as King Glory, Hero League, Crossing the Line of Fire, etc., need to set multiple encryption locks during operation. From the perspective of users, online games are a way of entertainment, while from the perspective of developers, online games are for profit [12]. The higher the activity of online games, the more vulnerable they are to attacks. By encrypting the data of online games, users' passwords and information can be effectively protected to avoid losses caused by leakage. At the same time, it can safeguard the interests of game developers and ensure the safe operation of games. No matter what kind of encryption system is used, data encryption technology mainly includes plaintext, ciphertext, and encryption and decryption device or algorithm, namely, the key. The model composition of the security system is shown in Figure 2.

3. Method

3.1. Construction of Computer Information Security Communication Transmission Model. In order to realize the secure communication of computer information, it is necessary to determine the specific transmission path first. In combination with the relevant requirements of the computer communication security specification, the communication transmission model adopted in the design of the computer information security communication mechanism is shown in Figure 3 [13].

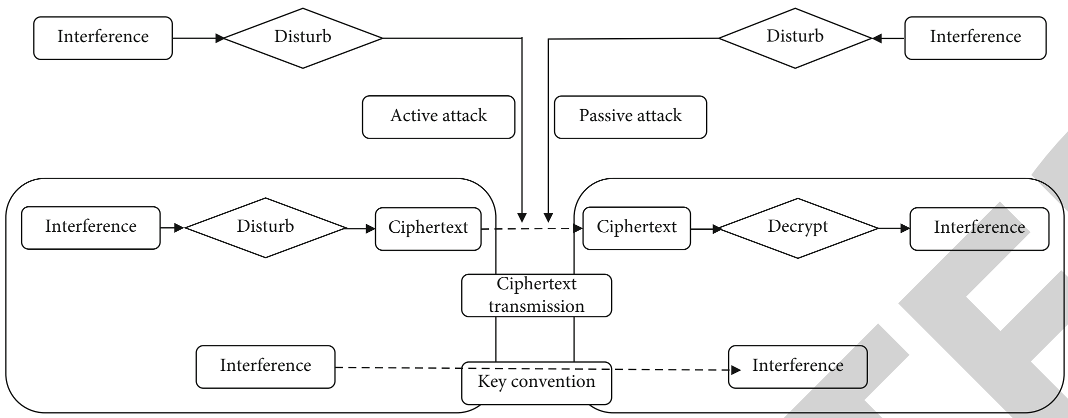

Figure 2: Composition of security system.

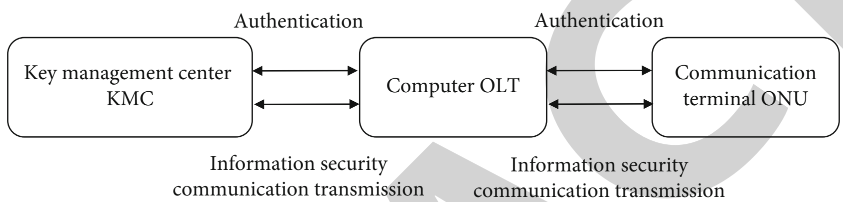

Figure 3: Computer information security communication transmission model.

Using the computer information security communication transmission model constructed above, the two-way authentication between the communication transmission terminal and each computer terminal is completed, so as to realize the identification and isolation of illegal intruders. At the same time, data encryption technology is introduced into the model to build a more perfect secure communication mechanism for communication methods. In Figure 3, the key management center is mainly used to manage the encryption key of computer network information and data and to license and authenticate the relevant equipment of the information communication network connected to the computer network. The computer OLT is mainly used to adjust the basic control unit in the network, and the communication terminal ONU is mainly used to realize the interaction of users at each communication receiving end and sending end and to manage and configure the communication information transmitted in this process. In the process of computer information security communication transmission, identity authentication can be used to identify and authenticate the identity of users at the receiving end and the sending end. Only users who have passed identity authentication can realize information communication transmission in the computer network.

3.2. Computer Information Communication User Identity Authentication. The whole process of communication authentication is as follows: first, the sending end user generates the information that needs computer communication. Secondly, SHA-1 or MD5 is used to generate a hash code for this group of information. According to the private key of the sending end user, encrypt the hash code according to RSA and put the obtained results into the communication information. Verify the identity of the receiving end user and judge whether the receiving end user matches the sending end user. If it matches, the session key is used to decrypt the communication information. If it does not match, the information receiving request of the receiving end user is directly ignored. If the symmetric password authentication mechanism is adopted, a symmetric key needs to be introduced between any communication transmission channel, which is easy to cause a large number of nodes and affect the key generation and management. Therefore, the public key mechanism is used to authenticate the identity of both sides of communication. By distributing any one of the trusted keys, the number of key nodes can be effectively reduced, so as to improve the communication efficiency of the computer. The authentication information needs to include the user ID of the receiving end or the sending end, the public key or private key information of a node in the communication channel, the random number corresponding to a node, and the connection symbol between various information data. The generation method of random numbers can be expressed by the following:

$$X = g^x \bmod p. \tag{1}$$

In formula (1), X is the generated random number, G refers to the common parameters negotiated by the users at the receiving end and the sending end, X represents the random number with the largest value selected by the user at the sending end, and P is a large prime number. According to the above formula, the random number of a group of communication information user authentication

Table 1: Communication information data encryption and decryption symbols based on data encryption technology.

Serial number	Symbol	Meaning
(1)	Ks	Communication key, used in encryption system
(2)	KRa	The private key of the user at the receiving end or the sending end is used in the public key encryption mechanism
(3)	KUa	The public key used by the user at the receiving end or the sending end is used in the public key encryption mechanism
(4)	EP	Public key encryption processing
(5)	DP	Public key decryption processing
(6)	EC	Symmetric encryption processing
(7)	DC	Symmetric decryption processing
(8)	| |	Tandem relation
(9)	Z	Zip encryption algorithm compression processing

information is calculated. Only when the user's identity information contains all the above contents can it enter the process of identity authentication. In the absence of any content, it is considered that the information is incomplete and cannot be brought into the process of user identity authentication. The transmission of corresponding communication information or the regeneration of user identity authentication information is stopped and reauthenticated.

3.3. Encryption and Decryption of Communication Information Data Based on Data Encryption Technology. To realize the encryption and decryption of communication information data is an effective method to ensure the secure communication of computer information [14]. Therefore, after the identity information authentication of the communication user is completed, the data encryption technology is introduced to encrypt and decrypt the communication information data. According to the three different levels of computer information communication, different encryption methods are adopted. The symbols used in the encryption process are shown in Table 1.

After specifying the symbols in the encryption and decryption process, a crypto device is added between the node and the modem to generate the corresponding key. The header and message are encrypted at the same time, and the intermediate nodes in the communication information are encrypted [15]. When encrypting, the end-to-end encryption method can allow the whole communication process to be decrypted and further improve the security of communication information. In the above encryption process, the encryption results at different levels can be expressed by the following:

$$m_i : \{ci, \mathrm{seq}, i, T_i\}. \quad (2)$$

In formula (2), m_i is the encrypted communication information, c_i represents the generated ciphertext, Seq is the session sequence number of the group of communication information in the computer network communication environment, i represents a block identifier as communication information, and T_i is the timestamp of the communication information.

After encrypting the communication information data, if the receiving end user wants to obtain the real data in the information, it also needs to decrypt [16]. After acquiring the communication content expressed in formula (2), the receiving end user authenticates the identity information of the sending end user according to the authentication code negotiated by both parties in advance and decrypts it after ensuring that the authentication passes. According to the block identification of the encrypted communication information, all the information is reorganized to recover the communication information transmitted by the user at the sending end to obtain the plaintext. Through the above discussion, complete the encryption and decryption of communication information data, ensure the security of information in the computer communication environment, and realize the accurate processing of information.

3.4. Computer Secondary Communication Key Update. If the same key is used for a long time, the probability of information disclosure will increase. Therefore, the key used in the first communication process will be updated. In the communication method designed in this paper, the key management center is responsible for setting and configuring the key update during unicast communication [17]. After completing a communication task, the key needs to be updated within the specified time. It is executed by using the key update function provided by OpenSSL and initiated by the KGC key control center. During the update process, the master key and temporary private key are selected, and the master key update program is called. All private keys are obtained through operation, and the final key parameter results are published.

4. Results and Discussion

4.1. Experimental Preparation. In order to further verify the application advantages of data encryption technology in this communication method, this method and the ZigBee-based communication method are applied to the same computer communication environment [18]. It is known that the environment in which the two communication methods are applied in the experiment is the distribution network of a power enterprise. The simulation of the real information communication environment is realized by simulating the secure communication process of the network control center in the computer. In this experimental environment, the memory of the computer is 512 M, the main frequency is 512 mHz, including 3.2 GHz Intel i5 480 processor, and 256 mssd hard disk. In order to facilitate the follow-up discussion, the communication method based on data encryption technology proposed in this paper is set as the experimental group, and the traditional communication method based on ZigBee is set as the control group. The two communication methods are applied to the above experimental environment.

4.2. Comparative Analysis on the Security of Communication Methods between the Experimental Group and the Control Group. The capacity value is selected as the evaluation index of the feasibility of information communication security encryption, and the capacity is expressed as the loss of information data in the communication process. When a computer is threatened during communication, its capacity will change. At the same time, the greater the noise in the communication process, the greater the capacity loss. When there is no zero space in the computer communication environment, it indicates that the capacity has been lost. At this time, the information data in the communication process will be lost. That is, the larger the capacity value, the better the encryption effect of the communication method. The smaller the capacity value, the worse the encryption effect of the communication method. The calculation formula of capacity value (3) is

$$K = P - \frac{\delta}{M}. \tag{3}$$

In formula (3), K is the computer capacity value, δ represents the amount of data lost in the communication transmission channel during computer information communication, M represents the information traffic that the computer needs to complete, and P is the total space capacity of computer communication. According to the above formula, the capacity of the two communication methods of the experimental group and the control group is calculated. In order to ensure the objectivity of the experimental results, in the communication process, the experimental parameters under the application of the two communication methods are set the same. Set the information communication transmission path to 8, including 8 communication information receiving ends and 8 communication information sending ends. The total power in the communication process is 750 mW, the data frame length is 4/5, the adjustment mode of communication information is BPSK, and the fixed signal-to-noise ratio of communication transmission channel is 4.5 db. According to the above experimental parameter settings, the comparative experiment is completed, and the capacity of the two traffic methods of the experimental group and the control group is calculated according to formula (3), as shown in Figure 4.

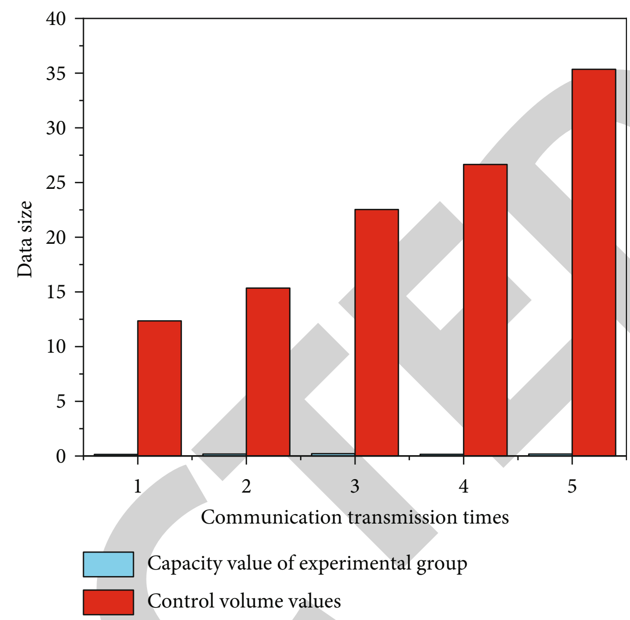

Figure 4: Record of capacity value of communication method between the experimental group and control group.

From the data recorded in Figure 4, it can be seen that in the five communication transmissions, the capacity value of the experimental group is obviously smaller, and with the continuous increase of the amount of communication information data, the capacity value of the control group shows an increasing trend, while this phenomenon does not occur in the experimental group. Therefore, it is proved that the communication method based on data encryption technology proposed in this paper can effectively reduce the capacity value of the computer in practical application, will not be affected by the amount of information data, and has higher communication security and stability [19].

Table 2: Comparison record of communication efficiency between the experimental group and control group.

Communication transmission path	Experimental group time		Control group time	
	Encryption	Decrypt	Encryption	Decrypt
Path I	26 ms	26 ms	38 ms	39 ms
Path II	31 ms	28 ms	42 ms	46 ms
Path III	22 ms	22 ms	48 ms	48 ms
Path IV	25 ms	26 ms	45 ms	49 ms
Path V	26 ms	25 ms	39 ms	51 ms

4.3. Comparative Analysis on Communication Efficiency of Communication Methods between the Experimental Group and Control Group. Choose the time-consuming situation in the process of encrypting and decrypting communication information as the evaluation index and compare the time-consuming situation of encrypting and decrypting information in the process of communication between the two communication methods. Select 5 random information communication transmission paths from the above 8 as the research object, perform encryption and decryption processing for different information on different communication transmission paths, record the corresponding time, and draw it into Table 2.

From the data obtained in Table 2, it can be seen that the addition of encryption time and decryption time of the experimental group can be basically controlled within 70 ms, while the addition of encryption time and decryption time of the control group exceeds 70 ms. In the actual process of computer information communication, there is a network delay phenomenon. The whole communication time of the experimental group, that is, the sum of encryption and decryption time and network delay, can still be controlled at the MS level, while the control group communication method can not achieve this effect. Therefore, the above experimental results further prove that the communication method based on data encryption technology in this paper can further improve the efficiency of communication and effectively ensure the needs of computer information communication on the premise of ensuring information security [20].

5. Conclusion

In this paper, a new communication method is proposed, and the feasibility and advantages of this method are verified from two aspects of security and communication efficiency through comparative experiments. In practical application, the communication method proposed in this paper effectively solves the problem of low efficiency of computer information communication to a certain extent by introducing data encryption technology and greatly improves the security and reliability of communication. However, this communication method is only applicable to ensure the secure communication transmission of information from three aspects: computer access authentication, information encryption, and information signature. If it needs to be more reliable, it also needs to comprehensively consider the entire security scheme according to the computer security system. Therefore, in the follow-up research, more in-depth research will be carried out to provide innovative directions for the further improvement and optimization of the general methods in this paper.

Data Availability

The data used to support the findings of this study are available from the corresponding author upon request.

Conflicts of Interest

The authors declares that he/she has no conflicts of interest.

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Retraction

Retracted: Integrated Development of Smart City Tourism and Cultural and Creative Industries Based on Internet of Things

Wireless Communications and Mobile Computing

Received 10 October 2023; Accepted 10 October 2023; Published 11 October 2023

This article has been retracted by Hindawi following an investigation undertaken by the publisher [1]. This investigation has uncovered evidence of one or more of the following indicators of systematic manipulation of the publication process:

(1) Discrepancies in scope
(2) Discrepancies in the description of the research reported
(3) Discrepancies between the availability of data and the research described
(4) Inappropriate citations
(5) Incoherent, meaningless and/or irrelevant content included in the article
(6) Peer-review manipulation

The presence of these indicators undermines our confidence in the integrity of the article's content and we cannot, therefore, vouch for its reliability. Please note that this notice is intended solely to alert readers that the content of this article is unreliable. We have not investigated whether authors were aware of or involved in the systematic manipulation of the publication process.

Wiley and Hindawi regrets that the usual quality checks did not identify these issues before publication and have since put additional measures in place to safeguard research integrity.

We wish to credit our own Research Integrity and Research Publishing teams and anonymous and named external researchers and research integrity experts for contributing to this investigation.

The corresponding author, as the representative of all authors, has been given the opportunity to register their agreement or disagreement to this retraction. We have kept a record of any response received.

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[1] S. Liu, "Integrated Development of Smart City Tourism and Cultural and Creative Industries Based on Internet of Things," *Wireless Communications and Mobile Computing*, vol. 2022, Article ID 8669570, 8 pages, 2022.

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Research Article

Integrated Development of Smart City Tourism and Cultural and Creative Industries Based on Internet of Things

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In order to solve the problem of asymmetric development of cultural and creative industries in smart city tourism, this paper proposes an analysis method based on the IPA model. Based on the analysis of the current situation of the tourism cultural and creative projects in the traditional block, this method combines the RMP analysis theory and the tourist satisfaction theory to study the local cultural elements and the satisfaction of tourism cultural and creative projects with the IPA model. The results are as follows: sightseeing (42.5%) is the highest motivation of tourists, followed by cultural and creative experience (16.2%), of which 84.8% are self-help tourists, and only 2.3% choose to join the group. Life custom is a significant factor influencing the satisfaction of patients who think it is very important but are actually dissatisfied. Smart tourism and creative tourism projects are considered important by the respondents, but there is a large difference between expectations and perceptions. These are the projects that managers need to focus on to correct at present. It proves that the activation of tourism cultural and creative projects should follow the market-oriented principle, the principle of reflecting characteristics, the principle of cultural guidance, the principle of effectiveness, and the principle of sustainable development in order to achieve the ultimate success.

1. Introduction

As early as the end of the 20th century, the view that "computing is no longer only related to computers, it will determine our survival" was put forward, which set off a digital wave. With the continuous promotion and application of computer network technology, the world has entered the Internet era. Subsequently, the global Internet ushered in a new round of innovation and change. Major breakthroughs have been made in big data, cloud computing, and other technologies. The scope of cross-border integration of the Internet has expanded. Revolutionary and disruptive changes have taken place in traditional industries and people's lives.

Cities should be "making life better" and providing poetic dwelling for human beings. The development of cities must be a process towards more humanization and intelligence. Therefore, driven by modern information technology and based on Digital City, smart city came into being. On the basis of full integration, mining, and utilization of information technology and information resources, smart cities gather human wisdom and endow things with intelligence, so as to achieve accurate and intelligent management in all areas of the city and intensive utilization of urban resources and promote the sustainable development of the city.

Driven by the tide of global creative economy, cultural and creative industries have developed into strategic industries and pillar industries in various countries and regions. With the continuous development of the new generation of information technology and innovative ideas, the creative economy has further moved towards the sharing economy, and the society has set off a new wave of creativity, innovation, openness, and sharing. Cultural creativity under the combination of technology, culture, and innovation is not only the driving force of urban economic development but also an important means to reflect urban characteristics and vitality. With the transformation and transformation of cities, the ecological environment on which cultural creativity depends will also change. In the development of smart cities, innovative technology and innovative thinking are the core of their development and transformation. How these

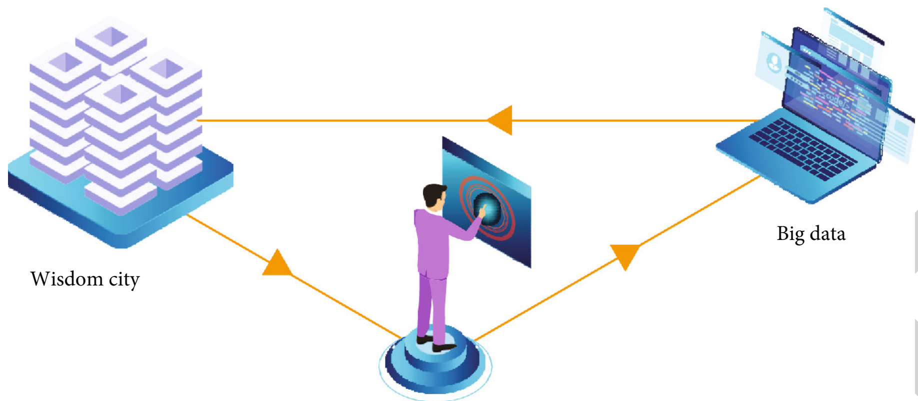

Figure 1: Smart city tourism and cultural and creative industry integration of Internet of Things.

factors affect the development of urban cultural and creative ecology will be the focus of our research [1]. As shown in Figure 1.

2. Literature Review

Chen et al. put forward the concept of "creative class" on the basis of the theory of creative industry and creative economy, investigated the creative class and its impact on urban regeneration, and concluded that urban facilities and tolerance are the key to successfully attracting and retaining the "creative class" through empirical research on several cities in the United States [2]. Tong and Sun systematically expound the group of "creative class." The book records the major changes in people's personal choices and attitudes in chronological order. It not only expounds the changes that are taking place but also explains the underlying economic reasons behind these changes. It clearly shows us how a new economic class will lead our future economic development [3]. At the same time, Nakip et al. creatively put forward the 3T theory of attracting creative talents and believed that talent, technology, and tolerance are the key to attracting creative talents, stimulating innovative development and promoting economic growth [4]. Sun et al. proposed that "the world is not flat." Through a large number of empirical studies, it shows the context and laws of the global distribution of wealth and wisdom and developed a "residence determiner" to provide a residence guide for people with different personalities, different needs, and at different stages of life, which provides a new perspective for people to understand cities and make choices [5]. Chang and Hung discussed the development of creative class and urban area from social capital theory, human capital theory, and creative capital theory and analyzed the relationship between regional selection of creative class and urban high-tech industry [6].

In the 21st century, how to creatively carry out self-development and find their own unique development potential and cultural assets has become the core goal of urban development. Chang et al. put forward the theory of "creative city" [7]. Ning et al. described the general track of the 150-year long development of the cultural and creative industry in New York, the "city of creativity," and showed the strong impetus of the cultural and creative industry to the economic development of New York. He believed that many factors, such as media groups, cultural industry policies, and art activities, were the environmental factors for the sprouting of the creative industry. These factors triggered the trend of cultural quotient crystallization and promoted the rapid development of the cultural and creative industry [8].

From "cultural ecology" to "creative ecology" and then to "cultural creative ecology," exploring the relationship between culture, creativity, and environment from an ecological perspective is a further expansion and extension of relevant theories after the coordinated development of culture and creativity. As a new concept, "creative ecology" has been supported by many scholars. However, most of the existing studies are from the perspective of cultural and creative industries, and some scholars have noticed the overall cultural and creative atmosphere and cultural and creative ecological development of the city, but there has not been a more systematic study on the whole. At the same time, the development of cultural creativity makes the urban wisdom not only stay in the intellectualization and industrialization of the technical level but also become humanized and poetic in the direction of cultural creativity. Therefore, the ecological development of cultural creativity in smart cities will be an important way to promote the poetic dwelling of cities [9].

On the basis of the current research, this paper expounds and evaluates the general situation of a traditional block and its tourism and cultural and creative projects through on-the-spot visits, surveys, and consulting relevant materials. Based on the RMP analysis theory and the tourist satisfaction theory, the IPA model analysis of cultural elements and tourism cultural and creative projects of traditional blocks in Wudian city is carried out through a questionnaire survey [10, 11].

3. Research Methods

3.1. Activation Path of Tourism Cultural Innovation Project. Based on the research results of activation path and the concept of cultural and creative project activation, the specific path of tourism cultural and creative project activation is summarized with the main line of ontology activation and tourist experience activation. As shown in Figure 2, the project

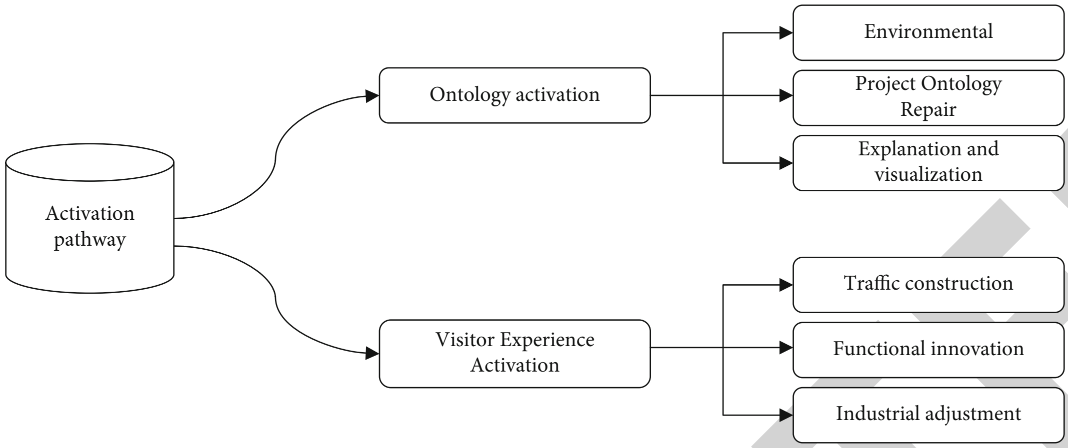

Figure 2: Activation path of tourism cultural and creative projects.

ontology is "activated" through three aspects: environmental regeneration, noumenon restoration, and representational interpretation, and then the tourist's experience is "activated" through three aspects: functional innovation, traffic construction, and industrial adjustment.

3.1.1. Environmental Regeneration. Environment refers to the natural and cultural soil on which tourism cultural and creative projects depend. Environmental regeneration is the basic activation step of tourism cultural and creative projects and plays a key role in the external atmosphere of tourism cultural and creative projects and the ecological authenticity of cultural elements. Environmental regeneration in this paper includes natural environment, health status, local customs, and cultural atmosphere [12].

3.1.2. Restoration of Tourism Cultural and Creative Projects. For the restoration of material cultural heritage, most of the ancient buildings in the block can be transformed and packaged according to their own characteristics. On the basis of repairing the old external space, appropriate transformation has been carried out in the internal space to build the existing art museum, museum, various characteristic shops, etc. [13].

3.1.3. Representational Interpretation. The traditional streets are rich in folklore and folk stories. In the years of development, many legends of celebrities have been left. However, in the interpretation of the scenic spot, there are not many stories that tourists can hear, so it is difficult to have a deep understanding of Minnan culture and folk culture. Traditional streets should strengthen the excavation of folk stories and add rich story elements to various interpretation media to make tourists feel interesting and meaningful [14].

3.1.4. Traffic Construction. Once more, people flow in traditional blocks, it is easy to cause traffic congestion, and traffic evacuation becomes an important task. In terms of external traffic, we should strengthen the construction of traffic infrastructure, such as parking management, especially the parking management of large vehicles. In addition, special operating buses for the scenic spot can be added. Tourists can take franchised buses to avoid traffic jams caused by self-driving. Connect the transportation hub belt, an important transportation node, and create a border tourism circle.

3.1.5. Functional Innovation. Create a creative space. The appearance of traditional buildings in the block is not suitable for creative design, but many idle buildings and repeated dining and shopping business areas. They can be transformed inside according to the cultural elements of Southern Fujian, so that tourists can enjoy traditional culture in fashion. Then create creative landscapes, ranging from garbage cans, signs, and other infrastructure to the whole building, which are the realistic carriers of creative landscapes. Then create creative projects and design creative activities to enhance the creative experience of tourists on traditional culture or other cultural elements. Educational function activation mainly refers to carrying out popular science tourism around traditional cultural heritage, using traditional cultural heritage as an educational tool to learn entertainment for tourists of different ages [15].

Various tourism cultural and creative projects can fully tap the six theme elements of local culture and apply them to existing projects. This will transform the culture that is easy to spread, understand, and accept into situational experience projects, so that tourists can experience the traditional cultural connotation, as shown in Figure 3.

3.2. Study Design. In order to further study the activation of tourism cultural and creative projects in traditional blocks, this paper not only studies the tourism cultural and creative projects themselves but also studies from the perspective of tourist experience. Based on the understanding of tourism cultural and creative project development, combined with RMP analysis theory and tourist satisfaction theory, this paper makes an IPA model analysis on the cultural elements of traditional blocks and the satisfaction of tourism cultural and creative projects [16]. Lay a foundation for the activation path and direction of subsequent tourism cultural and creative projects.

Based on the RMP analysis theory, this research is designed to collect data from three aspects: resource analysis, tourism market analysis, and adaptive reuse analysis. Among them, cultural elements, activation of tourism

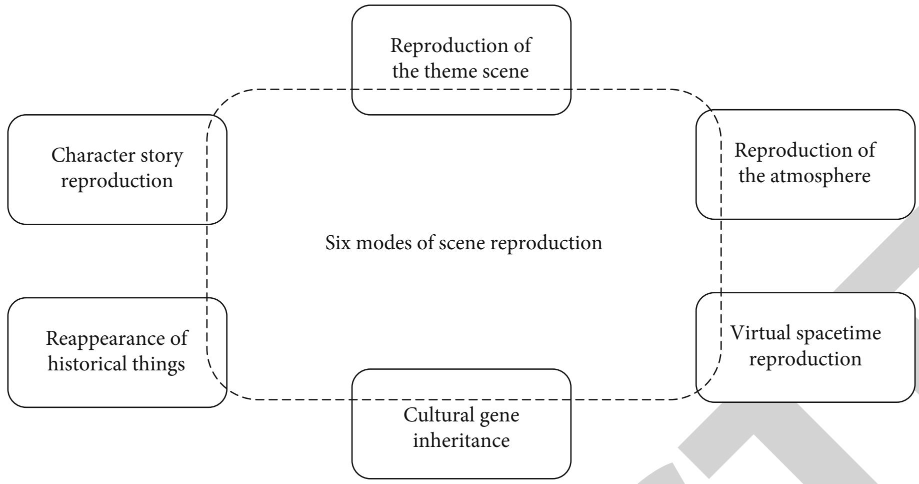

Figure 3: Situational experience mode.

cultural and creative projects, and satisfaction theory are combined to summarize the satisfaction indicators of cultural elements and tourism cultural and creative projects. A variety of quantitative analysis methods are used to study the activation of tourism cultural and creative projects in traditional blocks of Wudian city from a quantitative perspective [17, 18].

3.3. Research Implementation. The purpose of this questionnaire survey is to obtain the personal information and tourism status of tourists in traditional blocks, the interests of tourists, and the satisfaction of tourists' experience. The data obtained through the questionnaire survey are analyzed to reflect the existing problems. The design of the questionnaire will have an important impact on the follow-up empirical research and the final analysis results [19].

The questionnaire is mainly divided into three parts. The first part is the importance of cultural factors satisfaction analysis. The second part is the satisfaction analysis of the importance of tourism cultural and creative projects. The third part is the statistics of tourist demographic characteristics and tourist behavior information. The first part includes 15 factors: traditional architecture, traditional performance, traditional art, traditional skills, dialect, oral literature, life customs, religion, folk beliefs, ancestor worship, sages, festivals, martial arts, health medicine, and diet. The Likert scale was used to score. The second part includes 9 factors: architectural culture experience project, religious culture experience project, drama culture experience project, craft culture experience project, folk culture experience project, food culture experience project, cultural root seeking project, science and technology knowledge tourism experience project, and creative project. The Likert scale was used for scoring.

3.4. Reliability Analysis. In this paper, Cronbach's coefficient is used for reliability analysis. In social surveys, Cronbach's coefficient is the most frequently used reliability analysis method. It was proposed by American educator Lee Cronbach in 1995 to measure the internal consistency of the scale. The mathematical definition is shown in the following:

$$\alpha = \frac{k\bar{r}}{(1+(k-1)\bar{r})}, \quad (1)$$

where k is the number of evaluation items and $\bar{r}$ is the mean value of the correlation coefficient of k items. The value of α is between 0 and 1. The higher the value of α, the greater the credibility of the data. On the contrary, the value of α determines the credibility of the data. Generally speaking, if α is less than 0.5, it means the reliability is too low, and a large number of amendments need to be made to the questionnaire: if α is between 0.5 and 0.8, it means that the questionnaire setting is acceptable and reasonable [20, 21]. When the reliability of the questionnaire reaches 0.8, it means that the reliability of the measurement or questionnaire is excellent.

4. Result Analysis

4.1. Reliability Analysis. Through SPSS, the Cronbach coefficient reliability analysis is used to standardize the data in this paper. The overall reliability results of the questionnaire are shown in Table 1, indicating that the reliability is good.

4.2. Tourist Market (M) Analysis. The investigation on tourists' travel motivation shows that the highest motivation of tourists is sightseeing (42.5%), followed by cultural and creative experience (16.2%), as shown in Table 2.

Based on the investigation on the travel modes of tourists, it is concluded that 84.8% of the tourists travel by themselves, and only 2.3% of the tourists choose to join the group, as shown in Table 3.

4.3. Cultural Element (R) Analysis. Select 15 major cultural factors, including traditional architecture, traditional performance, traditional art, traditional skills, dialect, oral literature, life customs, religion, folk beliefs, ancestor worship, sages, festivals, martial arts, health medicine, and diet, and

Table 1: Reliability analysis.

Dimension	Cronbach's alpha	Project
Importance of cultural elements	0.898	15
Satisfaction with cultural elements	0.935	15
Total cultural elements	0.947	30
Importance of cultural and creative projects	0.884	9
Satisfaction of cultural and creative projects	0.935	9
Total amount of cultural and creative projects	0.932	18

Table 2: Travel motivation and frequency.

	Response		Percentage of cases
	N	Percentage	
Travel motivation			
1. Sightseeing	97	42.50%	73.50%
2. Council affairs	9	3.90%	6.80%
3. Visiting relatives and friends	13	5.70%	9.80%
4. Learning and knowledge	21	9.20%	15.90%
5. Cultural and creative experience	37	16.20%	28.00%
6. Religious pilgrimage	4	1.80%	3.00%
7. Photography	22	9.60%	16.70%
8. Examination of professional nature	8	3.50%	6.10%
9. Others	17	7.50%	12.90%
Total	228	100.00%	172.70%

Table 3: Travel mode.

	Frequency	Percentage	Effective percentage	Cumulative percentage
Valid				
Travel agency delegation	7	2.3	2.3	2.3
Official travel	14	4.5	4.5	6.8
Community organizations	11	3.8	3.8	10.6
Self-help play	259	84.8	84.8	95.5
Other	14	4.5	4.5	100
Total	305	100.0	100.0	

understand the activation of cultural and creative resources in traditional blocks and subsequent improvement measures through the importance satisfaction analysis of cultural and creative resources [22].

The data shows that the total average of the 15 indicators under the category of importance is equal to 3.835, and the total average of the 15 indicators under the category of evaluation satisfaction is equal to 3.438. $i = 3.835$ and $p = 3.438$ are the coordinate origin. Draw the coordinate axis of vertical intersection based on the intersection point, divide the IPA diagram into 4 quadrants, and mark the vertical intersection point of each pair of indicators in the 15 pairs of indicators at the corresponding position in the quadrant, as shown in Figure 4.

As shown Figure 4, there are 7 items in the first quadrant: traditional architecture, traditional performance, traditional art, traditional skills, dialect, festivals, and diet. These indicators are the factors that respondents believe are of high importance and satisfaction. According to the IPA analysis model, it shows that for the factors in this quadrant, the respondents believe that these factors are important factors for their evaluation.

The factors in the second quadrant are ancestor worship and sages. The satisfaction of these two indicators is high, but their importance is not very same, indicating that these two indicators are only basic items in the cognition of the respondents and are not enough to influence their views and cognition of cultural elements. The factors in the third quadrant of the IPA chart are oral culture, religion, folk belief, martial arts, and health medicine. This quadrant is represented by areas that are not important or satisfied with the survey. The factors located in the fourth quadrant of the IPA chart are life customs. This factor is that the respondents think it is very important, but they are actually dissatisfied. There is a large difference between expectation and

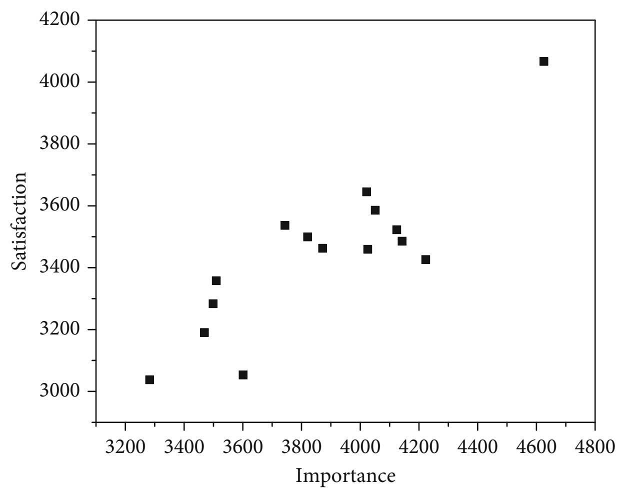

Figure 4: Cultural element importance satisfaction (IPA) matrix.

perception, which indicates that the item factor is a significant factor affecting patient satisfaction. According to the IPA analysis method, this is the project that managers need to focus on correction [23, 24].

4.4. Activation (A) Analysis of Tourism Cultural and Creative Projects. Nine major cultural factors are selected, including architectural culture experience project, religious culture experience project, opera culture experience project, craft culture experience project, folk culture experience project, food culture experience project, cultural root seeking project, science and technology informed tourism experience project, and creative project. Through the importance satisfaction analysis of tourism cultural and creative projects, understand the activation of tourism cultural and creative projects in traditional blocks and the later improvement measures [25].

The data shows that the total average of the respondents to the 9 indicators under the importance category is equal to 4.100, and the total average of the 9 indicators under the evaluation satisfaction category is p equal to 3.300. The point where $i = 4.100$ and $p = 3.300$ is the coordinate origin. Draw the coordinate axis of vertical intersection based on the intersection point, divide the IPA diagram into 4 quadrants, and mark the vertical intersection point of each pair of indicators in the 9 pairs of indicators at the corresponding position in the quadrant, as shown in Figure 5.

As shown in Figure 5, there is one item of architectural culture in the first quadrant. These indicators are the factors that respondents believe are of high importance and satisfaction. According to the IPA analysis model, it shows that for the factors in this quadrant, the respondents believe that these factors are important factors for their evaluation.

The factors in the second quadrant are as follows: opera culture, craft culture, folk culture, food culture, and cultural root seeking. The satisfaction of these five indicators is high, but the importance is not very same, indicating that this indicator is only a basic item in the cognition of the respondents and is not enough to influence their views and cognition of cultural elements.

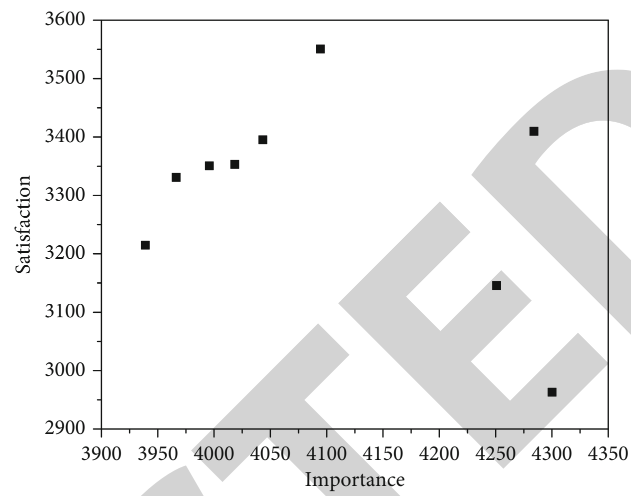

Figure 5: Importance satisfaction (IPA) matrix of tourism cultural and creative projects.

The factor in the third quadrant of the IPA chart is an indicator of religious culture. This quadrant is represented by areas that are not important or satisfied with the survey.

The factors in the fourth quadrant of IPA chart include smart tourism body and creative tourism projects. These two factors are that the respondents think they are very important, but they are actually dissatisfied. The large difference between expectation and perception indicates that these two factors are significant factors affecting patient satisfaction. According to the IPA analysis method, this is a project that managers need to focus on correcting.

5. Conclusion

This paper takes a traditional block as the research object, discusses the activation mode of tourism cultural and creative projects through IPA research method, and provides a new perspective for the activation and development of tourism cultural and creative projects in traditional blocks. The conclusions are as follows:

(1) Among the cultural elements of traditional blocks, most of them are in the state of shallow development. Through the IPA model analysis of cultural elements, it is concluded that traditional architecture, traditional performance, traditional art, traditional skills, dialect, festivals, and diet are the factors with high importance and high satisfaction; life customs are the factors with high importance but low satisfaction, which need to be improved. Traditional blocks should strengthen the activation of the experience of life and customs elements on the basis of strengthening architectural transformation and traditional festival performances

(2) Through the importance satisfaction analysis, smart tourism projects and creative tourism projects are the types of tourism cultural and creative projects that the respondents think are very important but

are actually dissatisfied with. There are great differences between expectations and perceptions, which are the projects that managers should focus on improving

(3) The activation path of tourism cultural and creative projects in traditional blocks of Wudian city is constructed. The activation starts from two aspects: ontology activation and tourist experience activation. Ontology activation includes environmental regeneration, ontology restoration, and interpretation visualization. Tourist experience activation includes traffic construction, functional innovation, and industrial adjustment

At present, the cultural and creative project of the block is still in its infancy, and there is still much room for improvement in the project planning. Cultural and creative tourism is a new form of tourism that breaks the traditional tourism model. The concept of cultural and creative project activation is introduced into the project development of traditional blocks, which enhances the attraction of blocks and the influence of cultural brands.

Data Availability

The data used to support the findings of this study are available from the corresponding author upon request.

Conflicts of Interest

The author declares no conflicts of interest.

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Retraction

Retracted: Recognition of English Vocabulary and Speech Corpus Based on Computer Image Processing

Wireless Communications and Mobile Computing

Received 18 July 2023; Accepted 18 July 2023; Published 19 July 2023

This article has been retracted by Hindawi following an investigation undertaken by the publisher [1]. This investigation has uncovered evidence of one or more of the following indicators of systematic manipulation of the publication process:

(1) Discrepancies in scope
(2) Discrepancies in the description of the research reported
(3) Discrepancies between the availability of data and the research described
(4) Inappropriate citations
(5) Incoherent, meaningless and/or irrelevant content included in the article
(6) Peer-review manipulation

The presence of these indicators undermines our confidence in the integrity of the article's content and we cannot, therefore, vouch for its reliability. Please note that this notice is intended solely to alert readers that the content of this article is unreliable. We have not investigated whether authors were aware of or involved in the systematic manipulation of the publication process.

Wiley and Hindawi regrets that the usual quality checks did not identify these issues before publication and have since put additional measures in place to safeguard research integrity.

We wish to credit our own Research Integrity and Research Publishing teams and anonymous and named external researchers and research integrity experts for contributing to this investigation.

The corresponding author, as the representative of all authors, has been given the opportunity to register their agreement or disagreement to this retraction. We have kept a record of any response received.

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[1] X. Sun, "Recognition of English Vocabulary and Speech Corpus Based on Computer Image Processing," *Wireless Communications and Mobile Computing*, vol. 2022, Article ID 3992955, 7 pages, 2022.

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Research Article

Recognition of English Vocabulary and Speech Corpus Based on Computer Image Processing

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In order to solve the problem that the function and performance of traditional systems in English machine translation cannot meet the needs of intelligence, the author proposes an English vocabulary and speech corpus recognition system based on computer image processing. On the basis of designing the overall structure of the system, the hardware structure is designed by designing the server and translator. In the software design, the semantic features of the input English sentences in human-computer interaction are analyzed by using the enhanced algorithm, the decoding algorithm is designed according to the analysis results, and the English machine translation model is constructed. Experimental results show that when the number of sentences translated by this system is from 100 to 1000, the BLEU indicator keeps rising from 7 to 10. The English vocabulary and speech corpus recognition system based on computer image processing is more efficient.

1. Introduction

With the continuous development of network informatization in recent years, computer technology is gradually applied in various industries. The content of the computer is very broad, and the most widely used is the image recognition technology. Image recognition technology requires that the processing computer has a high configuration, the speed of the computer must meet certain requirements, and it has a large storage space. With the continuous development of network informatization, computer image recognition technology has become more and more widely used, from the initial simple image processing to the current intelligent recognition processing. Nowadays, computer image recognition technology mainly recognizes characters and numbers and can currently recognize three-dimensional images of objects. In the 1950s, computer image recognition was still in digital and word processing; in the late 1960s, people gradually had other ideas for information recognition. On this basis, using computer intelligent processing technology, complex images can be processed. Since the 1970s, the technology of the computer industry has been continuously optimized and reformed and the processing of image recognition technology has developed in a more advanced direction. People have begun to study how to use computers to express the meaning of images and have achieved important results in practical applications. Among them, the most worth mentioning is the vision concept of foreign scholars, which has become the central idea of the computer for more than ten years. In the 1980s, people began to apply image recognition technology to geographic systems to study the automatic generation of massive images. The real development of image recognition processing technology was in the 1990s, and the real leap forward is in the 21st century. At this time, image recognition technology has been widely used and valued in many industries and fields, including medical industry, military industry, and agriculture [1, 2].

2. Literature Review

With the development trend of world integration, the exchanges between countries have become increasingly close and the academic circle has covered all countries in the world.

As a common academic language, English translation quality determines the transmission efficiency of academic ideas and achievements. Traditional pure human translation is too expensive and inefficient to meet the growing demand for translation. In addition, in the era of the Internet of everything, with the vigorous development of artificial intelligence and big data, computer translation has become an inevitable trend of development and it is also a breakthrough for improving translation efficiency. To this end, people put forward new requirements for the current auxiliary translation system [3, 4].

The original intention of people designing machine translation systems is to break the barriers of language communication; in the early days of the computer, its core design idea was to use the speed of computer operations and powerful storage functions to help translators complete complicated translation work, so as to achieve perfect conversion between languages. After the computer is widely used, scientists hope to use the computer to help people break the language barrier; therefore, the machine translation system was born. Nowadays, with the development of economic globalization, the communication and exchanges between people in various countries are becoming more and more close and economic exchanges are becoming more and more frequent and the demand for translation work is gradually increasing, the efficiency is very low, and it is also restricted by the quantity and quality of translation practitioners [5, 6]. Therefore, according to the current situation of economic globalization, an English machine translation system is designed, which frees translators from complicated translation work and engages in more creative and personal hobbies; using the English machine translation system is not only low cost, and the work quality and efficiency are greatly improved. In order to improve the efficiency of real-time sign language recognition, Yang et al. proposed an embedded recognition system based on the STM32 chip; through dual-axis sensors, 3 muscles and 6-channel MMG of the human hand were collected; the characteristics of the STM32 chip, combined with the neural network algorithm, build the embedded recognition system model and import the parameters into the model to realize the transplantation of the algorithm. Experimental results show that the embedded recognition system can realize real-time recognition of more than 50 sign languages, the recognition rate of the model is as high as 99%, and the real-time recognition efficiency can also reach more than 97.6%; the classification time of each action is controlled within 0.55 ms, poor functionality [7]. Navarro et al. proposed a sparse word recognition system using a variety of decoding strategies, using the transformer model to decode and process a variety of data information, reconstruct the words through the encoding program, and identify the translated sentences according to the basic principle of data fusion; the sparse words can greatly improve the efficiency of the translation, but the translation performance is poor [8].

Based on the abovementioned research background, an English machine translation system is designed by using the human-computer interaction enhancement algorithm, so as to meet the functional and performance design requirements of the system.

3. Methods

3.1. System Hardware Design

3.1.1. Overall System Architecture Design. The overall structure of the English machine translation system is mainly divided into the online translation module, dialogue module, English dictionary module, and conversion module. The overall architecture of the system is shown in Figure 1.

The overall architecture diagram of the English machine translation system is mainly divided into two parts, one is the server and the other is the client [9]. Among them, the server is mainly used to complete the conversion process of the English online translation system. The client is a client terminal app, which can also be regarded as a translator, mainly including a Chinese-English translation module, an English dictionary module, and a dialogue module. The architecture of the entire system adopts the CS architecture model to provide customers with real-time and efficient English translation services.

3.1.2. Translation Server Design. The translation server is mainly composed of multiple translation programs, and the process of Chinese-English translation is realized through the web server equipped with Apache. Different translation servers correspond to translation work between different languages; the author's English machine translation server is a distributed English machine translation system built to serve Chinese-to-English translation tasks. The core setting of the English machine translation server is the web server, which manages the client access port through the web server. By building a translation server and a web server to run an English translation server, users can access and query on the client side through the Internet protocol port provided by the web server [10, 11]. The web system in the English machine translation server is a complete web server system, which is mainly developed and designed through PHP, and online English translation is performed through the web server, the multifunctional requirements of the terminal [12].

3.1.3. Translator Design. The construction process of the English machine translator is mainly divided into two steps: The first is the training step. After inputting the source language using human-computer interaction technology, the Chinese-English translation data needed to calculate the high probability is selected from the massive English thesaurus. The second is the decoding step; according to the maximum training data of the high-probability Chinese-English translation data obtained by training, the initial training data is obtained by counting sentences and phrases in the English thesaurus; the decoding process is then used to find the optimal translation result in a large amount of training data. The design principle of the English machine translator is shown in Figure 2.

Through the design of the English machine translation server and translator, the hardware structure of the system is designed.

3.2. System Software Design

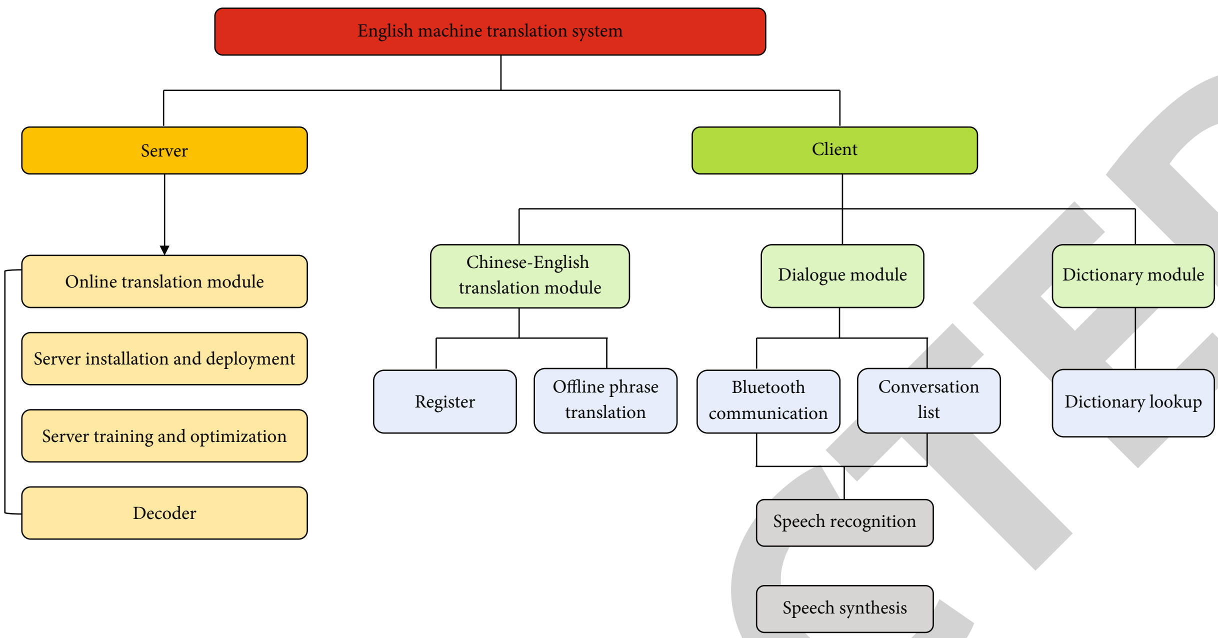

Figure 1: Overall architecture diagram of the English machine translation system.

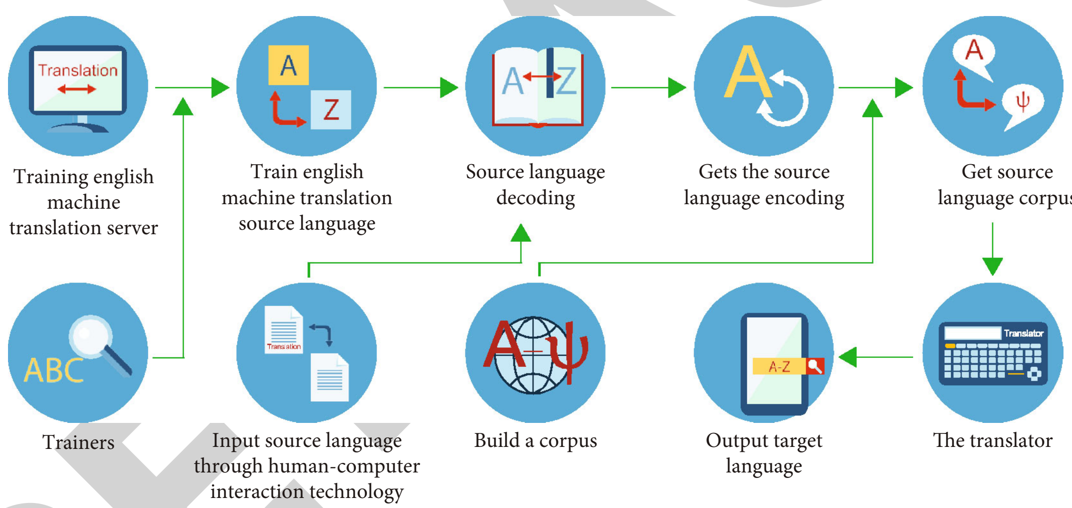

Figure 2: The working principle of the English machine translator.

3.2.1. Analysis of Semantic Features of English Machine Translation. In the client of the overall architecture of the English machine translation system, the English sentences to be translated are obtained by using human-computer interaction technology. On this basis, the enhancement algorithm is used to analyze the semantic features of English sentences [13–15]. The text to be translated is input into the deep structured semantic model, and the mapping of the sentence is completed in the input layer of the model to form a space vector. Then, after the word vector is obtained, it is input into the representation layer of the model and processed by weighted average; the processing steps are as follows:

Step 1. Pooling layer vector calculation.

$$P = W_1 W_2. \tag{1}$$

In formula (1), W_1 and W_2 represent word vectors of two different dimensions, wherein the dimension of W_1 is $n \times m$, and the dimension of W_2 is $1 \times m$. After processing by the pooling layer, a sentence vector can be obtained, that is, $1 \times m$. If ω_i is defined to represent the weight matrix, corresponding to the ith layer of the model and the bias term of the ith layer is represented by b_i, the calculation formula of the hidden layer of the model is as follows:

$$H_i = \omega_i P + b_i. \tag{2}$$

From this, the output result of the semantic feature matching layer of the text to be translated can be obtained as follows:

$$T = \omega_n P_{n-1} + b_n. \tag{3}$$

The T obtained in formula (3) is the semantic feature of the text to be translated after the enhancement processing.

Based on this, on the basis of extracting the English text information in the information source, the semantic similarity of English machine translation phrases M and N is obtained as follows:

$$\operatorname{Sim}(M, N) = \operatorname{Cos}(M, N) = \frac{D(M) \cdot D(N)}{|D(M)| \cdot |D(N)|}. \tag{4}$$

Through the semantic structure reconstruction method, the analysis of the ontology structure of English machine translation is realized and the English semantic mapping definition D is obtained; the similarity between the word information and the semantic type of the English machine translation system is described as follows:

$$t_{x,y}(u) = \frac{p_{x,y}(u) - sp_{x,y}(u)}{p_{x,y}(u)}. \tag{5}$$

The English machine translation word matrix T_w and the similarity English translation semantic matrix T_B are solved, and calculation formulas (6) and (7), respectively, are as follows:

$$T_w = \sum_{x=1}^{K} \sum_{y=1}^{K_i} \left(\beta_{xy} - \beta\right) \left(\beta_{xy} - \beta\right)^K, \tag{6}$$

$$T_B = \sum_{x=1}^{K} \left(\beta - \beta_{xy}\right) \left(\beta - \beta_{xy}\right)^k. \tag{7}$$

The optimal context of the semantic relevance matrix T_w and T_B is described as γ, f is used to measure the contextual relevance between semantics, and β represents the semantic mapping process [16].

Through the abovementioned solution results, the semantic features of English machine translation are obtained and relevant evaluations are obtained by performing irregular analysis on them. Assume that the semantic evaluation set of the English machine translation system is $\beta \in [0, T)$, the number of two ontology label evaluation sets S satisfying the rule vector is k, and then, the semantic feature vector β of the English machine translation system can be expressed by formula (8) as follows:

$$\Delta(\beta) = \begin{cases} t_k, K = \operatorname{round}(\beta), \\ b_i = \beta - k, b_k \in [-0.5, 0.5). \end{cases} \tag{8}$$

Among them, round is the semantic feature attribute set of English machine translation, which is used to describe the BinarySplits vector, realizes the screening and analysis of semantic features through the mapping method of semantic features, constructs the English translation database, and realizes the analysis of the semantic features of English machine translation combined with the subject headings.

3.2.2. Design Decoding Algorithms. English machine translation decoding is a decoding calculation process for all known parts of the English vocabulary that need to be translated. According to the current state t_j of the English machine translation decoder, the conditional probability of the jth English translation target word can be obtained; calculation formula (9) is as follows:

$$Q\left(z_j \middle| z_{j-1}, y\right) = h\left(t_j\right). \tag{9}$$

In formula (9), h is the nonlinear function of English machine translation and t_j is expressed by the following formula:

$$t_j = g\left(z_{j-1}, t_{j-1}\right). \tag{10}$$

Through the human-computer interaction enhancement algorithm, the known English machine translation decoding target vocabulary is the output and the translation output is obtained. The flow chart of the English machine translation decoding algorithm is shown in Figure 3. According to the abovementioned process, an English machine translation decoding algorithm is designed.

3.2.3. Building an English Machine Translation Model. According to the above-designed English translation machine server, the information source text is collected and the neural network is used to convert the vector. Then, information source input text expression (11) of English machine translation is obtained as follows:

$$Y = \{y_1, y_2, y_3, \cdots, y_n\}. \tag{11}$$

Among them, the number of words in English machine translation is n; in the initial stage of translation, the translator translates all words $y_i (i \in n)$ of the information source text information and obtains the corresponding English phrase links, such as formula (12) as follows:

$$E_{ij} = \frac{S_*}{E_\kappa} \cdot (U \times U_i) j. \tag{12}$$

Among them, S_* represents the basic criteria of English machine translation and E_κ represents the semantic feature module. U represents the information source word set, U_i represents the segmented information source words, and j represents the Chinese-translated phrase sequence.

The main semantic role of English machine translation is defined as $\varphi(t)$, and the translation of the English phrase set is selected, such as formula (13) as follows:

$$T_{\mathrm{aw}} = \frac{r_i \cdot \varphi(t)}{q(o)} \times \mathrm{SC}(o). \tag{13}$$

In the abovementioned formula, r_i represents the word modifier of English machine translation, $\mathrm{SC}(o)$ represents the number of semantic blocks of English machine

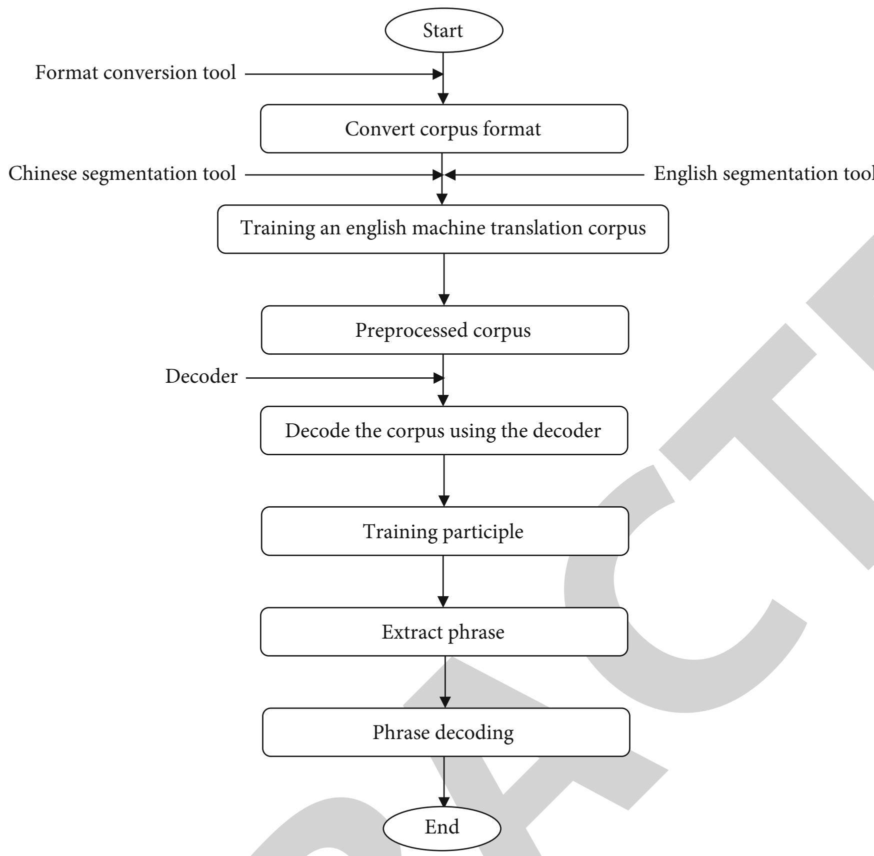

Figure 3: Flowchart of the English machine translation decoding algorithm.

translation, and $q(o)$ represents the recognized prepositional phrase.

Suppose, nf represents the word frequency of English machine translation, which is mainly used to express the number of occurrences of words in the process of English machine translation, and idf represents the frequency of document translation; formula (14) can be used to obtain the feature weight function of English machine translation:

$$\mathrm{Weight}_{\mathrm{nfidf}(t)} = \frac{\mathrm{nf}(t) \times \mathrm{idf}(t)}{f_i(n)}. \tag{14}$$

The gain information value of English machine translation text information is obtained by formula (15), namely,

$$G(Y, z) = \frac{H(Y) - H(Y|z)}{\mathrm{idf}(t)}. \tag{15}$$

In formula (15), $H(Y)$ represents the text information of English machine translation and $H(Y\,|\,z)$ represents the gain relationship between each information group in the information source.

Defining the semantic features in the English translation process as ϑ^{ν}, formula (16) can be used to complete the construction of the English machine translation model, namely,

$$WF_y = \frac{\vartheta^{\nu} \cdot I(F) \cdot S}{\psi^*} \bar{F}_{\gamma} \bar{\omega}. \tag{16}$$

In formula (16), $\bar{\omega}$ represents the redundancy of English translation, I represents any entry in the English machine translation dictionary, and ψ^* represents the value of the translation entry under different grammatical conditions. To sum up, by designing the English machine translation decoding algorithm, the English machine translation model is constructed and the system software design is realized.

3.3. System Test. In order to verify the practical application effect of the English machine translation system based on the above-designed human-computer interaction enhancement algorithm, the following test process is designed [19, 20].

3.3.1. Test Processing. The system test dataset comes from the Chinese-English parallel corpus in the United Nations Corpus, from which 100000 sentences are randomly selected as the training corpus and 11000 sentences are randomly selected as the test corpus. The relevant information of the test corpus is shown in Table 1.

The human-computer interaction enhancement algorithm is used to process the corpus as follows:

Table 1: Relevant information of the test corpus.

	Training set	Test set
Number of sentences	100000 sentences	1000 sentences
Average length of sentences in the source language	18.46	28.17
Average length of target language	25.35	32.94
The vocabulary size of the source language	47583	2382
The vocabulary size of the target language	29784	3168

Table 2: Parameter settings.

Parameter name	Parameter value
Word vector dimension	800
Source language vocabulary	6000
The number of target language vocabulary	5000
The number of human-computer interaction nodes	2048
Number of sentence frames	12
Human-computer interaction frequency	1200 Hz

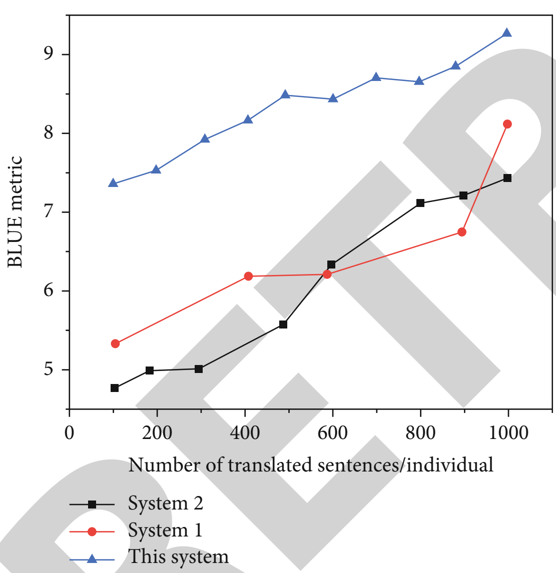

Figure 4: BLEU indicator test results of different systems.

(Step 1) On the basis of the divide and conquer method based on the neural network, use the human-computer interaction enhancement algorithm to analyze the phrase structure of Chinese sentences with a length greater than 15

(Step 2) For the implementation method of multisequence encoding, use language technology platform tools to perform word segmentation processing on Chinese sentences in the corpus and mark the part of speech and dependency analysis of Chinese sentences [17]

(Step 3) According to the analysis results of the phrase structure of the Chinese sentences, extract the part-of-speech sequence and the hypernym sequence of the Chinese sentence from the Chinese sentences in the corpus and form a complete set of part-of-speech sequences and hypernym sequences

3.3.2. Set Test Parameters. On the basis of corpus processing, the relevant parameters of system testing are set by using the open-source code, as shown in Table 2.

3.3.3. Performance Comparison Test. In order to further verify the application effect of this system, it is compared with the traditional real-time translation system (system 1) based on STM32 chip embedded recognition and the neural machine translation system (system 2) based on the fusion of various data generalization strategies. In the comparative test, the BLEU index is used to measure the quality of translations of different systems. The larger the BLEU value, the better the quality of the translation obtained by the system; the BLEU indicator calculation formula (17) is as follows:

$$\mathrm{BLEU} = \varphi \times \exp \sum_{i=1}^{n} w_i \log_{10} p_i. \tag{17}$$

In formula (17), φ represents the penalty factor, w_i represents the weight of cooccurrence i-grams, and p_i represents the accuracy of i-grams.

4. Results and Discussion

The test results in Figure 4 show that, compared to the two conventional systems, the BLEU index of this system has always been maintained at a higher level, indicating that the translation quality obtained by this system is higher. This is because in the client of the overall architecture of the English machine translation system, the human-computer interaction technology is used to obtain the English sentences to be translated [18]. The semantic features of English sentences are analyzed using enhanced algorithms. The text to be translated is input into a deep structured semantic model, and its semantic features are enhanced through mapping processing and weighted average processing, thereby effectively improving the translation quality.

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Retraction

Retracted: Application of Intelligent Recognition Technology in Recognition of Mechanical Material Structure

Wireless Communications and Mobile Computing

Received 18 July 2023; Accepted 18 July 2023; Published 19 July 2023

This article has been retracted by Hindawi following an investigation undertaken by the publisher [1]. This investigation has uncovered evidence of one or more of the following indicators of systematic manipulation of the publication process:

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We wish to credit our own Research Integrity and Research Publishing teams and anonymous and named external researchers and research integrity experts for contributing to this investigation.

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[1] X. Zhang, C. Wang, T. Wu, and Y. Wang, "Application of Intelligent Recognition Technology in Recognition of Mechanical Material Structure," *Wireless Communications and Mobile Computing*, vol. 2022, Article ID 8909122, 7 pages, 2022.

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Research Article

Application of Intelligent Recognition Technology in Recognition of Mechanical Material Structure

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In order to solve the related problems of mechanical material structure identification, the author proposes a method that integrates intelligent identification technology into mechanical material identification. Intelligent image recognition technology is based on image features, focusing on the main features of each image, and eliminates redundant input information, finds the key information needed, and completes the sorting of image information in stages to form a complete intuitive image. The experimental results show that the proposed method performs well in most cases, reaching 90.8% for coarse classification, 76.6% for medium classification, and 73.4% for fine classification. It is proved that artificial intelligence recognition technology is of great significance for the application of mechanical material structure recognition.

1. Introduction

Artificial intelligence is a branch of computer science and technology, and it is currently the most representative technology in this field; it tries to understand the essence of intelligence and make similar intelligent machines by simulating human thinking and consciousness [1, 2]. Virtual reality technology, simulation technology, speech recognition technology, etc. are all research contents of artificial intelligence. It can also be seen from this that artificial intelligence is also a comprehensive and practical technology.

First of all, the budding stage of artificial intelligence is precisely the stage of computer technology, because the computer technology at this time has just emerged, and it has only been applied in a limited field and has not yet been popularized. At this stage, the production mode of society mainly relies on manual work, and artificial intelligence technology has begun to appear, but it has not been able to play a greater role in production and life [3, 4]. Secondly, electronic information technology has developed rapidly, and the shadow of the Internet can be seen in people's study, life, and work. People have some understanding of artificial intelligence, but the degree of cognition is not deep, and the technology has not been widely and profoundly applied in various fields. But with the improvement of people's ideology, people have gradually realized the importance of artificial intelligence technology, which is developing rapidly. Finally, in the stage of popularization of artificial intelligence technology, although artificial intelligence technology is applied in production and life, the application of technology is not deep and proficient enough, and it has not been applied on a large scale [5].

Mechanical design, manufacturing, and automation are a highly integrated discipline with mechanized engineering as its core and also integrate automation, electronic engineering, and computer disciplines; this technology has a wide range of applications in the field of production. Especially with the development of science and technology and economy, this technology has been widely used in large industrial enterprises. With the development and update of network information technology, mechanical design, manufacturing, and automation will also penetrate into people's life field, which will facilitate people's life and promote the development of society.

The pace of science and technology is advancing rapidly, which has caused great changes in social production and people's lives, the production efficiency is getting higher and higher, and the pace of life is gradually accelerating. The application of artificial intelligence technology in the field of mechanical design, manufacturing, and automation, such as the use of information processing, fault diagnosis, and the use of neural networks for data storage and calculation, can effectively improve its work efficiency and quality and promote its development towards more intelligent development. From another point of view, mechanical design and manufacturing and automation also provide a platform and opportunity for artificial intelligence technology, and the two promote and develop each other.

2. Literature Review

With the rapid economic development and the continuous improvement of scientific and technological level, the research on the development and application of computer technology has become the focus of scholars. In particular, the research on artificial intelligence recognition has become more and more in-depth, and its application has become more and more extensive. The application of artificial intelligence recognition technology not only improves the efficiency of production but also provides convenience for people's production and life.

Intelligent identification technology is based on computer systems, scanning equipment, and camera equipment to intelligently identify the data information of the target [6]. The current artificial intelligence recognition technology is gradually developed from the speech recognition technology. Now, a number of intelligent recognition methods have been formed, such as face recognition, image detection, image retrieval, target tracking, and style transfer. The emergence of these intelligent identification technologies has improved people's quality of life, reduced people's workload, and improved the efficiency of production and life, which is of great significance for promoting the development of modern technology.

Image recognition technology is an important field and branch of computer artificial intelligence technology. Its core is to perform corresponding object recognition on images in order to distinguish between targets and objects in different modes [7]. In terms of development, image recognition technology has gone through three stages. They are text recognition, image processing and recognition, and object recognition. Through the corresponding processing and analysis of the image information, the research objectives we need are obtained. Today, image recognition is not only recognized by the naked eye but also recognized by computer which is an important recognition method. In the recognition principle, the computer image recognition technology is the same as the human customer's naked eye recognition. Image recognition by humans is based on the characteristics of the image itself, in order to identify the image. When we see a picture, our brain will quickly respond to the picture we know and classify and recognize and store memory. Artificial intelligence image recognition technology is based on image features, pays attention to the main features of each picture, eliminates redundant input information, finds the key information needed, and completes the sorting of image information in stages to form a complete intuitive image. In the process of artificial intelligence image recognition, pattern recognition is the key. Pattern recognition is to analyze and process the confidence of different forms of things, so as to realize the description, identification, and classification of a thing or phenomenon. As shown in Figure 1, it is a complete image recognition process.

Every object is made of one or more materials, and one can basically get a good idea of what it is made of just by glancing at it. People can easily judge whether the table they see is made of wood, whether the computer is made of metal, and whether the carpet is made of soft fibers; this ability to identify and distinguish materials and their properties is called material perception. Human perception of materials is obtained through a multitude of sensory organs such as hearing, sight, and touch. The material perception system based on computer vision mainly uses computer technology to process and analyze the image of the target object, obtain an understanding of the types and properties of materials, and provide the basis for analysis and judgment for subsequent actions or operations. The research on material visual perception technology is of great significance; for example, when operating a target object, the robot system needs to adaptively grasp the target object according to its physical properties such as weight, surface roughness, and softness. The robot judges whether the road is smooth during the navigation process and judges whether the food and fruit are fresh during the production process. Through the material visual perception technology, the robot can perceive the surrounding environment and interact like a human and adopt different action strategies according to different materials, such as intelligently avoiding the sharp edges of blades or broken glass, but not so sensitive to the corners of clothes. Be more careful when handling fragile ceramic cups than plastic ones. Initially, some researchers used manually selected features (such as color and SIFT) to provide standard classifiers. Based on this material identification system, Jia et al. downloaded 1000 images (including 10 materials, each the material contains 100 images) to build the Flickr material database (FMD). This database became the classic database for human and computer identification materials [8]. Liu et al. used crowdsourcing technology to build a database of materials in natural environments, which consisted of 23 materials containing 3 million hand-marked area pictures. There is no doubt that with the establishment and improvement of the material recognition database, the development of material visual perception will be promoted [9]. Yao et al. believed that the inherent characteristics of illumination will affect the surface gloss estimation ability [10]. Sáez et al. have experimentally demonstrated that surface gloss perception is spatially distributed inconsistently, and it suffers from specular highlights. For semitransparent materials like jade and porcelain, information such as specular highlights, render shading, and background has a

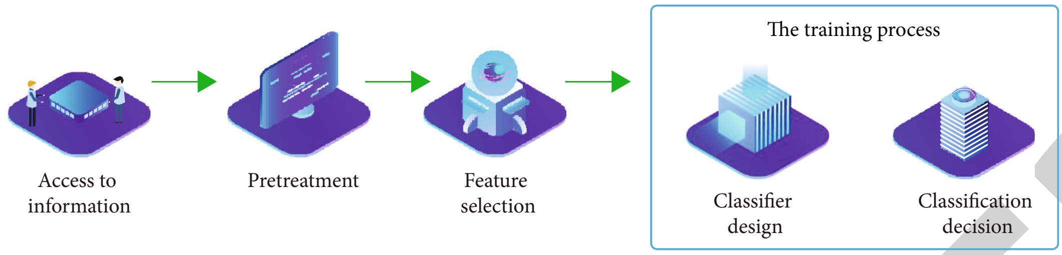

Figure 1: Complete image recognition process.

greater impact on glossiness estimation [11]. Parvini et al. emphasized the influence of geometric shape on intensity gradients, and the human visual system encodes changes in the geometric surface normal of an object into a rate of intensity change [12]. Gupta et al. simulated glassy pebbles in front of a textured background; maximum likelihood difference scaling (MLDS) is used to measure how the refractive index changes under changing conditions of the physical refractive index. They discovered a nonlinear compression function; this function has a strong correlation with the degree of background texture distortion caused by refraction [13].

In the field of computer vision research, the research on visual perception of mechanical material structures is far behind object recognition, both in terms of recognition accuracy and the number of research literature. Compared with object recognition, face recognition, and scene recognition, the research on visual perception of mechanical material structure is in the initial stage, and researchers are applying conventional methods to visual perception of mechanical materials. According to the characteristics of mechanical materials, the author proposes a novel and effective method to extract the robust features of materials, which is still a very challenging topic; therefore, the author will propose the application of intelligent recognition technology in mechanical material structure recognition. Figure 2 shows the image recognition technology.

3. Methods

3.1. Material Visual Perception System. In the computer vision system structure, the general processing flow is from image acquisition to image processing to image recognition. The process of material visual perception system is basically the same as the above; the difference is that image processing is divided into low-level image processing, intermediate image processing (estimating material properties), and high-level image processing (high-level feature space).

3.2. Research Status of Visual Perception of Materials. According to different research directions, the research methods of material visual perception can be divided into two categories: material identification and classification and material properties and parameter estimation. Material identification and classification is top-down, that is, using object identification methods to identify materials and infer their properties and parameters. For example, when people identify the target object as a glass, its transparency, hardness, roughness, and other information can be inferred. On the contrary, the estimation of material properties and parameters is bottom-up; that is, the material properties and parameters are obtained by intermediate image processing and then the material is identified, such as transparency, hardness, roughness, and other property information to identify whether the target is glass. These two approaches are not mutually exclusive, but mutually reinforcing.

3.2.1. Mechanical Material Identification and Classification. One of the main functions of visual perception of materials is to identify and classify them. However, there are still problems in the identification of materials by the existing methods of target recognition and scene recognition. There is no one-to-one mapping between object types and material types, especially man-made products, although currently in object recognition, the recognition success rate of computer vision surpasses that of humans, but in terms of material recognition, the performance of computer vision is far inferior to that of humans. Some researchers believe that the reason why material recognition lags behind object recognition may be the lack of training databases. Table 1 shows the databases for material identification created by researchers in recent years, among which CUReT and KTH-TIPS are mainly used for material property and parameter estimation.

3.2.2. Material Properties and Parameter Estimation. Invited some volunteers, experiment on a subset of FMD, neither of these volunteers was explicitly told that the pictures were from different categories, there was also no requirement to categorize the materials, but they were 90 percent correct on nine attributes that help material identification. This shows that pictures can be used for accurate material identification, and material properties are closely related to material types. Using the method of classification and identification to classify materials (wood, leather, glass, plastic, etc.) cannot reflect the rich subjective feelings of human beings to materials. Computer pattern recognition technology assigns corresponding boundaries and labels to images; this makes them ignore most of the material's sensory characteristics, yet it is these sensory characteristics that make different materials attractive, precious, and distinctive. Human visual perception of materials is the perception of certain inherent properties and parameters of objects (reflectivity, stiffness, and translucency), which are called material properties and parameter estimation. The estimation of material properties and parameters can be roughly divided into two categories: estimation of optical properties of

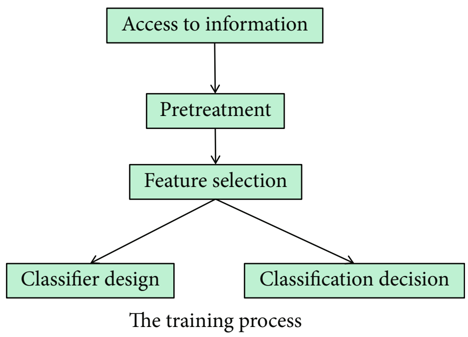

Figure 2: Image recognition technology.

Table 1: Material identification database.

Database	Creator	Creation time	Number of pictures/piece	Type of material
CUReT	Dana	1999	12505	61
KTH-TIPS	Hayman	2004	810	10
FMD	Sharan	2009	1000	10
MINC	Bell	2015	3000000	23
GMD	Wieschollek	2016	10000	10

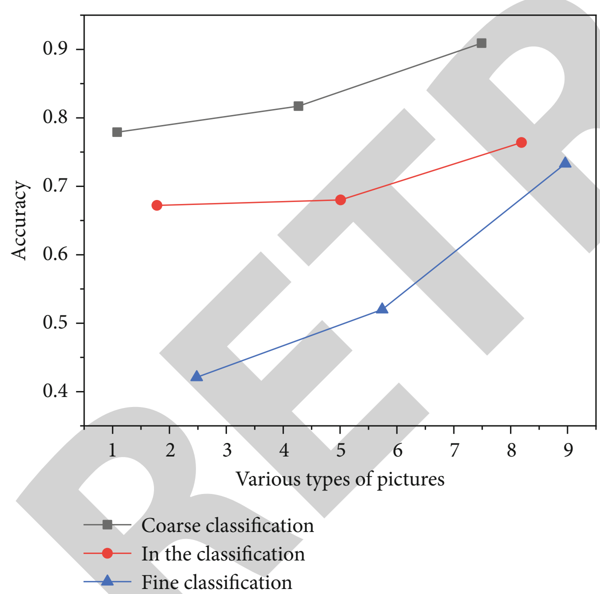

Figure 3: Experimental results.

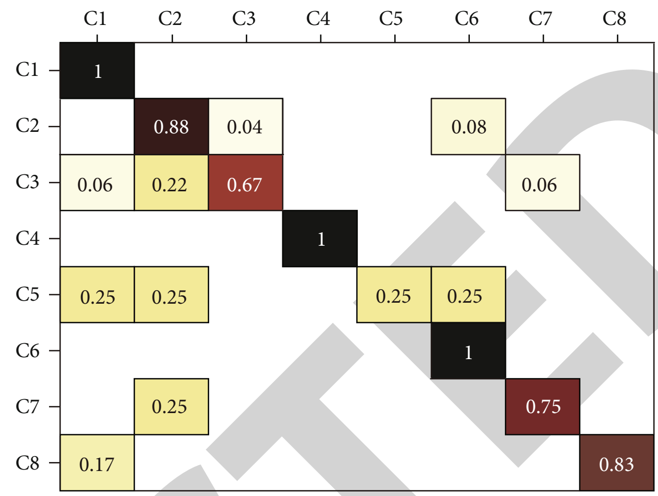

Figure 4: Confusion matrix of coarse classification and recognition results.

materials, such as surface reflectance, gloss, and transparency, which are currently studied, and mechanical properties of materials, such as viscosity and elasticity.

3.2.3. Optical Property Estimation of Materials. When light hits the surface of an object, the light may be absorbed, reflected, or transmitted, and different objects exhibit different optical properties. For opaque objects, the light propagation characteristics can be described by the bidirectional reflection distribution function (BRDF) [14]. The distribution function (1) describes the distribution of the reflected light at various angles after the incident light is emitted. BRDF is defined as

$$f(l,v)=\frac{dL_0(v)}{dE(l)}\Rightarrow f(\theta_i,\varphi_i,\theta_r,\varphi_r)=\frac{dL_0(\theta_r,\varphi_r)}{dE(\theta_i,\varphi_i)}, \quad (1)$$

where l is the incident light direction, v is the viewing direction, $dL_0(v)$ is the differential radiance of the reflected light reflected from the surface to the v direction, and $dE(l)$ is the differential irradiance on the surface from the incident light direction l. The original model of the bidirectional reflection distribution function has many variables, and an approximate analytical model containing some variables is often used to replace the original model in the actual processing process.

At present, research on the optical properties of materials mainly focuses on the perception of surface reflectance. Surface reflectance perception is the process of estimating unknown parameters in the bidirectional reflectance distribution function from photographs [15]. However, it is still unclear which parameters are inferred by humans and how many parameters are used, most research works only consider those simple picture information, and some recent studies have begun to consider picture information that can better express the real world. Pictures of real objects and pictures synthesized with image software are used to identify real materials. Studies have shown that image information such as the shape of a grayscale image of light is closely related to the reflectance of diffuse and specular reflections [16].

Only opaque objects have been discussed above; however, people often encounter transparent objects such as glass, water, jam, and crystal in real life [17, 18]. These

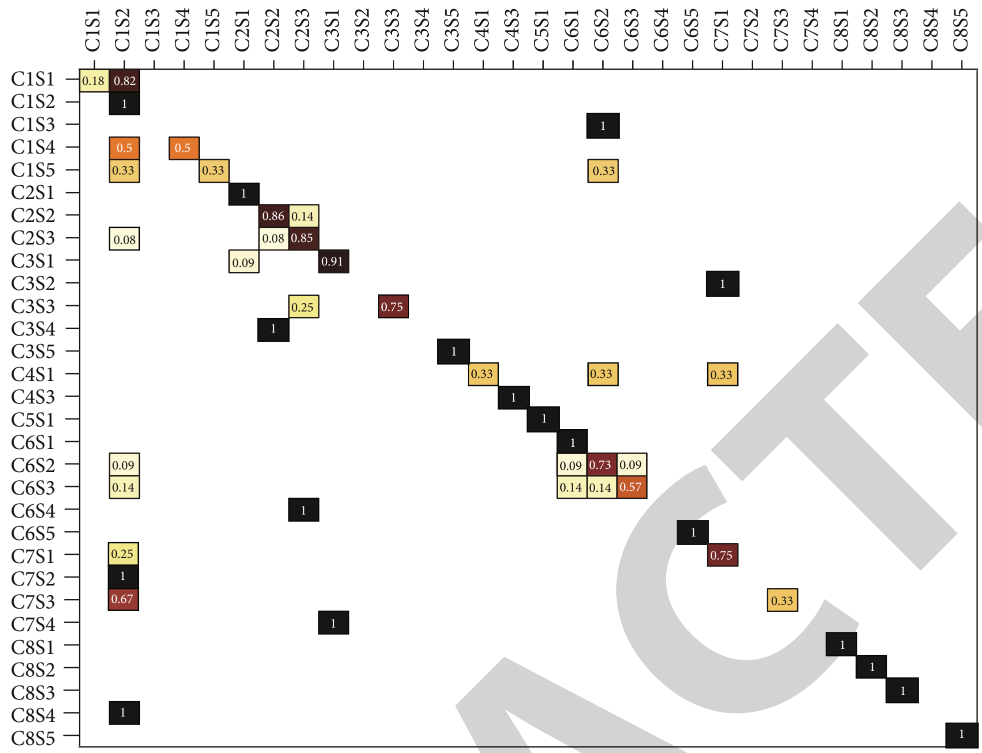

Figure 5: Confusion matrix of classification and recognition results.

transparent objects cannot be described by BRDF, because for transparent objects, light incident from point A will be emitted from other points. This property of transparent objects can be described by a bidirectional surface scattering distribution function model. Since these objects are all optically denser than air, this will result in (a) specular emission, which makes most transparent objects appear glossy [19], and (b) refraction, a feature that makes the internal visible view of a transparent object appear fragmented or distorted. When the transmitted light is transmitted into the interior of the object, part of it is dispersed and part is absorbed [20]. Scattering fills the interior of the material with light, making the background pattern invisible and causing the material to exhibit a unique milky, slightly luminous, translucent appearance, such as marble and jade [21].

Most studies on transparent materials idealize the object as a transparent filter sheet, so that refraction and scattering effects can be ignored [22]. When viewing the surface through the filter, the resulting image patch is the result of a fusion of the background and filter colors [23].

4. Results and Discussion

In the experiment, there are a total of 736 training samples and 184 test samples, the classification experiments are carried out at three levels of coarse, medium, and fine; the results of a single random experiment are shown in Figure 3. The proposed method performs well in most cases, reaching 90.8% for coarse classification, 76.6% for medium classification, and 73.4% for fine classification. GKSC has better performance than KNN, and in medium classification experiments, the performance of GKSC is similar to KNN [24]. However, in most cases, the performance of both KNN and GKSC degrades as the classification accuracy increases. An obvious reason is that the total number of samples is fixed, and as the degree of refinement of the classification increases, the number of categories also increases. In addition, the confusion matrix of the coarse recognition result is shown in Figure 4; it can be observed that the main part of identification errors occurred during the identification of C5 and C3, where 75% of the test samples for C5 were incorrectly identified as C1, C2, and C6. In medium classification, the confusion matrix is shown in Figure 5; it can be clearly observed that due to the improvement of the recognition precision, the recognition error rate has increased compared with the rough classification, especially in the recognition process of C8S1, C8S4, C7S2, C3S2, C3S4, C1S3, and other categories; the error rate is higher [25].

5. Conclusion

The author proposes an intelligent recognition technology, and the technology is applied to the identification of mechanical material structure. In the process of artificial intelligence image recognition, pattern recognition is the key, and pattern recognition is to analyze and process the confidence of different forms of things, so as to realize the description, identification, and classification of a thing or phenomenon. With the continuous improvement of economic level and science and technology, the application of artificial intelligence identification technology is becoming more and more extensive, so the research on artificial intelligence identification technology is of great significance to improve the quality of people's production and life.

Data Availability

The data used to support the findings of this study are available from the corresponding author upon request.

Conflicts of Interest

The authors declare that they have no conflicts of interest.

Acknowledgments

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Retraction

Retracted: Heterogeneous Cluster Application Communication Optimization and Computer Big Data Management

Wireless Communications and Mobile Computing

Received 18 July 2023; Accepted 18 July 2023; Published 19 July 2023

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The presence of these indicators undermines our confidence in the integrity of the article's content and we cannot, therefore, vouch for its reliability. Please note that this notice is intended solely to alert readers that the content of this article is unreliable. We have not investigated whether authors were aware of or involved in the systematic manipulation of the publication process.

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Research Article

Heterogeneous Cluster Application Communication Optimization and Computer Big Data Management

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In order to adapt to the constantly updated heterogeneous hardware and super-large-scale parallel computing environment and solve the problems of low programming level and difficult development, modification, and debugging of commonly used solutions, the author proposes a method for application communication optimization and computer big data management based on heterogeneous clusters. A new language mechanism is introduced to describe the multidimensional rule structure, arrangement, and communication mode of data and threads; and a software migration and optimization method between different types of heterogeneous systems based on the new language mechanism is proposed. And take direct method turbulence simulation as an example. Experimental results show that based on the Parray mechanism, it took only one week to complete the rapid migration of turbulence simulation applications on the Tianhe 1A system, and it was successfully run on a scale of 8192 cubic meters. *Conclusion*. The method realizes communication optimization and fast porting in different heterogeneous systems.

1. Introduction

In recent years, deep training has been successfully implemented in various skills such as drawing and natural language processing, as shown in Figure 1. The time is very long, usually days or even weeks, and in order to improve the positioning of the deep training standard, the measurement of data is too numerous, the time required for training also increases, and the computing power of the computer is limited and cannot be satisfied on demand. In order to improve the efficiency of system training, distributed training has been carried out on the cluster in recent years, and the training process on the original single machine is distributed to multiple machines for parallel execution, which improves the processing speed of data samples and greatly shortens the training time, for example, recently, HUAWEI CLOUD ModelArts used 16 nodes and 8 v100 GPUs per node to train ResNet-50 in a cluster distributed manner, and it only took 10 minutes and 28 seconds to converge on the ImageNet dataset. Distributed deep learning is a necessary means to cope with the increasing scale of data and models, becoming a key issue in both academia and industry [1].

When performing distributed training in a heterogeneous cluster, due to the large differences in computing and network performance of different machines, the iteration time of different worker nodes under the same workload will also vary greatly. When using the BSP algorithm, since each iteration needs to wait for all worker nodes to complete, the performance of distributed training is limited by the slowest worker node [2]. When using the ASP algorithm, each worker node updates parameters independently, and after completing some iterations, it can start the next iteration without waiting for other worker nodes, but this will make each worker node train based on different parameters, especially when some worker nodes are significantly slower than others, the slow worker nodes have completed multiple iterations and updated parameters during one iteration, while the slow worker nodes still calculate based on the old parameters before, however, the gradient update parameters obtained by training with outdated parameters will cause the parameters to deviate from the optimal solution, resulting in incorrect convergence, thereby slowing down the convergence speed [3].

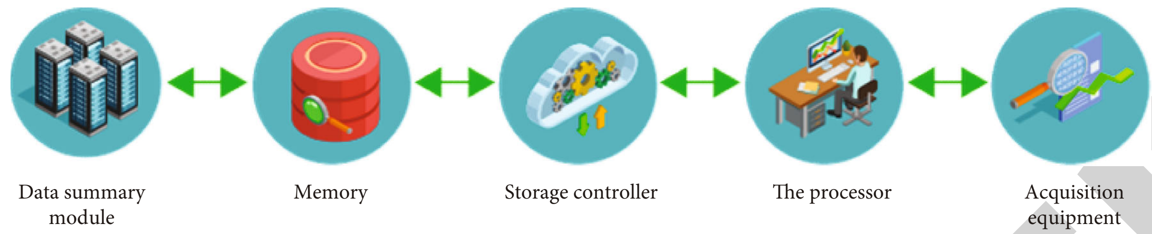

Figure 1: Flowchart of computer big data management.

Table 1: Features of existing cluster programming languages.

Language	Accomplish		Address space		Control		
	Language	Library	Global	Local	Cluster	Multicore	Many core
Chapel	√		√		√	√	
CAF	√		√		√		
HPF	√		√		√		
HTA		√	√		√	√	
MPI/PVM		√		√	√		
Titanium	√		√		√		
UPC	√		√		√		
X10	√		√		√	√	
ZPL	√		√		√		

2. Literature Review

Wang et al. created a software library capable of supporting C++ applications, using a hybrid implementation of the MIC coprocessor, communicating with SCIF for data transfer and synchronization. Although COI and SCIF have their own research work and programming guidance, so far, no researchers have proposed a programming method that uses COI and SCIF mixed. Many core algorithmic programs and real-world applications have been studied on MIC coprocessors [4]. Jayakumar et al. summarized the key techniques for obtaining high performance of MIC coprocessing [5]. Xu et al. ported an existing scientific computing application and a number of microkernels to a single MIC coprocessor [6]. Li et al. developed a SIMD molecular dynamics application on a single MIC coprocessor [7]. Goldenberg et al. accelerated large-scale sparse linear system iterative algorithm PQMRCGSTAB, image and video compression IDCT algorithm, molecular dynamics simulation application, etc. on MIC coprocessing and studied the automatic conversion method and optimization of offload code from OpenACC to Intel offload mode method [8].

In terms of programming framework research, Bachiller et al. proposed the Uintah software computing framework and solved the interaction problem of solving multiple fluid structures on an adaptive structured grid [9]. For Uintah, the problem of solving complex multiscale and multiphysics fields is studied, by integrating various simulation components, users can describe the dependencies between components through DAG diagrams, automatically generate parallel code and handle load balancing. The fluid structure joint interaction simulation (Uintah AMR MPMICE) is carried out on Stampede accelerated by coprocessing, by using peer-to-peer MPI communication, the MPI process is run separately on the host CPU and the coprocessor, the device is regarded as an independent node, and it performs cooperative calculation through MPI communication. The MPI process on the device develops CPU multicore or coprocessor many-core parallelism through Pthreads multithreading. The host side of each node in this study starts an MPI process, each MPI process develops sixteen Openmp threads, and the coprocessor side is Two MPI processes, and each MPI process develops sixty OpenMp threads. The application scales up to sixteen nodes, each with a MIC coprocessor. However, Uintah has a load imbalance problem on heterogeneous systems and even affects computing performance in nearly 60% of cases.

Taking the direct turbulence simulation method as an example, the author discusses the new software that should be used in this calculation from the perspectives of software compatibility, programming process, algorithm design and implementation, and software support and provides experience in various applications of the exchange software [10].

3. Research Methods

Existing compound sentences are often used in native language groups. Table 1 lists the characteristics of the existing programming paragraphs. Among them, the first row is categorized by how the language is used: (1) the operations of data communication and sharing are realized in the form of libraries, while other operations are represented by traditional serial language elements; (2) the parallel semantics are expressed explicitly or implicitly by language constructs or primitives. The second column categorizes the languages according to the address space visible to each execution

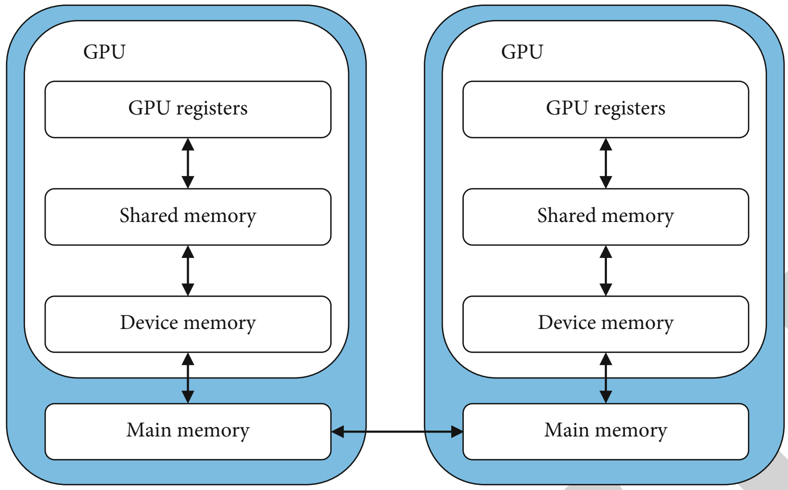

Figure 2: Multilayer storage structure of GPU cluster.

element of the parallel program: in MPI, processes can only access data directly from the local node. Other programming models allow threads to access global data at any node. The third line describes resource management in different languages [11].

The performance of data access, such as the ease of operation, can be divided into bandwidth constraints (such as storage bandwidth and communication bandwidth), data constraints, and external memory. During the counting process, important data can be stored in one large memory, multiple accelerator cards, or other memory. Multicore processors are now perfect for heavy duty applications that seem to have high performance. Computation-intensive tasks suitable for many-core acceleration (such as dense matrix multiplication and LINPACK) can generally achieve satisfactory performance utilization on many-core clusters, and the data storage location has little effect on performance.

However, the storage bandwidth is high, but the data area is good. Designing low-bandwidth communication functions (such as count disparity) requires data directly on the accelerator card for large memory and network connectivity [12, 13]. Using high bandwidth communications such as FFT, data can be stored directly in memory and counted by multiple card accelerators. This category of applications requires the bandwidth of the PCI bus to match the network bandwidth; otherwise, the bottleneck of the entire system will appear at the narrowest bandwidth.

For high-bandwidth communications such as FFTs, the performance of each band is often limited by node network bandwidth, bandwidth of multiple PCI interfaces, accelerator performance, GPU count speed, etc. itself. The speed of data transfer between the network and the PCI bus far exceeds that of the card. Such problems do not ostensibly benefit from many-core acceleration, but the implementation in many-core clustered FFT shows that many-core cluster architecture is beneficial to increase the effective total bandwidth of single-node memory and processing units. Additionally, the card can store more than the CPU cache, which means large operations can be sent to memory at once and run faster, reducing data to the same level as the average [14]. How to make a processor for high-bandwidth applications, optimization of non-homogeneous parallel computing algorithms usually focuses on reducing the number of data transfers from memory to memory to the processor.

The new 3D FFT algorithm for the first GPU cluster divides the Z dimension into $N3$-sized 3D data $(Z * Y * X)$ by P nodes and $N/P\ Y-X$ 2D pages by the amount of memory (X is a tight configuration). Each page is sent to the GPU for 2D FFT computation and back into large memory. All nodes need to reassemble the Z dimension at each node, then swap big data like Alltoall for FFT computation on GPU. GPU memory typically ranges from 3 GB to 6 GB, which is larger than the CPU cache, allowing it to receive very large blocks from main memory for a single operation and charge. Allow limited bandwidth of the main PCI bus. The bandwidth limitation of PCI bus between main memory and GPU is compensated. In contrast, when doing file blocking, the CPU needs to access critical memory more than the large cache.

The difficulty with the above scheme is the need to change the size of the matrix divided by each cluster. Heterogeneous clusters have more multitier structures than traditional systems [15]. Taking the GPU cluster as an example, as shown in Figure 2, the data stored in the memory is very important, but including the GPU, the data must be stored in the GPU memory; at the same time, in order to utilize GPU for high-performance computing, it is necessary to consider the shared memory and register structure of GPU and perform targeted programming. Therefore, many groups have more options for large changes of matrices in the FFT than the key memory model for existing groups.

There are several ways to identify changes in cluster distribution in different groups: (1) large communication interfaces like Alltoall can switch locations from nodes; (2) main memory can carry tens of GB of data exchanged in scale; (3) GPU can carry high-speed small matrix switches [16, 17]. Fixing all the benefits of network communication, how memory bandwidth is still less than GPU memory bandwidth, is not the key to algorithm optimization, but how to

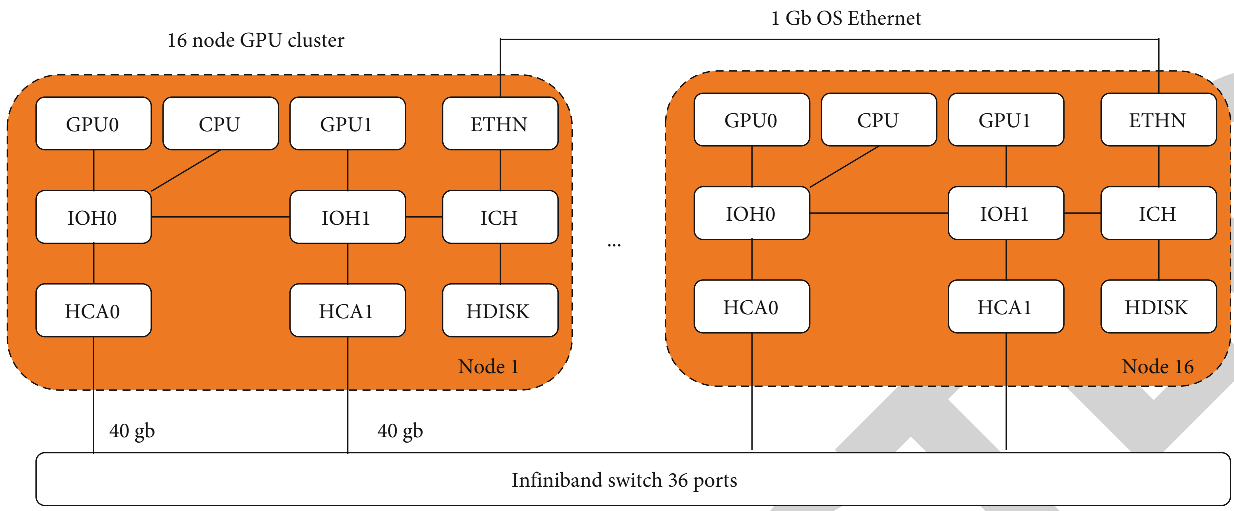

Figure 3: Architecture of PKU McClus.

reduce memory performance. The main innovation is to further divide the data into blocks during the data transmission process and adjust the relative offset of the data blocks, so that the connection between this "offset switch" and the GPU transposition can only be completed for three hours of large, medium, and small. Memoryless transposes in the main move function. Note: different communication systems have different rules for communication granularity (such as the length of data segments). For example, a PCI transfer from critical memory to the GPU requires more than 2 MB of storage to almost peak, while the optimal density for an Infiniband network requires more than 10,000 bytes. Because data sharing reduces the complexity of relationships, the best strategy for saving base memory must take the complexity of relationships into account.

The authors performed validation experiments on a small GPU cluster at PKU McClus to determine the idea of using data movement to FFT groups and adjusting the relative variance of data blocks to minimize memory critical functions [18]. Although the cluster has only 16 nodes, it has a unique architecture, as shown in Figure 3. Each node has two IOHs, each connected to the GPU and Infiniband NIC.

To design dual GPUs and dual Infiniband NICs in a PKU McClus GPU group, we developed detailed procedures for changing the process of distributing data to 2 GPUs per count and using 2 Infiniband NICs to communicate across multiple integrated data channel (directly via IB/veRbs via communication module).

The dimension transformation of the PKUFFT algorithm for this PKU McClus GPU cluster is as follows. Divide the array data into 16 segments according to the length of X, and divide them into 16 nodes. Since they each have 2 GPUs, the data nodes are split into 2 additional parts. Also, the decomposition of the Y length is the same as the decomposition of the X length. First, each GPU performs 128 ($x1$ dimension $\times$ $x0$ dimension) 2D FFTs and computes the data in Y- and Z-dimension instructions. The 128 2D FFTs are divided into 32 groups, each group is 4 2D FFTs of 4 096 $\times$ 4 096. The loop executes 32 times, sending a set of files to the GPU and 2D each time. Compute the FFT, and pull the result to the Infiniband output, unlike a GPU. In the process of writing from the Infiniband output to the Infiniband output buffer of other nodes, the program transposes the $x3$ dimension and the $y3$ dimension; when the data output by Infiniband is not in the pinned memory of the corresponding GPU, the dimension is adjusted; finally, the transformation is repeated in GPU memory before the 1D FFT of the X dimension after the data is transferred from the memory key to GPU memory. Note: in the subsequent implementation, the GPUDiReCe technology is used, so that the data in the Infiniband output buffer can be directly uploaded to the GPU device memory, thus realizing a complete headless transposition operation.

4. Analysis of Results

4.1. Tianhe 1A Cluster FFT Algorithm and Its Parray Description. Tianhe-1 group and Peking University McClus are two GPU groups, but the models are completely different: each Tianhe-1 group has one GPU and only one communication card. Although the implementation of the PKU McClus FFT algorithm has a similar concept, it needs to provide data sharing for each session and repeat the representation of the communication [19, 20]. The author only describes the implementation of the FFT algorithm for the Tianhe-1 cluster.

We use Parray to represent the pseudocode of the algorithm. For simplicity, the pseudocode only recognizes the array type, not the exchange of real objects. As a benchmark, we employ a single-precision complex float2 (length 8 bytes) to complex (C2C) transform and assume that the data is communicated and back in place after the FFT computation.

In the above virtual code, "2DCUFFT" refers to calling the CUFFT library to perform $N2$ 2D FFT in Y and X dimensions, while "1DBATCHED CUFFT" refers to performing FFT calculation of size N in N dimension Z. The dummy code also gives time estimates for each step. $\beta h2d$ represents the ideal data transmission bandwidth from the main memory to the GPU card (about 5 GB/s). $\beta d2h$ is the

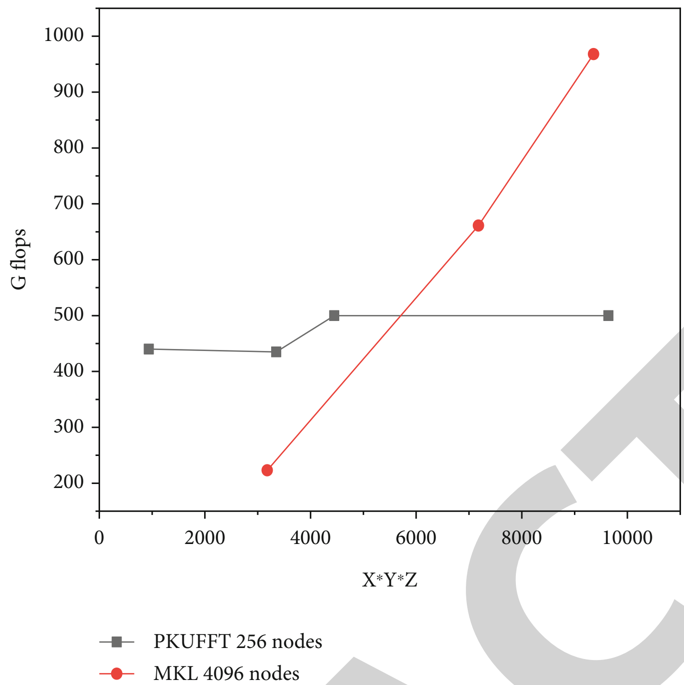

FIGURE 4: Comparison of Parray 3D FFT code with system performance.

bandwidth of data transmission back to the main memory (about 4 GB/s). $\beta d2d$ is the bandwidth of data transmission in the GPU card (about 100 GB/s). $\beta a2a$ is the average bandwidth of all nodes communicating to each port at the same time (1.2 GB/s for the whole Tianhe machine). And FFT is the single-precision floating-point of reasonable-scale FFT on GPU (the total number of floating-point for a single M-length FFT is 5 Mlog M) calculation speed (about 200Gflops/s). The time-consuming estimation of the three-dimensional FFT with the size of 14336 for the whole 7168 nodes of Tianhe is as follows:

$$\frac{N^3}{P}\cdot\left(2\cdot\frac{8}{\beta_{h2d}}+2\cdot\frac{8}{\beta_{d2h}}+2\cdot\frac{8}{\beta_{a2a}}+2\cdot\frac{8}{\beta_{d2d}}+\frac{5\log N^2}{\phi_{FFT}}+\frac{5\log N}{\phi_{FFT}}\right)\approx 35.8s. \tag{1}$$

We measured the whole machine in Tianhe for 35 s.

The FFT data values used in the turbulence simulations are half of those tested above, split into a forward transform of real to complex (R2C) and a reverse transform of complex to real (C2R). Both real and hard have digit counts, so the exchange rate can be returned to that location without further communication at the end of the line. Note: the R2C and C2R of the CFFT library are slower than C2C, and the model performance varies greatly, so C2C is a necessary measure.

The 3D FFT performance of the GPU group used by Parray was tested on Tianhe 1A and compared with Intel MKL 10.3.1.048 [21]. Figure 4 is the 3D FFT comparison of different scales of the same hard disk (figure PKUFFT is the 3D FFT model of the GPU group used by Tianhe-1 A Parray). It can be seen that the performance of PKUFFT far exceeds that of MKL. Figure 5 shows that PKUFFT has better performance scalability compared to MKL.

4.2. Migration of Direct Method Turbulence Simulation Program. Isotropic direct simulation methods are often used for large Fourier switches. In Tianhe-1A, the measurement of the whole machine can reach 14,336 three-dimensional single-digit real numbers, and the packaging material can reach 11 TB. A turbulent system must have more than a dozen arrays to represent the different components of the system. The competition has shifted from traditional culture to different groups of Tianhe No. 1, and it is necessary to reconstruct the distribution, preparation, and output information according to the characteristics of the heterogeneous groups of buildings.

For the core FFT algorithm used in direct competition, although the FFT algorithm of Tianhe Group 1A is similar to the application algorithm of Peking University McClus, due to changes in product distribution, data preparation and distribution must be reused. Its implementation requires re-coding universally. There are similar problems for porting applications of different heterogeneous groups. The application development based on Parray provides a new mechanism for software migration between different types of heterogeneous systems.

According to the Parray programming interface, agile development and changes of applications in heterogeneous groups can be seen with minimal and fastest code modifications by changing the file types and sizes described in Parray programs. Rapid migration of Parray-based applications typically includes the following steps, please scan the OSID for specific requirements.

(1) Improve the Parray programming interface for new heterogeneous processes, and provide support for new threads and storage formats, this process is done by programmer programmers

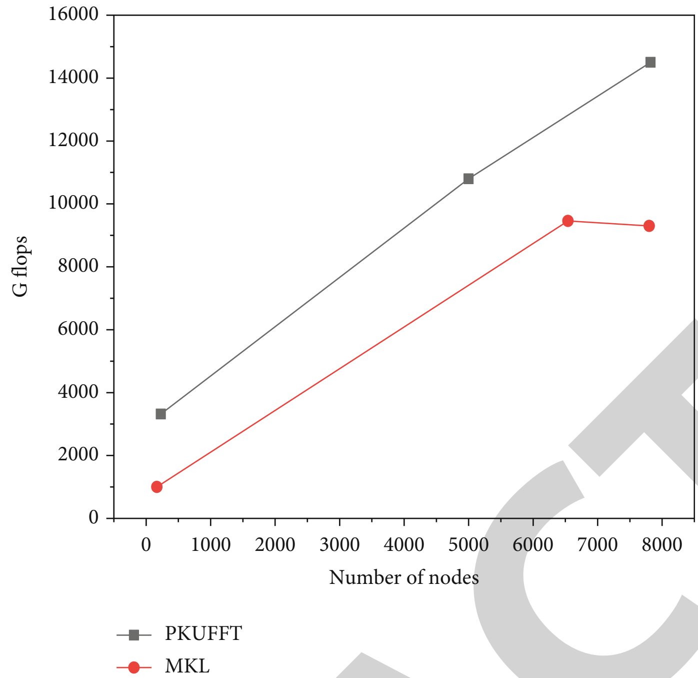

Figure 5: Speedup of Parray 3D FFT code.

(2) For example, for GPU clusters, providing GPU device memory and support for GPU phones through the Parray programming interface, a CUDA strategy must be developed; similarly, new types of support can be quickly introduced to the MIC team

(3) Modifications to applications using Parray are made by the application programmer. For applications not using Parray, use Parray to describe their file distribution and classification, and compare stakeholders; for applications successfully implemented using Parray, the Parray file format and Parray parallelization code need to be modified to accommodate different new demand. During traditional operation, data transfer variables can be looked up by nesting multiple turns, clear description, and application in Parray array mode

(4) Debug new heterogeneous groups for Parray applications. In the process of porting turbulent services, the original code based on MPI is to ensure the accurate operation of heterogeneous groups. The program is not optimized for the same acceleration components and network transfer types. Then, enter the Parray process/thread array mode in the code, and specify the current counting process/thread parallel mode; the Parray data array format is introduced to represent the data array according to the type of application data relationship, and the Parray mixed array format shows the variety of data arrays sex. Allocation is between storage methods and subroutine communication. Simplify the description of data communication methods and optimize transmission. For equations that require composite acceleration, the thread-array type heterogeneous Chinese material is called, further consider the optimal representation of data storage distribution and transmission in heterogeneous computing components and complete the implementation and transplantation of thread computing code in the thread array of heterogeneous computing components

According to the Parray mechanism, we achieved a rapid conversion of the thermal efficiency of the Tianhe-1A system within a week, achieving a measurement of 8192 cubic meters.

5. Conclusion

The authors introduce Parray's communication model to describe the different models, planning, and communication of information and messages. For new heterogeneous processes, Parray can extend the line array type, expand the array support type, and represent new data distribution models; at the same time, by extending and optimizing the performance of subroutine replication, new submissions will be provided. Multithreaded array type integrated telephone can support the transmission of various heterogeneous systems. As an example of using direct turbulence simulation in heterogeneous group transformation, the authors develop an agile method for transforming heterogeneous group programs by changing file types and sizes, based on the Parray programming interface. Minimal and faster than code modification, this process is especially important for the use of heterogeneous groups.

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Retraction

Retracted: Development and Application of Sales System Software Based on Computer Network

Wireless Communications and Mobile Computing

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This article has been retracted by Hindawi following an investigation undertaken by the publisher [1]. This investigation has uncovered evidence of one or more of the following indicators of systematic manipulation of the publication process:

(1) Discrepancies in scope
(2) Discrepancies in the description of the research reported
(3) Discrepancies between the availability of data and the research described
(4) Inappropriate citations
(5) Incoherent, meaningless and/or irrelevant content included in the article
(6) Peer-review manipulation

The presence of these indicators undermines our confidence in the integrity of the article's content and we cannot, therefore, vouch for its reliability. Please note that this notice is intended solely to alert readers that the content of this article is unreliable. We have not investigated whether authors were aware of or involved in the systematic manipulation of the publication process.

Wiley and Hindawi regrets that the usual quality checks did not identify these issues before publication and have since put additional measures in place to safeguard research integrity.

We wish to credit our own Research Integrity and Research Publishing teams and anonymous and named external researchers and research integrity experts for contributing to this investigation.

The corresponding author, as the representative of all authors, has been given the opportunity to register their agreement or disagreement to this retraction. We have kept a record of any response received.

References

[1] C. Liu, "Development and Application of Sales System Software Based on Computer Network," *Wireless Communications and Mobile Computing*, vol. 2022, Article ID 4524698, 7 pages, 2022.

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Research Article

Development and Application of Sales System Software Based on Computer Network

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In order to solve the problem that the automobile sales management becomes more and more complicated, this paper proposes a sales system software platform based on a computer network. The automobile sales management system based on the MVVM framework, with Java as the development language and MySQL as the database, is implemented by the progressive framework Vue in the front end and developed by the Spring Boot framework in the back end. Starting with the design and implementation of the system, the technical framework, functional modules, and implementation processes used to develop the system are studied. The experimental results show that the function tests are normal, the response time of the system client is generally 1-2 seconds, the processing speed is fast, and the influence ability is good. The system improves the comprehensive management ability and promotes the rapid development of automobile industry.

1. Introduction

In recent years, with the development of computer technology and the arrival of the Internet era, we have entered the information age. In this digital age, the continuous and rapid development of Internet technology also puts forward new requirements for the traditional automobile sales model. At some times, some defects in the traditional automobile sales model can be solved through the convenience of the network. According to the needs of automobile sales market management, in order to provide perfect services for the majority of car users, the automobile sales and leasing system came into being [1]. It integrates ordering, leasing, replacement, customer service and other businesses. Its successful structure will bring good social and economic benefits to the company and provide simple and fast services to our customers. With the strong support of the state for the automobile industry and the continuous improvement of people's living standards, it has become a reality for cars to enter the family [2]. The continuous expansion of the application range also puts forward further and deeper requirements for the traditional electronic information and data centralized management of automobile sales. It also makes the development and improvement of automobile sales management system. Based on the network, the mature and stable Internet platform, relevant database system, and Java language with good cross platform portability are used to complete the development of relevant program content to meet the ease of use, stability, and wide use of the system [3]. The automobile online sales management system based on the Internet makes the enterprise break through the limitations of time and space. Both consumers and employees and managers of the enterprise can access the system through the public platform of the network, which has strong timeliness and improves the competitiveness of the enterprise. Because the core part of the system adopts Java language, it solves the problem of cross platform application of software and can be used on any operating system without obstacles. It integrates the functions of ordering, leasing, replacement, customer service, and business management. Its successful structure will bring good social and economic benefits to the company and provide simple and fast services to our customers.

2. Literature Review

With the development of information technology, more and more enterprises introduce the concepts of information management and e-commerce into their own management and marketing activities. This not only improves the quality and efficiency of enterprise management but also brings more profits and development space to enterprises. Din and Paul mainly applied data mining technology when analyzing and predicting the real estate market and demonstrated that this technology has a good application effect. Other scholars have applied this situation to issues related to customer relationship management [2]. Guo and others mainly used data mining technology to analyze customer relationship management issues from multiple perspectives, such as customer retention and customer segmentation [4]. Yang and others mainly analyzed and discussed cart decision tree comprehensively according to the actual situation and improved and optimized it under the guidance of Fayyad boundary point determination principle, so as to ensure that the decision tree technology can be widely used in the real estate industry and obtain good practical results. Specifically, the decision tree can be improved from the following two aspects. First, when the decision tree is built, the analysis is carried out after the threshold value of continuous attribute segmentation is selected. In this process, it is not necessary to check all the segmentation points. The second is to properly solve the uneven distribution by adopting specific methods to ensure that this technology has good practical application [5]. Neves and others discussed how to use b/s structure and java development language to develop and design a real estate sales management system with strong scalability and maintainability [6]. Kovács and others mainly used the analytic hierarchy process when dividing the system structure and then set the authority structure. They mainly used the MVC mode when designing the real estate sales management system [7]. After understanding the business development of the real estate market, Guo and others applied GIS and java development technology in the system design to meet the needs of relevant institutions [8]. Sussner and Campiotti took a real estate enterprise as an example to design the system. When analyzing business requirements and system architecture, they applied unified modeling language. When building the real estate sales control management system, they applied Java EE and hibernate technology [9]. In their research, Li and others mainly analyzed the role and development trend of the housing sales system under the current era background, applied Net4.0 and other technologies for system research, development and design, and then tested it, continuously improved work efficiency, optimized and improved the existing business processing process, reasonably adjusted the enterprise structure, and accelerated the development of information construction in the real estate industry [10].

With the rapid development of China's economy, there are more and more sales orders for automobile enterprises. Therefore, an investigation is conducted on the automobile sales information of automobile enterprises. It is found that with the increase of automobile sales information, the sales management of automobile stores is becoming more and more cumbersome. Manual management can no longer meet the current needs. It is error prone and has a large amount of data. Therefore, in order to improve the efficiency of sales management in automobile enterprises, it is necessary to develop an automobile sales management system.

3. Research Methods

3.1. System Design

3.1.1. System Architecture. The automobile sales management system is developed with b/s architecture and MVVM framework, which is an improved version of the standard MVC mode. The whole system is divided into four layers, namely, Dao layer, service layer, controller layer, and view layer. Dao layer is responsible for the interaction with the database, service layer is responsible for the application logic of the business, controller layer is responsible for the request processing and business process control, and view layer is responsible for page data rendering. The front end of the system is developed by the progressive framework Vue, and the back end is developed by the Spring Boot framework, which reduces the coupling between the front and back ends and realizes the separation of the front and back ends.

3.1.2. Function Module Design. The system is mainly divided into two user roles: administrator and employee, which are as follows:

(1) Administrator

After the administrator logs in, the main functions include personal information, employee management, automobile information, sales information, statistical reports, system management, and announcement management [11]. The function module diagram of the administrator is shown in Figure 1.

(2) Employees

The main functions of employees after logging in include announcement information, personal information, car information, sales information, and statistical reports. The function module diagram of employees is shown in Figure 2.

(3) Coding management module

In order to ensure the consistency of relevant names during information entry, query, data statistics, and other operations of the management system, the system has uniformly coded the information of automobile brands, suppliers, sales outlets, salespeople, and so on. Users only need to select from the drop-down menu during operations.

(4) Daily business management module

The daily business management module is divided into three submodules: sales management, purchase management, and inventory management:

(i) Sales management submodule: its main function is to complete the entry of vehicle files, owner files, sales invoices, and other information. It can flexibly handle the sales without vehicle collection, sales without Invoicing, and sales agency business (account registration, insurance, etc.) and automatically charge accounts. Handle sales returns effectively to ensure the accuracy of sales data. Query, statistics, and

Figure 1: Administrator function module diagram

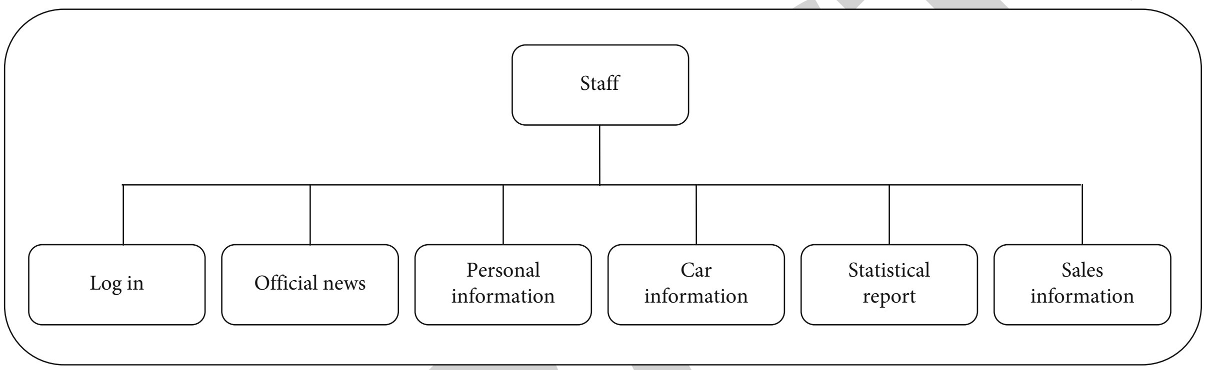

Figure 2: Employee function module diagram

analysis are carried out for the sold vehicles in a variety of ways, so that the decision-makers of the enterprise can timely and accurately obtain the current market sales situation and provide a scientific and powerful basis for the sales and procurement decisions of the enterprise [12]

(ii) Purchase management submodule: its main functions are purchase entry, purchase/return processing, purchase settlement, and purchase classification query and statistics

(iii) Inventory management submodule: inventory management is an important part of enterprise logistics system. The main function and function of inventory is to establish an effective buffer zone between the supply and demand of finished vehicles, so as to reduce the contradiction between the supply and demand of finished vehicles [13]. Scientific and reasonable inventory management can not only promote sales and improve labor productivity but also reduce sales costs and increase economic benefits. The main functions of the module include the management of vehicle in/out notification, vehicle status (in/out time, main performance parameters, storage location, appearance, etc.), vehicle internal allocation management, inventory query, inventory statistical analysis, safety inventory early warning, etc., so as to monitor the inventory status in real time, realize inventory early warning, reduce the inventory level as much as possible, and reduce the backlog of funds

(5) Order contract management module

The order contract management module is a management module for sales orders and contracts. It includes the functions of order and contract formulation, modification, summary, execution, query, and statistics.

(6) Plan management module

Based on the current management system of the enterprise, to meet the actual needs of integrated plan management, an integrated plan management subsystem with purchase plan generation, sales plan management, and other functions is established, which takes the contract as the entry point and aims to meet the needs of enterprise sales and improve work efficiency. Shorten the preparation time of various plans (annual, quarterly, monthly purchase plans, contract to sales plans, etc.), improve the effectiveness and scientificity of the plans, and provide detailed management information. The formulation of the plan is based on the

Table 1: Administrator information table.

Field name	Field meaning	Field type	Field length	Primary key	Can it be empty
adminId	Number	Int	10	Yes	No
adminName	User name	Varchar	20	No	Yes
adminPassword	Password	Varchar	15	No	Yes
adminPhone	Telephone	Varchar	20	No	Yes
adminSex	Gender	Int	10	No	Yes
adminAge	Age	Int	10	No	Yes
AdminXingming	Full name	Varchar	10	No	Yes

Table 2: Employee information.

Field name	Field meaning	Field type	Field length	Primary key	Can it be empty
userId	Number	Int	10	Yes	No
Username'	User name	Varchar	20	No	Yes
userPassword	Password	Varchar	15	No	Yes
userXingming	Full name	Varchar	20	No	Yes
userSex	Gender	Int	10	No	Yes
userAge	Age	Int	10	No	Yes
userPhone	Telephone	Varchar	20	No	Yes
userMark	Remarks	Varchar	255	No	Yes
userDate	Entry time	Datetime	15	No	Yes

orders, contracts and market forecasts of the enterprise in each period.

(7) Report management module

The report management module is a module for managing reports related to the management of enterprise purchase, sales and inventory. Process various forms and time periods of statistical reports according to users' specific needs, such as sales year, quarter, month, daily report, issue details, and receipt details. This module involves a large number of data query, statistics and report generation, so it is a key and difficult point of the system.

(8) Human resource management module

The human resource management module contains the comprehensive functions of enterprise personnel management. It consists of the following functions: personnel file management, labor and personnel management, personnel business assessment, attendance management system, personnel education and training, recruitment management, etc.

3.1.3. Database Design

(1) Database E-R Diagram Design. E-R diagram is an entity connection diagram, which provides a method to represent entities, attributes and connections. It is a conceptual model used to describe the real world [14]. Entities are what we call objects or fields, attributes, and methods, that is, the attributes and methods of an object. E-R diagram is a data description method to describe and display the relationship between data types. E-R diagram can completely map the relationship between real models. The three most important elements in the E-R diagram are entity, attribute and relationship. The E-R diagram is composed of these three points.

(2) Database Table Design. The automobile sales management system needs a background database. The system uses MySQL database to store data. The following describes the details of each table in the database.

(1) Administrator information table is used to store administrator information, as shown in Table 1

(2) Employee information table is used to store employee information, as shown in Table 2

(3) Automobile information table is used to store automobile information, as shown in Table 3

(4) Sales information table is used to store car sales information, as shown in Table 4

In order to overcome the impact of the dynamic changes of the network on the database transmission, the network QoS monitoring technology is introduced, and real-time monitoring is used to lay a good foundation for intelligent transmission control. Add a timestamp at the protocol layer to monitor the network delay, add two fields to each message, and record the last received timestamp (LRT) and the currently sent timestamp (CST). After receiving the message, the receiving end calculates the local packet delay according to the LRT and SCT of the message. At the same time, the processing delay of the message in the network can be obtained by

Table 3: Vehicle information table.

Field name	Field meaning	Field type	Field length	Primary key	Can it be empty
shangpinId	Number	Int	10	Yes	No
shangpinName	Name	Varchar	20	No	Yes
shangpinMark	Manufactor	Varchar	20	No	Yes
shangpinMark1	Color	Varchar	10	No	Yes
shangpinMark2	Model	Varchar	20	No	Yes
shangpinMark3	Other	Varchar	40	No	Yes
shangpinDate	Purchase time	Datetime	15	No	Yes
shangpinZong	Total	Int	10	No	Yes
shangpinType	Type	Varchar	10	No	Yes

Table 4: Sales information.

Field name	Field meaning	Field type	Field length	Primary key	Can it be empty
spchuId	Order no	Int	10	Yes	No
spchuDate	Time	Datetime	15	No	Yes
spchuZong	Total	Int	10	No	Yes
spchuJine	Unit Price	Double	20	No	Yes
spchuZe	Total	Double	20	No	Yes
shangpinId	Car number	Int	10	No	Yes
shangpinName	Vehicle name	Varchar	20	No	Yes
userId	Employee number	Int	10	No	Yes
userName	Employee name	Varchar	20	No	Yes
consumerName	Customer name	Varchar	20	No	Yes
consumerPhone	Customer telephone	Varchar	20	No	Yes

subtracting the processing delay of the opposite end according to the last time stamp (LST) saved by the receiving end and the time when the message is currently received [15].

When end B replies a message,

$$\begin{aligned} \mathrm{LRT} &= \mathrm{TB}+\Delta t1, \\ \mathrm{CST} &= \mathrm{TB}+\Delta t1+\Delta t2. \end{aligned} \tag{1}$$

When end A receives the message from end B, its local

$$\mathrm{LRT} = \mathrm{TA}+\Delta t1. \tag{2}$$

And its current time is

$$\mathrm{CT} = \mathrm{TA}+\Delta t1+\Delta t2+\Delta t3. \tag{3}$$

At this time, it can be calculated that the bidirectional delay of message sending is

$$\mathrm{CT} - \mathrm{LST} - (\mathrm{CST} - \mathrm{LRT}). \tag{4}$$

3.2. System Realization. The implementation of this system is divided into two modes: administrator and employee. The system adopts b/s architecture and MVVM framework development, separates the view UI from the business logic, realizes the separation of the front and back ends, and achieves the purpose of understanding the coupling. The interaction between the front and back ends is realized through Axios cross-domain. The front end of the system is developed by the progressive framework Vue. The Vue framework is based on modularization and componentization. The modularization idea is to encapsulate the modules and provide external interfaces. The componentization idea is to piece together complete pages with components to realize code reuse. The front end sends a request to the back end by calling the interface API provided by the back end. After receiving the data returned by the back end, the front end stores the data first and finally renders the page through two-way binding of data [16].

The back-end of the system is implemented by the Spring Boot framework. It is mainly responsible for receiving and processing the front-end requests, interacting with the database and returning the required data to the front-end. The back-end does not need to care about how the data is loaded into the front-end and how the front-end pages are rendered [17]. The back-end is mainly divided into three layers, namely, Dao layer, service layer, and controller layer. The controller layer is responsible for receiving and processing the front-end requests and providing the front-end with the interface API to be called. After receiving the front-end requests, it calls the service layer and Dao layer in turn, and finally returns the data to the front-end in JSON format.

The database of this system is MySQL database, the server uses the Tomcat server built in springboot, and the development

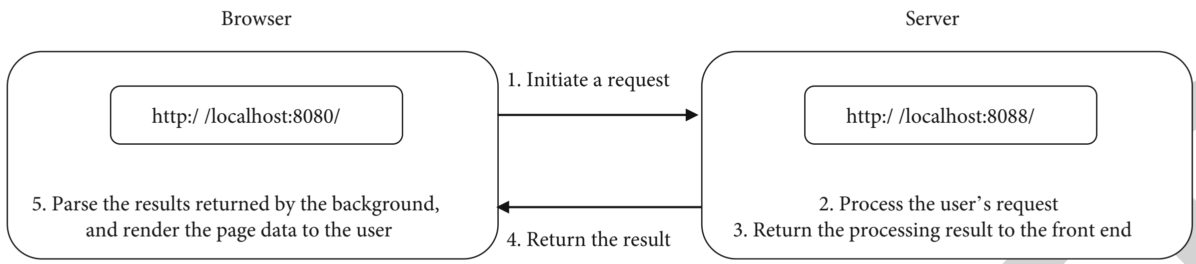

Figure 3: Front and rear end interaction diagram.

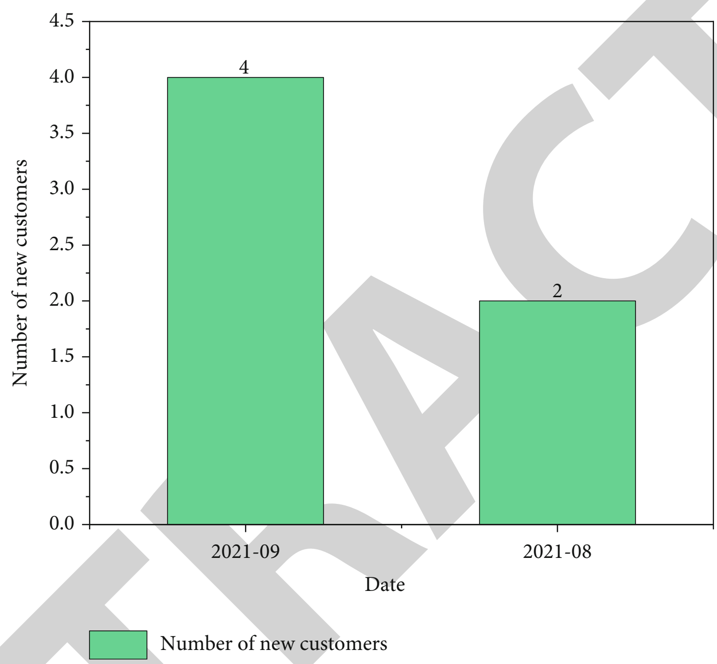

Figure 4: Statistics of customer information by month.

environment is JDK1.8.0. The reason why MVVM framework is adopted is that it has the advantages of low coupling, reusability, independent development, and convenient testing. The operation of the system only requires the user to call the API interface to send a request to the background. The background will process the received request and then return the processing result to the front end. After receiving the data returned from the background, the front end will render it to the page. The interaction process between the front end and the back end of the system is shown in Figure 3.

4. Result Analysis

System function test includes link test, programming language test, form test, data addition, editing, deletion test, and input and query test. Figure 4 shows the current number of customers counted by the system. After querying the database for comparative analysis, it can be seen that the system can correctly count the number of customers, and the data calculation is correct and can meet the corresponding requirements. Other content items of this system function test can also meet the needs of dealers, including links, forms and page display, which will not be listed in detail here. The system performance test is used to check whether the system can return the prompt for correct processing and whether the system exception handling meets the expectations. In addition, it also includes whether the system architecture can withstand the heavy load business capability, the system response capability, the system throughput, etc. This system test verifies the login reminder of the system [18].

The system designed in this paper can make friendly reminders for the abnormal conditions of login. The test results are consistent with the expectations. Other abnormal conditions can also be reminded, which will not be listed in detail here. For the test of system architecture load capacity, response capacity and throughput, in the local test phase, the response time of the system client is generally 1-2 seconds, with fast processing speed and good impact capacity. In the remote test stage, the response capability of the system is related to the user's hardware and network performance [19]. This test has only been tried in a small range. Therefore, at present, the load test and stress test cannot be fully implemented, which will be the focus of the next test of the system. System availability test is to evaluate the availability of the system and check whether

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Retraction

Retracted: Commodity Information Collection and System Construction of e-Commerce Platform Based on Network Data

Wireless Communications and Mobile Computing

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This article has been retracted by Hindawi following an investigation undertaken by the publisher [1]. This investigation has uncovered evidence of one or more of the following indicators of systematic manipulation of the publication process:

(1) Discrepancies in scope
(2) Discrepancies in the description of the research reported
(3) Discrepancies between the availability of data and the research described
(4) Inappropriate citations
(5) Incoherent, meaningless and/or irrelevant content included in the article
(6) Peer-review manipulation

The presence of these indicators undermines our confidence in the integrity of the article's content and we cannot, therefore, vouch for its reliability. Please note that this notice is intended solely to alert readers that the content of this article is unreliable. We have not investigated whether authors were aware of or involved in the systematic manipulation of the publication process.

Wiley and Hindawi regrets that the usual quality checks did not identify these issues before publication and have since put additional measures in place to safeguard research integrity.

We wish to credit our own Research Integrity and Research Publishing teams and anonymous and named external researchers and research integrity experts for contributing to this investigation.

The corresponding author, as the representative of all authors, has been given the opportunity to register their agreement or disagreement to this retraction. We have kept a record of any response received.

References

[1] M. Qi, "Commodity Information Collection and System Construction of e-Commerce Platform Based on Network Data," *Wireless Communications and Mobile Computing*, vol. 2022, Article ID 1359374, 8 pages, 2022.

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Research Article

Commodity Information Collection and System Construction of e-Commerce Platform Based on Network Data

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In order to quickly and accurately collect the massive commodities and corresponding transaction data of large-scale e-commerce platforms, and improve the ability of data analysis and mining, this paper proposes a platform commodity information collection system based on splash technology. The system prerenders the javascript code in the product page, combined with the Scrapy crawler framework, to realize a system that quickly and effectively collects product data from different platforms, and uses "mobile phone" as the retrieval keyword to verify the designed system, respectively. The experimental results show that the system can effectively collect up to 60,000 comments and 6,000 system requests. *Conclusion*. The platform commodity information collection system based on splash technology has certain application value and promotion for the commodity data collection of different platforms of e-commerce.

1. Introduction

With the rapid development of e-commerce, online shopping has become an important form of shopping. Large scale e-commerce platforms generate a large amount of commodity transaction data every day. A large number of researchers choose the commodity data of e-commerce platform as the experimental data set. The mining and analysis of these data have important research value for optimizing the platform construction, increasing product sales, and improving consumer shopping experience. For performance and security reasons, e-commerce platforms often display data through asynchronous loading. When some product pages are viewed in the browser, all product data can be displayed, but the crawler can download the page to the local, but the data you want to collect cannot be obtained or only part of the data can be obtained [1–3]. For example, the display of product prices is dynamically loaded. By viewing the page source code, you will find that there is no content in the HTML tag displaying prices. For these large-scale e-commerce platform data, the common practice is to capture and analyze the HTTP requests in the page to find the data source. This approach is usually very worthwhile. In the end, structured and complete data and faster crawl speed can be obtained. However, the pages of large-scale e-commerce platforms are rich in content and complex in structure. A commodity page can generate hundreds of requests. Moreover, the parameters required by the interface are often difficult to obtain and difficult to analyze. If the parameters are deleted, the accuracy of the obtained data is difficult to be guaranteed, and it is easy to be found by the anticlimbing mechanism of the platform, resulting in shielding. With the business development and technology iteration of the platform, the interface parameters will also change. When it is necessary to obtain commodity data from different platforms, it is necessary to re capture and analyze, which is time-consuming and technically difficult [4, 5]. Figure 1 shows the commodity information collection and system construction of e-commerce platform.

This paper analyzes the commonness of page structure, basic interaction process, and commodity loading mode in e-commerce platforms, and puts forward a general data

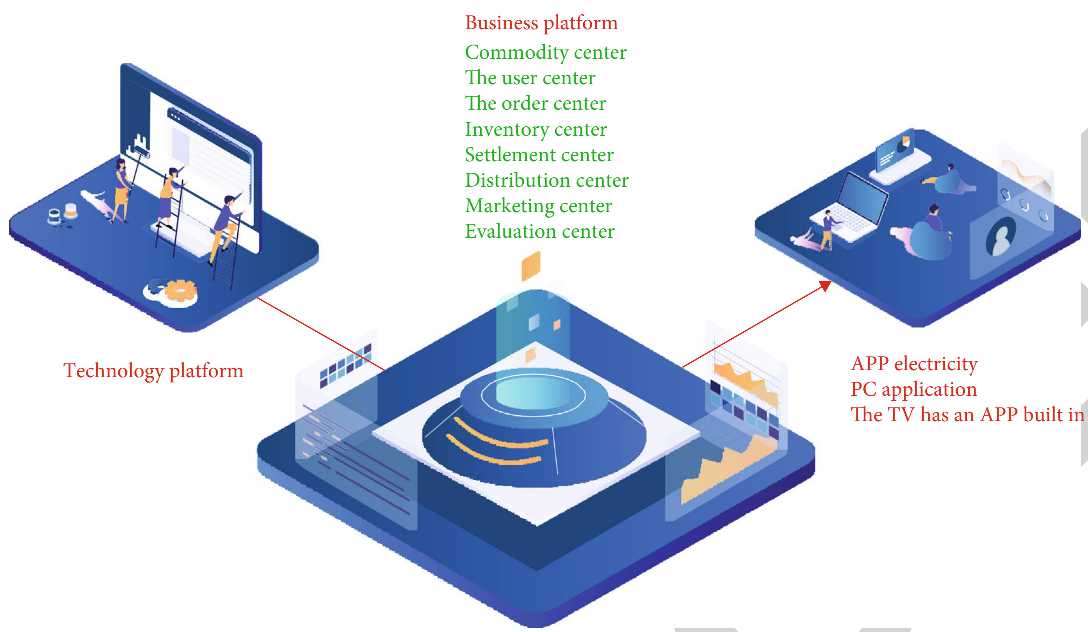

Figure 1: Commodity information collection and system construction of e-commerce platform.

capture strategy for different e-commerce platforms. Through the method of simulating browser operation, combined with the Scrapy crawler framework, we can quickly collect commodity information on different platforms.

2. Literature Review

With regard to the research on e-commerce commodity information collection system, Wen, Y. and others proposed to use crawler technology to collect the information about the confirmed cases of novel coronavirus pneumonia and their activity tracks published on the "headlines today" website, analyze the clinical and epidemiological characteristics, and provide reference basis for the prevention and control of COVID-19 pneumonia [6]. Su, X. and others proposed the auxiliary technology of reptile and dietary assessment to analyze the dietary structure of patients with COVID-19 in Wuhan shelters hospital, so as to provide reference for the scientific nutrition supply of medical staff and patients [7]. Cai, W. and others proposed a theme-based web crawler technology to collect the basic data required for regional coal mine gas disaster risk early warning in the Internet environment, which provides a useful reference for the development and construction of regional coal mine major disaster risk early warning system. Python crawler technology realizes the automatic download and real-time update of the earthquake directory of high-precision positioning results and provides help for earthquake prevention and disaster reduction [8]. Zhang, X. and others proposed to collect topics related to the "COVID-19" in the microblog and analyze the overall attitude and emotional fluctuation of Internet users in different stages of the epidemic development. Taking the "8.12" dangerous chemical explosion accident in Tianjin as an example, the crawler technology is used to collect relevant topic data in the social platform, analyze the evolution trend of public opinion in emergencies, analyze the laws and potential risks, and provide decision support for public opinion guidance [9]. Wu, C. H. and others proposed to study the parking optimization strategy of shared bicycles based on the web crawler data of mobike bicycles. By obtaining the real-time road condition data and other traffic information data in the Gaode map, the impact of the decline in the traffic capacity of the road section in the road network on the damage to the service capacity of the road network is analyzed, providing a reference for the traffic management department to strengthen the governance of key sections and formulate congestion mitigation policies [10]. Yla, B. and others proposed taking "rainstorm disaster" as the theme, tried to introduce the multiobjective optimization algorithm into the theme crawler, and then proposed a web page spatial evolution algorithm based on multiobjective optimization. They designed a topic crawler search strategy combined with gray wolf algorithm, which provides a reference for solving the problem that topic crawlers are difficult to achieve the optimal solution in global search [11]. Guan, Z. and others proposed a focused crawler based on semantic similarity vector space, which improved the crawling accuracy to a certain extent by introducing the text semantic option into the similarity calculation index. By training supervised learning classifiers, the accuracy of similarity calculation between text content and links to be crawled is improved, and good results are achieved [12].

On the basis of the current research, this paper proposes a platform commodity information collection system based on splash technology. A commodity information collection system is designed and implemented through splash to simulate the browser operation, combined with the Scrapy crawler framework, which can quickly collect the commodity information of different platforms.

3. Research Methods

3.1. Basic Principles of Web Crawler. The main function of the web crawler is to download the target page locally according to the user-defined capture strategy and then collect the required information through the predefined parsing rules for persistent storage. The collection process of the crawler system may vary according to the specific application scenarios and functional requirements, but in general, it can be summarized as the following steps. Figure 2 shows the corresponding collection process [13].

(1) The collector starts to pass the initial URL link to the scheduling module

(2) The URL scheduling module must first process the received links, filter out the duplicate pages that have been captured, sort the remaining links according to their priority, and pass the page address with higher priority in the result (the top in the sorting result) to the downloader module

(3) The downloader module interacts with Internet resources to download the target page to the local [14]

(4) The page parsing module parses the required information according to the predefined collection rules. The new link parsed from the page is passed to the URL scheduling module, and the collected structured data is stored in the database

(5) Repeat the above steps ②–④ until the number of links in the URL scheduling module is 0, or when the stop condition is met, the operation of the program is terminated

3.2. Realization of Technology. Generally speaking, the implementation technology of crawler program mainly includes page download, content analysis, and anticrawler detection. Among them, page download refers to the successful download of the target page and the content contained in the page to the local. Page downloading is often divided into static page downloading and dynamic page downloading according to the loading method of page content [15]. Static pages generally refer to pages in pure HTML format, and the content is fixed. The page captured by the crawler is the same as the page rendered by the browser. The dynamic page refers to the part of the content in the page, which is dynamically written by executing JavaScript code. When the page is downloaded to the local by crawling, the corresponding dynamic content is not written to the target file due to the lack of the vascript code running environment, resulting in the lack of content in the page captured by the crawler [16]. For the collection of dynamic content in the page, it is often necessary to integrate other technologies in the implementation of the crawler, such as PhantomJS, Selenium, and Splash [17].

The analysis of page content mainly refers to the process that the crawler extracts the text information embedded in HTML tags by writing customized collection rules after successfully downloading the page to the local. Common methods include regular expressions, CSS selectors, XPath expressions, and some mature parsing libraries [18], for example, BeautifulSoup, lxml, and html5lib. The compilation of collection rules is usually a process of practice making perfect. Based on the accumulated technology, this paper focuses on the use of CSS selectors to compile parsing rules, with a small amount of regular expressions.

Anticrawler detection means that in the process of information collection by a crawler, it is necessary to use certain technical means to disguise itself as a real user when visiting the page to avoid being detected by the target server and then prohibit access [19]. Common methods include dynamic replacement of IP information and user agent fields, as well as limiting the crawler's access speed per unit time and increasing the random interval between two visits. There are many mature crawler frameworks in the Internet that can be used directly. When collecting data, users only need to focus on the compilation of collection rules without building a crawler from scratch. Some common crawler frameworks are listed in Table 1.

Among them, the requests library is easy to use and is especially suitable for beginners. However, it is not designed asynchronously and is easy to cause blocking. Nutch is an open source crawler program produced by a large company. It has rich functions and also includes an out of the box search engine. Heritrix has existed for a long time. It has been updated many times and used by many people. HeadlessChromeCrawler is a distributed crawler based on HeadlessChrome, which can collect dynamic content in pages. The Scrapy framework is designed based on asynchronous mode, with good documentation support and strong scalability. In this paper, we choose to customize the development based on the Scrapy framework [20].

3.3. Experimental Design. Large-scale e-commerce platforms have tens of thousands of commodities and a wide variety of commodities. In order to facilitate consumers to quickly locate products of interest, they usually provide the function of "commodity search." Some common large-scale e-commerce platforms provide the function of commodity retrieval. When describing commodities on the commodity details page, these platforms include the following parts: basic commodity information, specification parameters, user comments, and a group of pictures for commodity display. Therefore, this experiment mainly collects data for the four parts contained in the product details page. When retrieving goods on the e-commerce platform, you first need to enter the name of the goods in the "commodity search box", click the "search button" to return to the first page of the search results, and select the page address at this time as the URL(start_url) of the program. At the same time, under the commodity search page of the e-

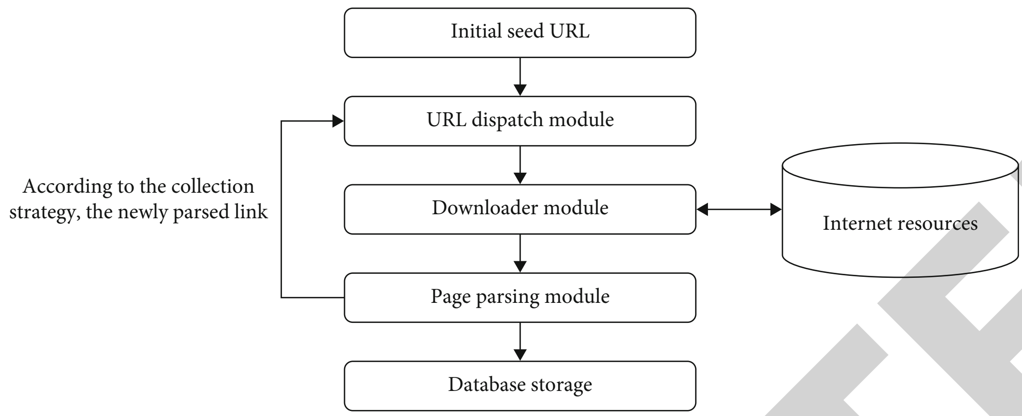

Figure 2: Basic acquisition flow chart.

Table 1: Common crawler frames.

Frame name	Official website address	Development language
Scrapy	https://scrapy.org/	Python
Requests	https://requests.readthedocs.io/	Python
Nutch	http://nutch.apache.org/	Java
Heritrix	https://github.com/internetarchive/heritrix3	Java
Headless chrome crawler	https://github.com/yujiosaka/headless-chrome-crawler	Node.js

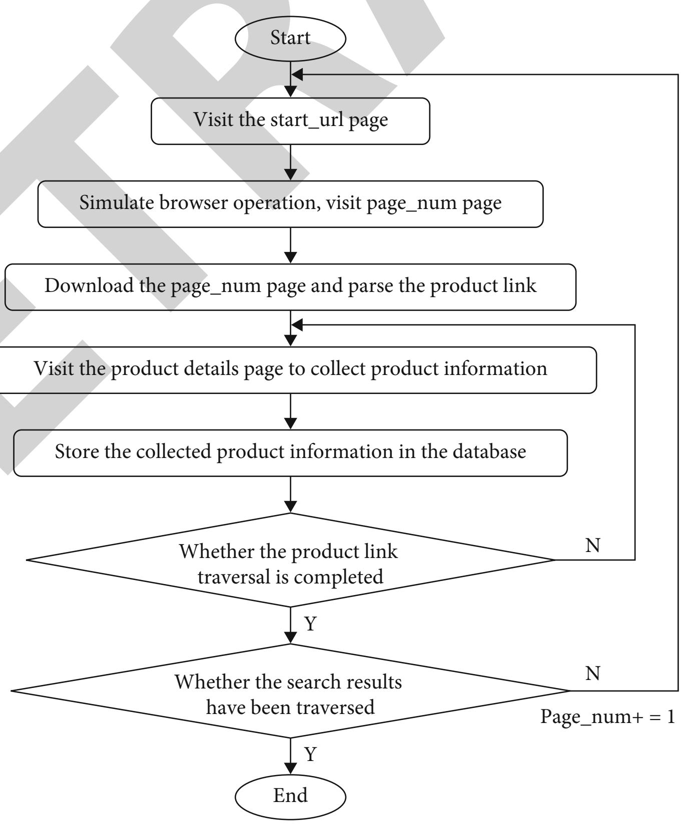

Figure 3: Procedure flow chart.

commerce platform, there is usually a row of paging buttons for displaying page information [21].

3.4. System Algorithm Design. The basic steps of the experimental design are as follows (Figure 3 shows the corresponding program flow chart):

(1) First, visit the start_url page

(2) Simulate the browser operation and access page_num in the product search results:

(a) Fill in page_num in the text input box shown in Figure 3

(b) Click OK to access the page_num page in the search results

(c) Selectively increase the page scrolling operation according to the actual situation (applicable to those e-commerce platforms that load the remaining goods on the current search page by page scrolling)

(3) Download the contents of page_num in the search results to the local, and resolve the address of the product details page in the page

(4) Traverse the product details page and collect the basic information, pictures, and comment data of the product in turn

(5) Store the collected commodity information into the database

(6) Page_num + =1, repeat steps (1) to (5) to grab the product information in the remaining search pages

(7) The program is finished

Note: in this way, the tedious work of capturing and analyzing the HTTP requests of the platform is avoided. When it is necessary to collect commodity data from other platforms, or when the interface parameters change, it is only necessary to change the start_url to quickly start the collection.

3.5. Specific Implementation Technology. When setting up the experimental environment, there are several preparations to be done: ① since splash runs in the docker container, docker needs to be installed first. After the installation is successful, it is very slow to pull the splash image from the DockerHub, which is easy to fail. The configured image source can be solved later. ② When adopting the Scrapy+Splash structure, you also need to install the python package Scrapy-Splash to achieve a seamless combination between the two. When installing Scrapy-Splash, pay attention to the content in the "configuration" section. ③ When installing the crawler framework through the "pipinstallscrapy" command, it is easy to encounter that an exception is thrown due to timeout and the crawler framework cannot be downloaded successfully. You can select some stable and fast images to download. You can also use this method to speed up the installation of other Python packages.

As for the framework structure of Scrapy, the processing and flow of data between internal components, Figure 4 shows the complete system framework. From the figure, it can be seen that the collection of commodity information can be divided into two categories: one is to dynamically render the content in the page through splash (the essence of simulating browser operation is to dynamically execute custom js script), for example, commodity search page and commodity details page. During collection, the default ScrapyRequest object needs to be converted into a SplashRequest object acceptable to splash through the package Scrapy-Splash, and then, splash accesses the corresponding page to return the rendered content. The other one does not need to be pre rendered by splash, and can directly obtain data through access, for example, display pictures and reviews of commodities [22].

After splash returns the contents of the product details page, the address of the product image can be obtained through parsing. The included ImagesPipeline module in scratch can automatically download the image to the local file system. However, in order to facilitate persistent storage, we directly record the downloaded image content (in binary format) in the corresponding product item and then store the item in the database when the product comments are downloaded. When we browse comments on the product details page, the jump of the comment page generates fewer HTTP requests, and the data source is easy to determine. In the experiment, we directly grab the comment information of the product through the comment interface. It should be noted that during the operation of the program, the search results page, product details page, product pictures, and product comments are downloaded at the same time. Scrapy will automatically maintain the request and response queue. We can also set the priority for the request object to specify the execution order of the request.

4. Result Analysis

This experiment uses "mobile phone" as the retrieval keyword to verify the designed system, respectively. Collect the first 10 pages of mobile phone product data, and collect product introduction, specification packaging, pictures, and all comment data on the product detail page. For Dangdang.com, the first 5 pages of mobile phone product data are collected. In the product details page, only basic information such as product introduction, specifications, and pictures are collected. When collecting product data, we set the number of iterations of the outer loop to 1. When the program runs, only the product information in one retrieval page is collected. By setting the value of page_num to 1, 2, 3, …, 10 in turn, the product information of the first 10 pages is collected in stages. When collecting the Internet, the number of iterations of the outer loop is set to 5, and the initial value of page_num is set to 1. When the program runs, the basic information of the first 5 pages

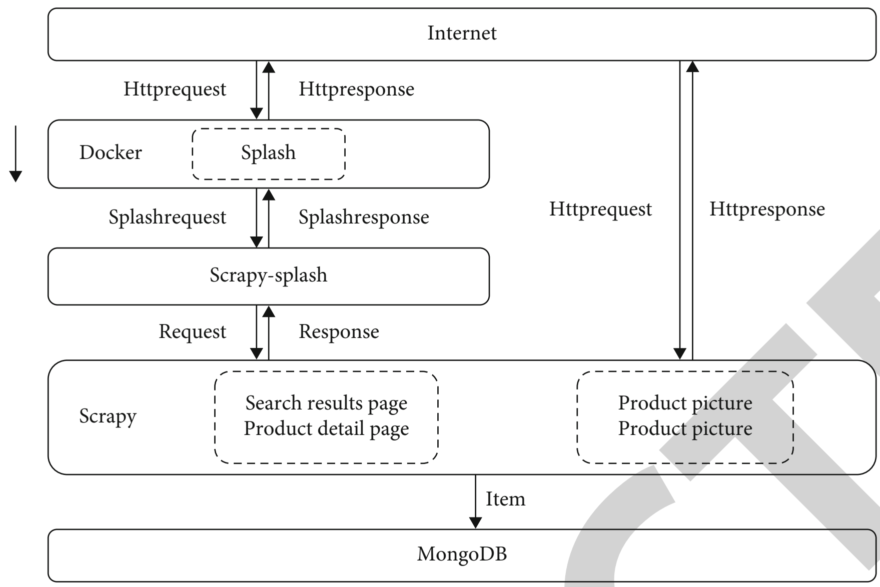

FIGURE 4: Scrapy system framework.

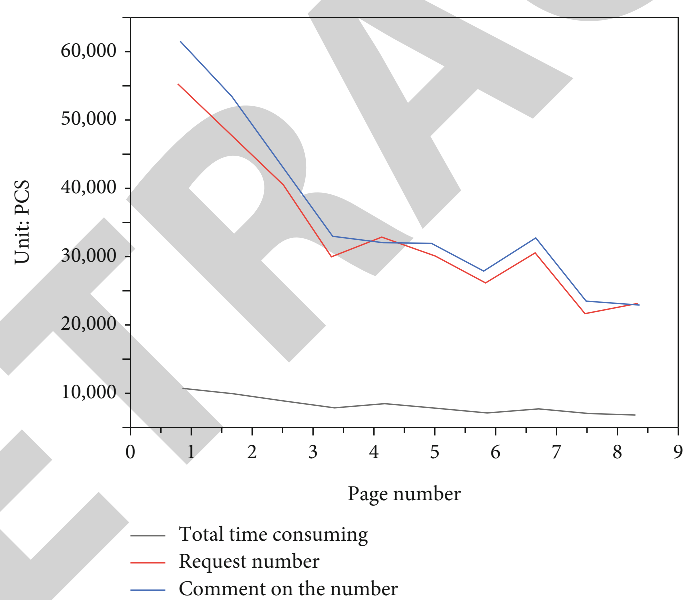

FIGURE 5: Time consuming curve of commodity information collection.

of goods is directly collected. Figure 5 shows the time-consuming curve of data on each page, the total number of reviews of products on the retrieval page, and the curve of the number of requests generated by the collection during page-by-page collection. The x-axis in the figure represents the retrieval page number at the time of collection, and the two y-axes represent the total number of product reviews (or the number of requests generated) and the total time spent. Finally, the figure shows the total time spent on Dangdang.com collecting 5 pages of basic commodity information at one time.

Carefully observe the time-consuming curve in the figure and compare the total time-consuming when Dangdang does not collect product reviews. It can be found that the time-consuming of data collection is mainly affected by the number of product reviews. There are two abnormal points on the time-consuming curve in the figure. The time-consuming of pages 5 and 10 is higher than that of the previous point, but the number of comments is lower than that of the previous point. By analyzing the log, it is found that when collecting these two pages of data, more retry_requests are generated in the program; that is, when a request fails to download due to various reasons, the collection request is reinitiated. This analysis can also be confirmed by comparing the value of these two points with the previous point in the contrasting demand curve.

Figure 5 objectively reflects the operation efficiency of the data collection method proposed in this paper. In practice, users can collect several pages of comments on commodities as needed to improve the collection efficiency. At the same time, due to the limitations of experimental conditions, the crawler system, database services, and virtual machines supporting splash and docker services are all running on the same laptop, which also affects the efficiency of data collection to a certain extent, which is also a future improvement direction. The success of data collection directly shows the feasibility of the commodity information collection method of large-scale e-commerce platform proposed in this paper. This method can realize the rapid collection of commodity data of different platforms and save the development time for the majority of researchers.

5. Conclusion

This paper proposes a platform commodity information collection system based on splash technology, combined with prerendering the javascript code in the commodity page, and combined with the Scrapy crawler framework, to realize a fast and effective collection of commodity data from different platforms. The designed system is verified, respectively. The experimental results show that the system can effectively collect up to 60,000 comments and 6,000 system requests. For the collection of commodity data on different platforms of e-commerce, it has certain application value and promotion.

Data Availability

The data used to support the findings of this study are available from the corresponding author upon request.

Conflicts of Interest

The author declares that they have no conflicts of interest.

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Retraction

Retracted: Application of BIM Technology in Data Collection of Large-Scale Engineering Intelligent Construction

Wireless Communications and Mobile Computing

Received 18 July 2023; Accepted 18 July 2023; Published 19 July 2023

This article has been retracted by Hindawi following an investigation undertaken by the publisher [1]. This investigation has uncovered evidence of one or more of the following indicators of systematic manipulation of the publication process:

(1) Discrepancies in scope
(2) Discrepancies in the description of the research reported
(3) Discrepancies between the availability of data and the research described
(4) Inappropriate citations
(5) Incoherent, meaningless and/or irrelevant content included in the article
(6) Peer-review manipulation

The presence of these indicators undermines our confidence in the integrity of the article's content and we cannot, therefore, vouch for its reliability. Please note that this notice is intended solely to alert readers that the content of this article is unreliable. We have not investigated whether authors were aware of or involved in the systematic manipulation of the publication process.

Wiley and Hindawi regrets that the usual quality checks did not identify these issues before publication and have since put additional measures in place to safeguard research integrity.

We wish to credit our own Research Integrity and Research Publishing teams and anonymous and named external researchers and research integrity experts for contributing to this investigation.

The corresponding author, as the representative of all authors, has been given the opportunity to register their agreement or disagreement to this retraction. We have kept a record of any response received.

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[1] H. Zhao, "Application of BIM Technology in Data Collection of Large-Scale Engineering Intelligent Construction," *Wireless Communications and Mobile Computing*, vol. 2022, Article ID 1168579, 9 pages, 2022.

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Research Article

Application of BIM Technology in Data Collection of Large-Scale Engineering Intelligent Construction

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In order to solve the problem of data collection of intelligent construction of large-scale projects, the author proposes the application of BIM technology in the collection of intelligent construction data of large-scale projects; this method proposes to take advantage of the technical advantages of BIM; starting from the needs of the commercial complex operation and management stage, a BIM-based commercial complex operation management model is established, and the application content of this model to improve the efficiency of commercial complex operation and management is studied. The experimental results show that according to the design conditions and the depth of BIM application, the standard elements and variable factors can be divided into 70% and 30%, respectively. *Conclusion*. BIM can realize the refinement, intelligence, and quality of commercial complex operation.

1. Introduction

Under the background of the new normal of China's social and economic development, the main contradiction in Chinese society in the new era has been transformed into the contradiction between the people's ever-growing needs for a better life and unbalanced and insufficient development. Residents have put forward higher demands for various business formats such as material consumption, commercial shopping experience, health and wellness, education, and training, and commercial complexes are the carriers that carry these complex functions. Commercial complexes are social places with rich formats, complete functions, and fashionable atmosphere; therefore, the design of commercial complexes is becoming more and more difficult, and it is difficult for general design methods and technologies to meet the design needs. Since the introduction of BIM technology in China, it has achieved great development in various fields, and its application in the design stage of commercial complexes has become more common, but the application value of BIM technology still has a lot of room for improvement. In the application of BIM technology in the field of engineering, the application value of BIM technology in construction management, operation and maintenance, project cost, etc., is generally recognized, there are few researches on the application value in the design stage of commercial complexes, and there is insufficient understanding of the application value generated; it is not conducive to promoting the in-depth application of BIM technology in commercial complex projects. Therefore, fully understanding and attaching importance to the application value of BIM technology in the design stage of commercial complexes are urgent problems needed to be solved in the current industry.

2. Literature Review

Zhang et al. said that BIM (Building Information Modeling) technology is emerging in the construction industry in China and abroad today, and it has become more and more popular and has been highly praised by many scholars and architects [1]. Sheng said that the idea of BIM began to take shape in the 1970s, and since then, BIM technology has been continuously developed in practical construction and theoretical applications and supplemented and defined in more detail [2]. Pan et al. said that in the definition given by Wikipedia, it is pointed out that the purpose of BIM technology is to establish and manage the functions of engineering construction projects and the process of digitizing, visualizing, and visualizing physical characteristics [3]. Perera et al. said that multiple forms of model information have become an important resource platform for sharing data and information in the process of project construction and are deeply embedded in the entire life cycle of the project (including project planning, design, construction, operation, and maintenance stages) [4]. Gao et al. said that the various information generated by the continuous deepening and refinement of the BIM model in the project also changes continuously and closely, and finally, the information is closely related [5]. Wu et al. said that the building simulation technology in BIM technology is a multidimensional model information integration technology based on traditional CAD technology in recent years [6]. Guo and Hu said that all parties involved in the project can obtain project information in the digital virtual model established by BIM technology [7]. Borkowski and Wyszomirski said that it has also achieved a high degree of integration of scattered information in the past, which is an important feature of BIM technology that is different from other technologies, the infrastructure of the technology is the model, the relevant information is its soul, the software platform is the tool, the content is its focus, and management is the key [8]. Rwanyiziri et al. said that it provides support for the technology and method of decision-making, design, construction, and operation in the whole life cycle of complex construction projects [9]. Maliha and others said that the construction industry informatization based on BIM technology breaks the gap between management and technology; the project safety, quality, progress, cost, and performance that were in a state of separation in the past can be centralized, facilitating management, ensuring project efficiency, improving project quality, reducing risks, and improving industry efficiency and profits [10]. It can be seen from the foregoing that BIM is not only a technology but also a concept and an idea at a higher level. BIM technology realizes information integration, management, interaction, real-time update, and changes in the construction of complex projects, provide more abundant and accurate information exchange and sharing for different participants in the whole life cycle of engineering construction, and improve the level and efficiency of project management in construction projects, as shown in Figure 1.

3. Methods

The numerical simulation of PyroSim software is calculated based on grids; all objects in the simulation must be divided into cells; after the BIM model is imported, according to the specific parameters of the actual model, it is simplified to a grid cube of $80.4 * 48 * 15.3 = 59045.76\,\text{m}^3$, the grid size is set to $0.5 * 0.5 * 0.5$, and the total number of grids is 472360. The corresponding grid parameters are shown in Table 1.

The construction process of engineering projects has the characteristics of large volume, long construction period and many participants, complex construction process, and difficult management. Especially for large-scale key engineering projects, the construction schedule time requirements are urgent, and the construction schedule management is under great pressure [11]. Schedule, cost, and quality are the three most important goals in the process of engineering project management; the three goals must be balanced organically; the blind pursuit of progress will inevitably affect the unbalance of project quality and cost. Therefore, schedule management directly determines whether the project objectives can be achieved. For project progress management, its purpose is to formulate a schedule based on scientific methods and reasonable forecasts after systematically analyzing the project objectives, work tasks, and work logical relationships and duration. In order to ensure that each stage of the project can achieve the predetermined progress target and ensure the effective realization of the overall project schedule, it is necessary to plan, adjust, and analyze the progress of each management stage in the whole life cycle of the project. In the process of project implementation, in order to achieve the project goal, it is necessary to constantly find out the schedule deviation, analyze the cause of the deviation problem, and formulate corrective measures; through the implementation of corrective measures, the project can be completed on time and reduce the schedule deviation. Project schedule management includes the formulation of schedules and control of schedules. The project progress management process is shown in Figure 2.

The S-curve comparison method is a function diagram of the relationship between the completed engineering quantity and the construction period and calculates the actual cumulative completed engineering quantity and the change curve of the construction period during the implementation of the project; the same coordinate system is also drawn for comparative analysis. Because the resource input in the early and late stages of project implementation is usually less and the midterm investment is larger, the corresponding cumulative completed engineering volume is also the same, and the change curve is similar to the English letter "S" [12–13], as shown in Figure 3.

The application of BIM technology requires the support of BIM software, and the project management capability can be improved through software collaboration; the application of BIM technology in progress management requires the coordination and cooperation of many BIM software; construction projects include many types of design disciplines, difficulty, and high technical requirements; BIM technology has many application points in the whole project, so it is difficult to realize the effective application of BIM technology by a single software; even if the technology application of the whole process of BIM can be completed, its application effect and professional level are relatively low [14]. Therefore, BIM software is aimed at various majors, and the user needs of each participant are classified more carefully, which is also a reflection of the higher user experience and better application effect. At present, the main application software of BIM technology in the global market has the following types, as shown in Table 2.

The guiding ideology of the flow model theory in the construction production TFV theory refers to eliminating waste, shortening the construction period, reducing unnecessary construction procedures, and optimizing construction steps, thereby improving construction efficiency. In the

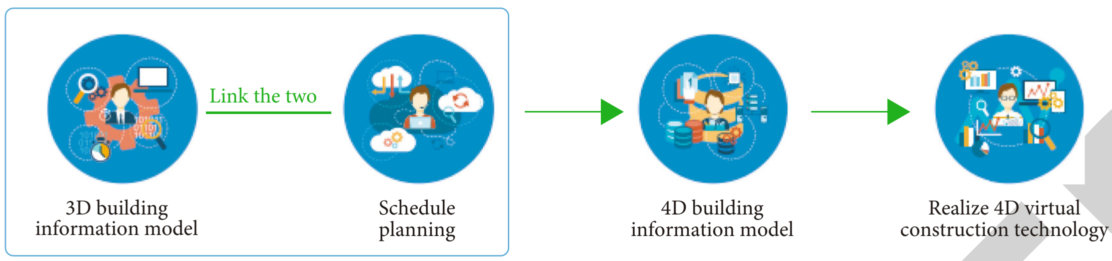

Figure 1: Application of BIM technology in data collection of large-scale engineering intelligent construction.

Table 1: Grid parameter table.

Axis	Minimum	Maximum value	Number of grids
X	-24	24	96
Y	-40.2	40.2	161
Z	0	15.3	31

process of project implementation, focus on the project goal, optimize the construction progress to the maximum extent, and achieve the goal of the lowest cost and the shortest progress. BIM-4D technology is the best way to achieve this goal; the BIM 3D model contains various resource information of project construction, which can better plan and arrange materials, manpower, and machinery and conduct simulation site layout in advance to discover unreasonable resource layout in time for resource optimization and reduce resource waste [15]. At the same time, in the BIM-4D construction simulation stage, each process is constructed, and the operation method can be expressed in an intuitive image through the BIM construction simulation software, fully grasp the content of construction tasks, quickly adjust unreasonable construction operations, and optimize construction simulation to improve production efficiency. At the same time, the huge information database in BIM technology can form data docking with material suppliers and information sharing; project participants can directly obtain information from BIM data and implement a pull supply chain. The relationship between the construction period and cost and the mutual influence between its components, as well as the impact of the construction period on the components of project cost, are the basis for the study of construction period cost optimization [16, 17]. The construction period and cost are the two most important factors affecting the construction process; they are independent of each other, influence each other, and have certain regularity with each other. Engineering costs have a direct impact on the benefits of an enterprise, and its components include direct costs and indirect costs; direct costs incurred in order to complete a certain construction task are direct costs, including labor costs, material costs, and construction machinery usage costs. Indirect cost refers to the cost incurred indirectly in the process of completing the construction of the project, which is relative to the overall project level and is not generated in a single construction task; it mainly includes enterprise management fees, construction site management fees, and financial expenses; generally, it is calculated by taking fees. The direct cost and the construction period have an inverse function relationship; that is, the longer the construction period, the lower the cost, while the indirect cost is just the opposite, showing a positive function relationship, and the longer the construction period, the higher the cost. Due to the complexity and uniqueness of the project itself, a lot of preparation work and management planning are required in the initial stage of the project construction, and more funds need to be invested; with the improvement of job proficiency, the production efficiency will be higher and higher, and the investment will be less and less [18]. Therefore, the direct cost gradually decreases as the construction period continues. Indirect costs are just the opposite and gradually increase as the construction period progresses. Clarifying the relationship between project cost components and construction period is the basis for construction period-cost optimization. Usually, we regard the indirect cost as a fixed value. There are two functional relationships between the direct cost and the construction period, linear and nonlinear functional relationships; the graph of the functional relationship is shown in Figure 4.

According to the image, the functional relationship can be obtained as follows: the functional relationship of the linear functional relationship is shown in

$$c_i^D = a_i t_i + b_i, \tag{1}$$

which is shown in

$$a_i = \frac{C_i^n - C_i^l}{t_i^n - t_i^l}, \qquad b_i = \frac{C_i^l t_i^n - C_i^n t_i^l}{t_i^n - t_i^l}, \tag{2}$$

where C_i^D is the direct cost of work i; t_i is the duration of work i; t_i^l, t_i^n are the minimum duration and normal duration of work i, respectively; and C_i^l and C_i^n represent the direct cost of i work under the shortest duration and the normal duration, respectively.

The functional relationship of the nonlinear functional relationship is shown in

$$C_i^D = a_i t_i^2 + b_i + C^1, \tag{3}$$

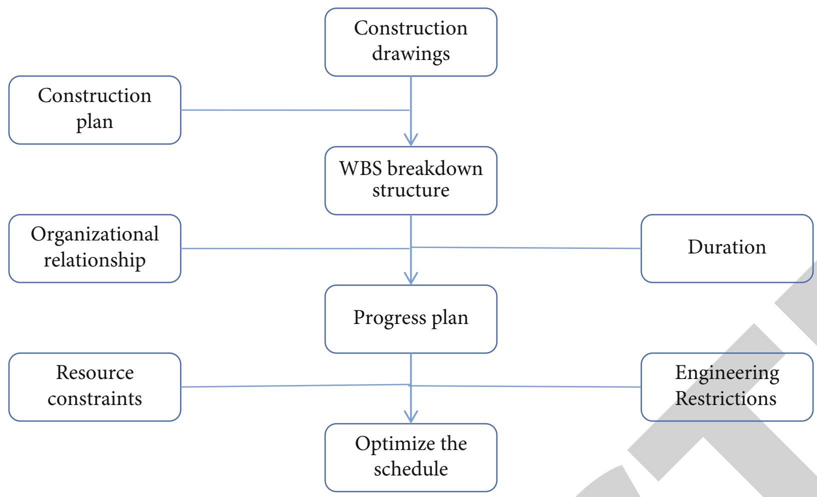

Figure 2: Traditional schedule optimization program diagram.

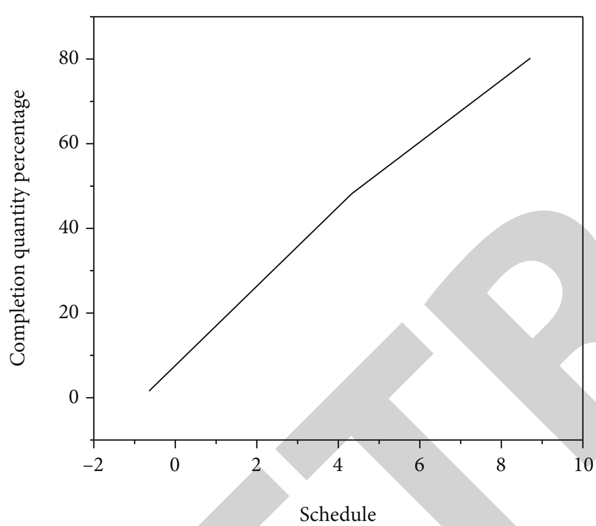

Figure 3: S-curve comparison method.

which is shown in

$$a_i = \frac{C_i^n - C_i^l}{\left(t_i^n\right)^2 - \left(t_i^l\right)^2},$$
$$b_i = \frac{C_i^n\left(t_i^n\right)^2 - C_i^l\left(t_i^l\right)^2}{\left(t_i^n\right)^2 - \left(t_i^l\right)^2}. \tag{4}$$

The indirect cost is proportional to the construction period. This situation also causes the relationship between the total cost and the construction period as shown in the figure, which is a curve relationship of decreasing first and then increasing. Then, the total cost must have a minimum point, which is the optimal point to be determined in the process of duration-cost optimization. It can be seen from the figure that the total cost curve has an extreme point (Ts, Cs), at which time the corresponding cost is the lowest, and the corresponding construction period is the most reasonable. The relationship between the total project cost and the duration function is shown in

$$\mathrm{TC} = \mathrm{DC} + \mathrm{IC} = \sum C_i^D + \Delta C^I T. \tag{5}$$

Among them, TC is the total cost of the project; C_i^D is the direct cost of i work; ΔC^I is the indirect cost rate; in general, it is approximated that the indirect cost rate and the work duration have a linear function relationship, which is a fixed value; T is the construction period; i work direct cost rate ΔC_i^D is shown in

$$\Delta C_i^D = \frac{C_i^l - C_i^n}{t_i^n - t_i^l}. \tag{6}$$

Therefore, the total cost rate $\Delta \mathrm{TC}_i$ of i work can be obtained as shown in

$$\Delta \mathrm{TC}_i = \Delta C_i^D + \Delta C_i^I. \tag{7}$$

Therefore, when $\Delta \mathrm{TC}_i<0$, the total cost is proportional to the construction period. When $\Delta \mathrm{TC}_i > 0$, the total cost is inversely proportional to the construction period. The construction period of engineering projects is long, and the amount of capital investment is large; the flow of funds is not a one-time payment, but a multistage and multipoint flow, which also causes the project cost to pass over time during the construction process; additional value-added charges will apply. Excluding the consideration of inflation, the value of the same amount of money invested at the moment is greater than the value generated by the investment in the future, because the current funds can be invested immediately and bring benefits. It can be seen that the passage of time will add a certain value to the funds, this part of the value for the owner of the funds becomes a benefit,

Table 2: BIM technology software.

Software classification	Name	Professional use	Priority
BIM core modeling software	Revit	Building, structure, electromechanical	High
	Rhino+GH	Building, structure, electromechanical	High
	ArchiCAD	Architecture	Middle
File sharing and collaboration software	Vault	Collaboration platform	High
	Navisworks	Collaboration platform	High
	ProjectWise	Collaboration platform	High
Analyzing software	Vasari	Green analysis	High
	PKPM	Structural analysis	High

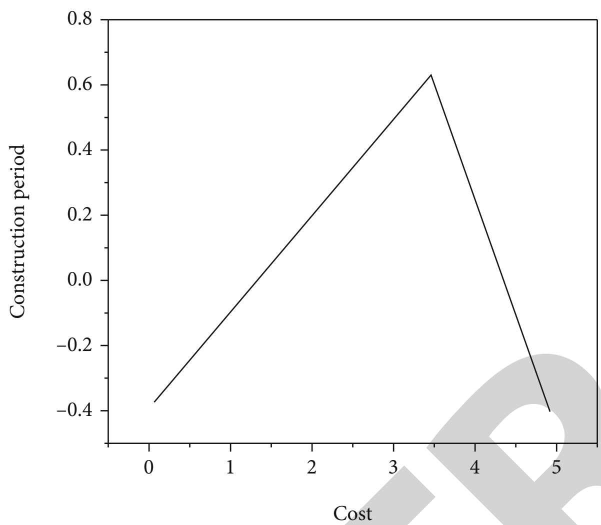

Figure 4: Duration-direct cost linear function diagram.

and this part of the value for the borrower of the funds becomes a cost. Therefore, it can be seen that due to the particularity of engineering projects, the time value of funds accounts for a large proportion of the total cost of engineering projects, and it is also a part that cannot be ignored in progress management. The traditional static duration-cost optimization only considers the amount of capital (the inflow and outflow of capital), while ignoring the time value of capital; with the more refined development of the construction industry, enterprises have stricter requirements for schedule management costs. To maximize the benefits, the time value of money has become the focus of the research on duration-cost optimization. It is also a hot spot for scholars in the research of progress optimization in recent years. In the process of cost payment for engineering projects, the most common form is multiple payments, and the flow of funds occurs at multiple points in time, rather than at a certain point in time. This also creates the time value of money. The time value of capital is considered in the optimization of construction costs, and the net present value is usually used as the optimization index. The calculation principle of net present value takes the time value of funds into consideration reasonably, its economic significance is clear, and the evaluation standard is easy to determine. Its formula is shown in

$$\mathrm{NPV} = \sum_{t=0}^{n} (\mathrm{CI} - \mathrm{CO})_t (1 + i_c)^{-t}, \tag{8}$$

where NPV is the net present value, CI is cash inflow, CO is cash outflow, $(\mathrm{CI} - \mathrm{CO})_t$ is the net cash flow in year t, $(1 + i_c)^{-t}$ is the present value coefficient of one-time payment, i_c is the benchmark rate of return, and n is the plan calculation period. The NPV indicator takes into account the time value of money and fully considers the capital status of the whole project cycle, the meaning of funds is clear, the calculation is accurate, and it is easy to analyze. When dynamically optimizing the cost of construction period 1 in the construction phase of a project, the schedule plan is usually prepared in units of days, which is the same as the interest-bearing period and conforms to the calculation method of continuous compound interest. In the process of dynamic optimization of construction period and cost, the essence is to reasonably arrange the relationship between construction activities and cost and time schedule, so as to achieve the goal of the lowest cost and the best construction period. The main idea of particle swarm optimization is to simulate the group behavior of birds foraging and a group of birds randomly searching for things in a limited area and by constantly updating the distance and speed between the bird and the food, until the food is found. In the particle swarm algorithm, the optimized fitness function is first defined, and each particle can be regarded as a bird; during the optimization process, the particles search and fly in the multidimensional space at a certain speed; according to the dynamics of the group, the flight speed and position are dynamically adjusted and updated, and the optimization is continued until the optimal fitness value is found. In the PSO algorithm, each particle represents a solution to the optimization problem, and the fitness function is used to check whether the particle meets the requirements. The particle moves in the solution space with a certain speed and trajectory direction; its motion direction and position are determined by the velocity variable. The optimal solution is achieved by continuously searching for particles that replace the optimal position. When the particle reaches the new motion position, it will first compare with the optimal position that it has experienced; if the comparison result is better, it needs to be compared with the global optimal position, and finally, the optimal solution is obtained. The position and velocity update of the particle will be achieved by the following formula as shown in

$$v_{id}^{t+1} = v_{id}^{t} + c_1 r_1 \left(P_{id}^{t} - x_{id}^{t}\right) + c_2 r_2 \left(p_{gd}^{t} - x_{id}^{t}\right), \tag{9}$$

$$x_{id}^{t+1} = x_{id}^{t} + v_{id}^{t+1}. \tag{10}$$

In the formula, r_1, r_2 is a random number, and its value range is $(0, 1)$; c_1, c_2 is the learning factor, usually $c_1 = c_2 = 2$. Among them, particles realize the update of speed and position through three parts, v_{id}^{t} is the particle "memory" part, $p_{id}^{t} - x_{id}^{t}$ is the "cognitive" part, and $p_{id}^{t} - x_{id}^{t}$ is the "social" part; through mutual cooperation and comparison, the particles update the optimal position of the entire search global scope, indicating information sharing and mutual cooperation between particles.

4. Experiments and Analysis

The design of commercial complexes is quite different from the traditional commercial architectural design; the traditional commercial architectural design has limited functions and a single form; design work can be realized based on conventional design concepts and design methods. The emergence and further development of commercial complexes broke the rules of traditional architectural design; due to the diverse needs of commercial complexes, such as rich formats, complex structures, and rich facade shapes, higher requirements have been placed on the design. The application of BIM technology provides a variety of means for the design of commercial complexes; limited by the degree and scope of application, at present, the application of BIM technology in the design stage of commercial complexes still mostly stays in two-dimensional design, single-specialty design, and other dimensions, and the application value of BIM technology has not really been brought into play [19, 20]. With the diversified development of design methods, various drawing and modeling software emerge in an endless stream; these tools provide designers with a variety of choices to get rid of simple two-dimensional design; however, from the essence of design thinking, these tools are only auxiliary functions; design thinking is still in the two-dimensional stage; the starting point of design is still the scrutiny and thinking of the plane; when necessary, BIM modeling software is used for scrutiny, and the powerful 3D display and simulation functions of BIM technology are not fully utilized; a shift from consciousness and thinking levels to three-dimensionality is required [21]. In the design of commercial complexes, because there are many specialties involved, it is necessary to repeatedly raise funds, review, and modify each other during the design process. However, affected by the division of design majors and traditional design ideas, the design work of various majors in commercial complexes is still relatively independent, and there is no change at the level of design thinking. Although in the design of commercial complexes the drawings are combined and checked against each other according to the design progress, there are still many loopholes; in the places where there are still a lot of mistakes and omissions in the construction process according to the drawings, the value of BIM technology is small. With the update and iterative upgrading of commercial complexes, the work in the design phase of commercial complexes has become more complex, and the majors involved have increased to architecture, structure, HVAC, water supply and drainage, electrical, curtain wall, landscape, interior decoration, guide signs, weak current intelligence chemical, garage moving line, and many other specialties. With the deepening of the understanding stage of commercial complex design, the traditional single-specialty design mode is no longer applicable, and new application modes such as general design contracting and BIM general contracting have been derived; with the in-depth application of the general design contracting mode and the maturity of BIM technology, the industry is constantly exploring how BIM technology can give full play to its application value in commercial complex projects; China's leading commercial real estate companies, Wanda, Xincheng, China Resources, Longfor, etc., are all conducting design research, development, and application exploration [22, 23]. In 2017, after completing all R&D and project pilots, Wanda Group publicly proposed for the first time to comprehensively promote the BIM general contracting model, implementing in all direct investment Wanda Plazas across the country, with the BIM model as the core to achieve the comprehensive goals of design control, plan management, cost control, and quality control. The BIM general contract management mode is a BIM-based design general contract mode, which runs through the whole life cycle of the project and has the characteristics of coordination and synchronization, management preposition, and mode unification. The BIM general contract management mode is the intelligent construction mode of Wanda commercial real estate, and it is another milestone change after the general construction contract; on the basis of the general design contract, the comprehensive introduction of BIM technology is aimed at achieving BIM as the core, improving the design efficiency and quality through the unified and coordinated management of the general design contract, and ultimately providing guarantee for the construction and operation of the project. Since the design general contracting mode will greatly increase the work content and difficulty of the general design contracting, how to effectively manage the design subcontracting from the aspects of technology and management is the key and difficult point [24]. The BIM general contracting mode has been deeply optimized on the basis of the design general contracting mode; the core point is to fully introduce the BIM model, which requires the general design contract to use the BIM model as the core, and carry out the design results of all design subcontracts through the BIM collaborative work platform and integrate and manage through information technology. In addition, in order to ensure the quality of the design, the general design contract is managed by formulating the standard contract for the general design contract, the design task statement, and the performance assessment, and in the introduction of a third-party review mechanism, the consulting company hired by the construction unit shall review the results of the general design contract; in order to ensure compliance and rationality, with the in-depth application of BIM technology in various fields, the production factors and work efficiency improvements generated by BIM technology have been widely recognized; the BIM application model has also undergone major changes, gradually shifting to the general design contract and BIM model as the core, and the value of the general design contract, BIM model, and BIM collaboration platform will become more and more important in the design stage of commercial complexes [25, 26]. Through the analysis of the changes in the application mode of BIM technology in the design stage of commercial complexes, by consulting relevant research literature and sorting out a large number of actual project cases, it is found that the application of BIM technology in the design stage of commercial complexes has brought design processes, design thinking, and design management. For equal dimensional changes, these changes have an impact on the application value of BIM technology in the design stage of commercial complexes. According to the conventional commercial complex design process, the design can be designed according to the preliminary design conditions and standards, and the design content can be adjusted according to the in-depth and perfect design conditions; if the design conditions change significantly, it will lead to subversive modifications of the design, which will bring great trouble to the design work. Especially in the design of commercial complex projects, there are many cases where major design modifications are caused by changes in external variables such as municipal, fire protection, and civil air defense [27]. After consulting the "Wanda BIM General Contracting Operation Manual," due to the standardization and informatization characteristics of BIM, this dilemma can be effectively improved in a sense, so the design elements are divided into two elements: standard and variable. According to the design conditions and the depth of BIM application, the standard elements and variable factors can be divided into 70% and 30%, respectively; 70% of the standards are locked in the design stage, and the rationality of the standards is strengthened; at the same time, it is necessary to maximize the controllability of 30% of the variable factors. According to traditional design conventions and thinking, the role of design is that of the designer, who realizes the owner's design task by giving full play to his professional advantages and skills [28]. With the in-depth application of BIM technology in the design stage of commercial complexes, it will force changes in design thinking such as role perspective, service content, and resource utilization. From the perspective of role, the design often starts from the single identity of the supplier and only needs to meet the requirements of the owner's design brief; this kind of design thinking often fails to comprehensively consider the actual needs of the owner, which leads to the emergence of the design transformation practice process, out of the way of the original design. Due to the changes in BIM design work requirements and supporting design contract modes, the design will change from the single perspective of the supplier to the multiple identities of the owner's perspective; at the same time, it can also help the owner to achieve greater comprehensive benefits. In the application cases of BIM projects in recent years, more and more design contracts link project output value with social benefit indicators, and the role perspective of design is gradually transforming. In terms of service content, the traditional design provides a single service, and the way of thinking is straight-line thinking, and the design task can only be completed according to the requirements of the design contract and the task book. The application of BIM technology makes this single service change to in-depth service, from linear thinking to comprehensive thinking. The application of BIM technology in the design of commercial complexes has changed conventional design thinking. In the dimension of the management platform, the traditional single-item design has been transformed into a general design contractor, which has changed the situation of individual majors fighting each other; in the end, the overall design is coordinated by the general design contractor; through the combination of drawings and verification, the contradictions between majors are found, and the overall design of the design can be brought into play; the coordination function of the package is solved. For the BIM design work platform dimension, from 2D design to BIM design, traditional 2D design can only achieve design goals through simple model and shape analysis; BIM technology has powerful three-dimensional display, space analysis, node decomposition, shape simulation, and other functions, which can fully meet various design requirements. In terms of the information work platform, the traditional 2D general contract management is gradually transferred to the BIM general contract management; under the leadership of the BIM general contract, the upstream and downstream design chain of the design will be closely designed around the BIM model, and finally, the general design contractor will transform the design results of various majors into the BIM model and output the design results through the BIM model. 3D modeling and space display are important aspects for BIM technology to play its advantages in practical applications; especially with the in-depth advancement of BIM general contracting and other application modes, the BIM model has become the application core of each system; all participants will work around the model; the construction unit determines the plan and calculates the cost through the model; the design unit optimizes the design scheme and drawings through the model; the construction unit guides the site quality, progress, safe and civilized construction, etc., through the refinement of the model; and the supervision unit can supervise various work on the construction site through the model; therefore, the accuracy, timeliness, and rationality of the model will become an important factor affecting the rapid and orderly progress of the project; it takes a lot of time and energy to invest in the BIM model work, and it is also necessary to study the application value points of the model stage. Through the in-depth analysis of the two new application modes of design general contracting and BIM general contracting, the BIM model plays a central role in the application of the design stage, and all parties involved must carry out related work around the BIM model, which is of great application value to the model. The point has an important impact. In addition, the transformation from simple design subcontracting to design general contracting also has a profound impact on the entire design concept; the application value of the design stage is developing towards integration, diversification, and informationizization; these changes provide an important basis for sorting out value points; it is helpful to select more scientific and reasonable value points for applied value research. From the definition and analysis of BIM, the model (model) is the core value point of BIM technology, and the building (build) and the information (information) are based on the extension of the model; the model is the basic platform and framework for the development and function expansion of BIM technology. Because the model plays an important role in BIM application, the model is the basic carrier of BIM application. In the model of commercial complex design, the models of various disciplines such as architecture, structure, and electromechanical finally form a complete model. Due to the complexity of the commercial complex model, the modeling stage requires a lot of time and effort, so it is necessary to study the value points of the model stage. The civil engineering model is the basis of the BIM model, and other professional models need to be attached to the civil engineering professional model. Therefore, the accuracy, depth, and efficiency of the civil engineering professional model will directly affect the entire design progress. In the civil engineering model, in addition to the main models such as walls, stairs, doors, and windows, detailed components such as steps, handrails, and reserved holes also have a great impact on the quality of the model. The main contents of the structural model include beams, slabs, columns, foundations, piles, and steel structures; since the BIM model needs to have the function of one-click measurement to provide a basis for cost verification and completion settlement, the structural model also needs to include a steel bar model. Due to the complicated sizes and types of steel bars in beams, plates, columns, pile foundations, and other parts, it brings great difficulties to the modeling of steel bars; it is necessary to continuously explore methods suitable for the characteristics of the project during the modeling process and improve model accuracy and modeling efficiency.

5. Conclusion

The number and scale of commercial complexes in China are growing rapidly; it has brought unprecedented challenges to operations that lack information technology management. The application of BIM technology is conducive not only to the realization of information management by the management parties working together but also to the analysis and organization of relevant data, so as to achieve effective supervision and control; at the same time, it can also provide managers with specific information and data and give their work reference content, which will ultimately help reduce management costs and improve management efficiency. However, the use of BIM technology means a new management mode; therefore, the author aims to seek a new mode of operation management by studying the operation management of commercial complexes based on BIM and to improve the management level by using the business innovation brought by BIM technology. Therefore, the author takes the operation management of large-scale commercial complexes as the research object, based on the BIM operation management model obtained by BIM technology, and obtained the BIM operation management model of the research commercial complex; it is of great significance to promote the management transformation and upgrading of the operation stage of China's construction industry.

Data Availability

The data used to support the findings of this study are available from the corresponding author upon request.

Conflicts of Interest

The author declares that they have no conflicts of interest.

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Retraction

Retracted: Indifference Computer Experiment for Mathematical Identification of Two Variables

Wireless Communications and Mobile Computing

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This article has been retracted by Hindawi following an investigation undertaken by the publisher [1]. This investigation has uncovered evidence of one or more of the following indicators of systematic manipulation of the publication process:

(1) Discrepancies in scope
(2) Discrepancies in the description of the research reported
(3) Discrepancies between the availability of data and the research described
(4) Inappropriate citations
(5) Incoherent, meaningless and/or irrelevant content included in the article
(6) Peer-review manipulation

The presence of these indicators undermines our confidence in the integrity of the article's content and we cannot, therefore, vouch for its reliability. Please note that this notice is intended solely to alert readers that the content of this article is unreliable. We have not investigated whether authors were aware of or involved in the systematic manipulation of the publication process.

Wiley and Hindawi regrets that the usual quality checks did not identify these issues before publication and have since put additional measures in place to safeguard research integrity.

We wish to credit our own Research Integrity and Research Publishing teams and anonymous and named external researchers and research integrity experts for contributing to this investigation.

The corresponding author, as the representative of all authors, has been given the opportunity to register their agreement or disagreement to this retraction. We have kept a record of any response received.

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[1] J. Yu, "Indifference Computer Experiment for Mathematical Identification of Two Variables," *Wireless Communications and Mobile Computing*, vol. 2022, Article ID 9181840, 7 pages, 2022.

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Research Article

Indifference Computer Experiment for Mathematical Identification of Two Variables

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In order to understand the two types of nonlinear differential equation problems in engineering dynamics, the author proposes a numerical analysis method for the two types of nonlinear differential equations based on computer simulation. This method establishes the MATLAB algorithm structure of the numerical solution of the fourth-order fixed-step Runge-Kutta and Lorenz models, discusses the error control in the case of variable step size, and plots the numerical solutions of the Lorenz system based on MATLAB in two-dimensional and three-dimensional space graphics. The x-direction displacement and y-direction displacement data are extracted from the Lorenz equation as iterative samples of the model, the regression curve obtained after iteration has a slope of 0.996, and the iterative regression model reflects the basic characteristics of the data well. This method presents the basic idea of numerical solution verification within acceptable error limits. For solving engineering problems with differential equations as mathematical models, an effective numerical solution method is provided, and further discussion on the numerical solutions of partial differential equations is of great significance.

1. Introduction

We know that the dynamic changes of many systems in the real world can be expressed by differential equations; in order to study the evolution law of the system, the solution of differential equations has become a very important problem. The theory and method of differential equations have always been one of the keys to the development of modern science and technology and also one of the key issues of mathematical research. However, most differential equations cannot be solved analytically, and even some differential equations that can be solved require very high skills; differential equations are a compilation of tricks [1]. Therefore, while people are looking for analytic solutions, discussing and studying the analytical features of the solutions have also become one of people's research methods. Especially with the rapid development of nonlinear scientific research, people not only need to discuss individual solutions of differential equations but also try to know the general trend and structure of a large class of solutions or all solutions; it is not only satisfied with the discussion of the local properties of the solution but also cares about the topological structure of the orbital formed by a solution in the corresponding space and even cares whether this structure will be destroyed due to small perturbations, in the case of perturbation and no perturbation, whether there will be orbital structures that are different from each other. People hope to study differential equations from a higher perspective, with newer viewpoints, and with more advanced methods, so as to obtain more and more profound results, which leads to the rise of the research upsurge of differential dynamical systems [2]. To put it simply, what the differential dynamic system pursues is to analyze the differential equations from the perspective of topology, so as to reveal the essential laws of the change and development of things.

The world we live in and face is an evolutionary system that is extremely complex. Complexity is everywhere, and complex systems are everywhere, such as cosmic celestial bodies, biological systems, and social systems. Currently, there is no unified understanding of complexity. It is generally believed that complexity can be summed up as the multilevel, multifactor, and multivariability of the system, the interaction between various factors or subsystems and between the system and the environment, and the ensuing overall behavior and evolution [3]. The so-called complexity research is to study the composition, structure, function, and interaction of the system, study the overall behavior and evolution of the system and the mechanisms that control them, and then establish models, conduct simulation experiments, and further influence, manage, and control them.

2. Literature Review

For this research question, Tu et al. based on the probability representation of linear backward stochastic differential equations proposed an approximate solution method for linear partial differential equations [4]. Leonov proposed an approximate solution to nonlinear parabolic partial differential equations based on second-order backward stochastic differential equations [5]. Zhu gave a numerical algorithm based on the probabilistic representation of the branch-diffusion process, which exploits the fact that the solutions of semilinear PDEs with a polynomial nonlinear form can be expressed as the expectation of the branch-diffusion process functional; although this method does not have the curse of dimensionality problem, its applicability is still limited due to the instability of the approximate solution in finite time [6]. For the high-dimensional case of such equations, Nafil et al. developed an algorithm based on compressed sensing and the Hopf formulation of the Hamilton-Jacobi equation, which achieved good numerical performance in high-dimensional cases [7]. Abdulwahid et al. proposed a general algorithm for this type of equation based on the Feynman-Kac formula, Bismut-Elworthy-Li formula, and Picard iterative multilevel decomposition, which has been proven for some applications in finance and physics very effective. For semilinear parabolic PDEs, the computational complexity of the algorithm is $O(d\varepsilon^{-4})$, where d is the dimension of the equation and ε is the desired precision [8]. Baothman and Edhah exploited recent advances in probabilistic machine learning to infer governing equations represented by parametric linear operators [9]. This method modifies the Gaussian process prior according to the form of the equation and is used to infer the parameters of linear PDEs from observations. Liu et al. proposed the use of deep neural networks to approximate the solutions of high-dimensional partial differential equations; the network is iterated to satisfy differential operators, initial conditions, and boundary conditions; the neural network operates on a randomly sampled set of time and space points, iteratively; the solution is approximated by a neural network [10]. Parise et al. by using different neural network structures and different parameterizations improved machine learning algorithms for solving semilinear partial differential equations; the proposed algorithm is compared with several algorithms that utilize deep learning techniques to solve semilinear PDE problems [11]. Ly et al. reviewed methods for solving partial differential equations using physics-informed neural networks (PINNs), a novel residual-based adaptive optimization method proposed to improve the iterative efficiency of PINNs. This paper also provides a Python program library DeepXDE for the implementation of PINNs; the program library DeepXDE can solve the forward problem of given initial value conditions and boundary value conditions and can also solve the inverse problem given additional measurement results [12].

"Numerical analysis" is the main content of computational mathematics, and its research scope covers almost all branches of mathematical science; in turn, many branches of mathematics need to explore numerical methods applicable to computers. In the theory of numerical calculation, the analytical solution of the general nonlinear differential equation does not exist and can only be solved numerically. The numerical solution problem and algorithm realization of nonlinear differential equations have very important applications in engineering dynamic control, computer simulation, mathematical modeling, etc. Figure 1 shows the nonlinear simulation technology. The author will study the algorithm, error, step size, and other problems of numerical solution of general nonlinear differential equation problems, the fourth-order fixed step size Runge-Kutta and its improved algorithm, and the numerical solution of the Lorenz model, which is the graphical interface for the results of MATLAB real variable operations.

3. Research Methods

3.1. Overview of Algorithms for Differential Equation Problems. As an important branch of mathematics, nonlinear differential equations and equation systems are traditional mathematical tools to describe or solve nonlinear dynamical system problems and have been widely used in many fields [13].

The numerical solutions of general differential equations are mostly numerical solutions to the initial value problems of differential equations; such problems can be described as the following formula (1) with a first-order explicit differential equation system:

$$\dot{x}(t) = f(t, x(t)). \tag{1}$$

Among them, $x^T(t) = [x_1(t), x_2(t), \cdots, x_n(t)]$ is called the state vector, and $f^T(\cdot) = [f_1(\cdot), f_2(\cdot), \cdots, f_n(\cdot)]$ can be any nonlinear function.

In the initial value problem, if the initial state $x_0 = [x_1(0), \cdots, x_n(0)]^T$ is known, the numerical solution method is used to obtain the value of each variable state $x(t)$ in a certain interval $t \in [0, t_f]$; t_f is also called the terminal variable [14].

3.2. Numerical Algorithm of Multivariate Nonlinear Differential Equations and Problems of Error and Step Size

3.2.1. Numerical Algorithm for Initial Value Problem. The multivariate nonlinear extremum problem is a very common mathematical problem; in theory, the multivariate nonlinear extremum problem is often reduced to the root-finding problem of the multivariate nonlinear equation system, and then, the Newton iteration method is used to calculate it. But in fact, the root-finding problem of multivariate nonlinear equations is more difficult to solve than the extremum problem of multivariate nonlinear functions. In

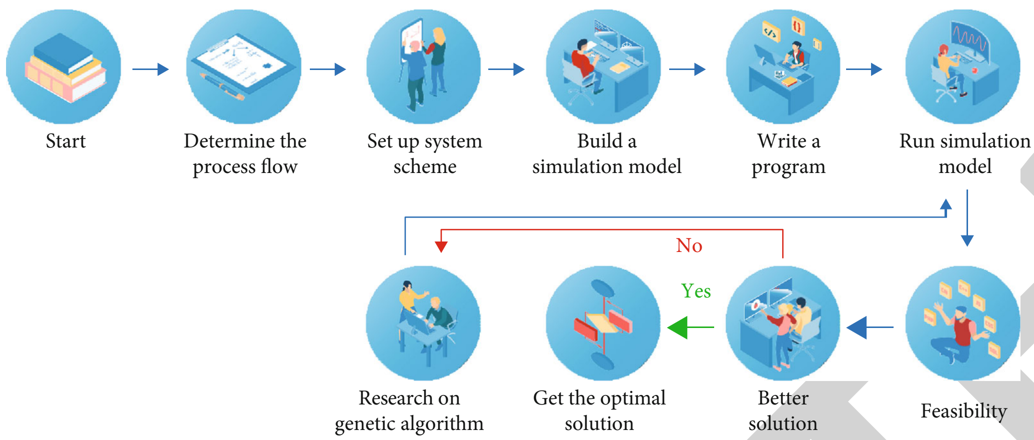

Figure 1: Nonlinear simulation technology.

computational mathematics, in order to solve the multivariate extreme value problem, many new methods have been introduced, such as the steepest descent method, genetic algorithm, and edge detection algorithm [15].

For the initial value problem of multivariate nonlinear differential equations, Euler's algorithm is a class that is easier to understand and control than other algorithms and is widely used in the numerical solution of complex differential equations; the following will give a numerical algorithm for the initial value problem of nonlinear differential equations based on MATLAB, taking Euler's algorithm as an example.

Assuming that the value of the system state vector at time t_0 is known to be $x(t_0)$, if a smaller calculation step h is selected, the derivative on the left side of the differential equation can be approximated as $x(t_0+h)-x(t_0)/(t_0+h)-t_0$, and the approximate solution of the equation at time t_0+h can be obtained by substituting it into the differential equation in the following:

$$\widehat{x}(t_0+h)=x(t_0)=hf(t_0,x(t_0)). \tag{2}$$

Due to the existence of the approximate solution error, the value of the system state vector at time t_0+h can be strictly expressed as the following:

$$x(t_0+h)=x(t_0)+hf(t,x(t_0))+R_0. \tag{3}$$

Or denoted as $x_1=x(t_0+h)$, then $\widehat{x}_1=\widehat{x}(t_0+h)$ is the approximate value of the system state vector at t_0+h time, that is, the numerical solution, where R_0 is the rounding error of the numerical solution.

More generally, assuming that the state vector of the system at time t_k is x_k, the numerical solution of Euler's algorithm at time x_k+h can be written as

$$x_{k+1}=x_k+hf(t,x_k). \tag{4}$$

For the above general numerical solution expression, the iterative method can be used to gradually obtain the given initial value problem within a certain time period $t\in[0,T]$, the original numerical solution at each time instant t_0+kh $(k=1,2,\cdots,n)$ [16].

3.2.2. Accuracy Control of Numerical Solution and Analysis of Influencing Factors of Variable Step Size. For the effect of variable step size on accuracy and speed, an effective way to improve the accuracy of numerical solutions is to reduce the value of the step size h, but the continuous decrease of the step size value will cause the following two problems:

Reduce operation speed. For the chosen solution time limit, reducing the step size is equivalent to increasing the number of computational points in a fixed time interval, which directly leads to a sharp drop in computational speed [17].

Expand the cumulative error. Due to the inherent error of the numerical solution, even if a small step size is chosen, the obtained numerical solution will be accompanied by a rounding error; decreasing the step size increases the number of loops, which increases the number of passes for the rounding error stacking, resulting in a larger cumulative error.

A schematic diagram of the relationship between rounding error, accumulated error, and total error is shown in Figure 2.

For an effective way of error control, in multivariate nonlinear differential equations, step size and error are a pair of contradictions; according to the algorithm and accuracy requirements of the actual problem, the following ways can be used to choose:

Choose an appropriate step size. When using a simple algorithm like Euler, the step size should be moderate and follow the principle of rather small rather than large.

Improve the accuracy of the approximation algorithm. Since the Euler algorithm only converts the original integral problem into a trapezoidal method for the approximate solution, it cannot effectively approximate the original problem due to its low accuracy.

The composite Simpson method or the more accurate spline interpolation method can be used to replace the Euler algorithm, among which the Runge-Kutta method and the Adams method are the most common [18, 19].

In using the variable step size method, in the numerical solution of multivariate differential equations, many methods can be solved by variable step size; if the error is

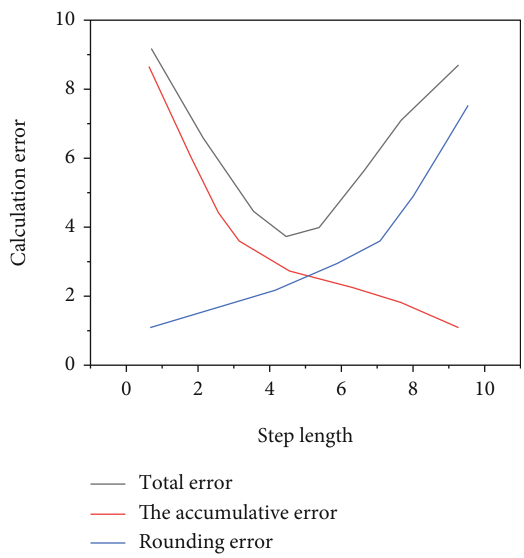

Figure 2: Error diagram.

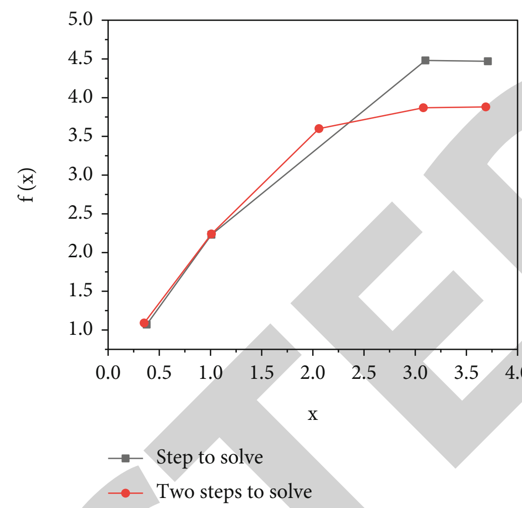

Figure 3: Schematic diagram of variable step size.

small, the step size will be increased, and if the error is large, the step size will be automatically reduced, so as to solve the initial value problem of differential equations accurately and effectively.

The principle of the general variable step size algorithm is shown in Figure 3. Knowing the state variable x_k at time t_k, calculate the state variable $\hat{x}_{k+1}$ under the step size h and $h/2$, respectively; if the error $\varepsilon = \|\hat{x}_{k+1} - \tilde{x}_{k+1}\|$ under the two step sizes is less than the given error limit, the step size can be used. If the error is large, gradually reduce the step size until the error is reduced to the allowable range [20]. This adaptive variable step size algorithm can solve two problems at the same time, namely, operation speed and calculation accuracy.

3.3. Algorithms and Functions for Numerical Solutions of Two Types of First-Order Differential Equations. The key to solving a system of first-order explicit differential equations is to write a function in MATLAB language and describe the system of differential equations to be solved.

In nonlinear differential equation solving, it is sometimes necessary to further set the algorithm and control conditions, which can be modified by the options variable in the solving process, and the initial variable can be obtained by the odeset() function.

For practical applications, it is often necessary to define some additional parameters, which can be represented by $m_1, m_2, \cdots, m_n$. The following two types of important algorithms in numerical analysis will be analyzed, and a general program structure will be established.

3.3.1. Fourth-Order Fixed-Step Runge-Kutta Algorithm and Its Improvement. For a complex function, it is always prohibitive to use Taylor expansion to find its derivatives; Runge-Kutta uses the idea of the Taylor series method but avoids the analytical derivation of the original function process. Therefore, in essence, Runge-Kutta is based on the Taylor series method; it abandons the drawbacks of the Taylor series method for derivatives and uses the idea of compound functions to achieve derivatives [21]. The Runge-Kutta method is a high-precision single-step algorithm widely used in engineering, including the well-known Euler method, which numerically solves differential equations. Due to the high precision of this algorithm, measures are taken to suppress the error. The numerical solution is obtained by the fourth-order Runge-Kutta method; its accuracy may not be as good as the improved Euler method. In the actual calculation, the appropriate algorithm should be selected according to the specific characteristics of the problem. For solutions with poor smoothness, it is better to use a low-order algorithm with a small step size.

The fourth-order fixed-step Runge-Kutta algorithm is an important algorithm in numerical analysis and system simulation theory. Its mathematical algorithm needs to define 4 additional vectors first, as shown in the following:

$$\begin{cases} k_1 = hf(t_k, x_k), \\ k_2 = hf\left(t_k + \dfrac{h}{2}, x_k + \dfrac{k_1}{2}\right), \\ k_3 = hf\left(t_k + \dfrac{h}{2}, x_k + \dfrac{k_2}{2}\right), \\ k_4 = hf(t_k + h, x_k + k_3). \end{cases} \tag{5}$$

Among them, Simpson is the calculation step, which is a constant in practical applications, and then, the state variable value of the next step is calculated by the Runge-Kutta algorithm as the following:

$$x_{k+1} = x_k + \frac{1}{6}(k_1 + 2k_2 + 2k_3 + k_4). \tag{6}$$

For the above expression, the iterative method is used to obtain the numerical solution at each time point $t_0 + h, t_0 + 2h, \cdots$ [22].

Based on mathematical algorithms, in MATLAB, the solution can be achieved through a set of loop statements.

In the above MATLAB algorithm, the variable span has two construction methods, namely, the equidistant time vector and the variable step vector based on t_0, t_f, h. After the function call ends, the matrix formed by the time vector and the state variable is returned by tout and yout in the program, respectively.

The abovementioned algorithm is characterized by simple structure and fast operation speed, but its limitation lies in its low precision. In order to ensure higher accuracy and numerical stability, we improve the above algorithm in terms of step size increment: that is, the $f_i(\bullet)$ function is evaluated 6 times in each calculation step, and this algorithm is called the fourth-order five-level RKF algorithm [23].

For the current step size h_k, six variables can be defined as follows:

$$k_i = h_k f\left(t_k + \alpha_i h_k, x_k + \sum_{j=1}^{i-1} \beta_{ij} k_j\right) (i = 1, 2, \cdots, 6). \tag{7}$$

In the formula, $x_{k+1} = x_k + \sum_{i=1}^{6} \gamma_i k_i$ is the current calculation time, and the intermediate parameters αi and βij can be given by the RKF algorithm coefficient table. At this time, the state vector can be expressed as the following:

$$x_{k+1} = x_k + \sum_{i=1}^{6} \gamma_i k_i. \tag{8}$$

In the above algorithm, if an error vector $\varepsilon_k = \sum_{i=1}^{6} (\gamma_i - \gamma_i^*) k_i$ is defined, the step size can be changed by the size of ε_k, thereby transforming into an adaptive variable step size algorithm, which makes the whole program easier to control [24].

3.3.2. Numerical Algorithm of Lorenz Model. The Lorenz model is a well-known equation describing chaotic phenomena, and the Lorenz system is worthy of detailed study from the point of view of both mathematics and physics [25].

Suppose the state equation of the Lorenz model is the following:

$$\begin{cases} \dot{x}_1(t) = -\beta x_1(t) + x_2(t) x_3(t), \\ \dot{x}_2(t) = -\rho x_2(t) + \rho x_3(t), \\ \dot{x}_3(t) = -x_1(t) x_2(t) + \sigma x_2(t) - x_3(t). \end{cases} \tag{9}$$

Among them, β, ρ, σ are fixed values, $x_1(0) = x_2(0) = 0$, $x_3(0) = \varepsilon$ is the initial value, and for $\varepsilon = 10^{-10}$, the numerical solution of the system of equations is obtained.

Since this equation is a nonlinear differential equation and there is no analytical solution, we can complete the programming of the numerical algorithm based on MATLAB according to the following steps.

First, use the Lorenzep.m function to describe the dynamic model of the system.

Then, call the numerical solution function ode45() to numerically solve the system described by the Lorenzep() function, and display the result graphically.

Among them, t_final is the set simulation termination time, x0 is the initial state, and the two commands draw

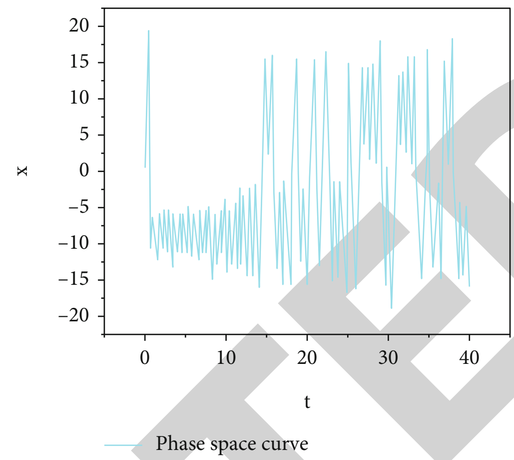

Figure 4: Phase space plot of the x state.

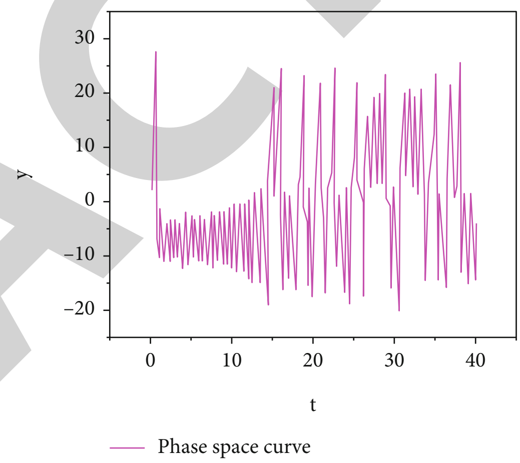

Figure 5: Phase space plot of y state.

the two-dimensional curve graph of the time relationship of each state of the system (as shown in Figures 4–6) and the phase of the three state space graphs.

In the above program, the comet3() function can also be used to draw an animated trajectory for observing the phase space trajectory; just rewrite the last statement appropriately. In order to establish a description function based on the MATLAB differential equation system, ode45() must be called, so writing the MATLAB function to describe the differential equation is the key to the numerical solution of the initial value problem, especially for the first-order nonlinear differential equation.

4. Result Analysis

In the process of numerical solution, if the simulation algorithm and control parameters are not selected properly, unreliable results or even wrong results may be obtained; therefore, the verification of the numerical solution can be carried out in two ways. A feasible method is to modify the simulation control parameters, such as the acceptable error limit, such as setting the RelTol option to a smaller value, and observe the obtained results to see if they are consistent

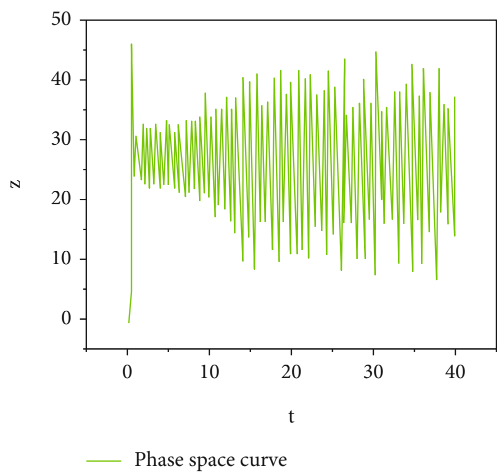

Figure 6: Phase space plot of z state.

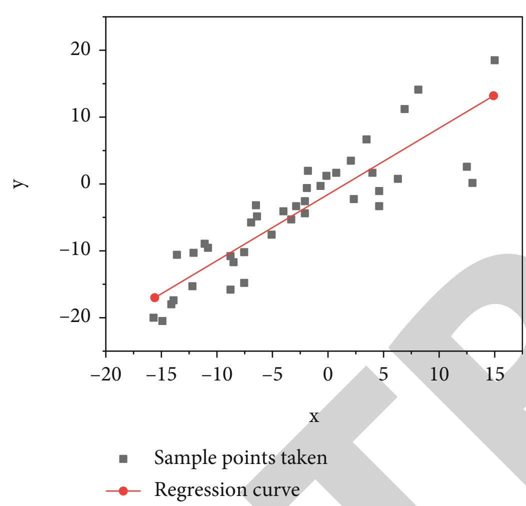

Figure 7: Lorenz equation x, y data image regression curve.

with the results of the first run; if there are no unacceptable differences, further reductions in the error limits should be considered. In addition, choosing a differential equation solving algorithm for the same problem can also check the correctness of the operation result.

The x-direction displacement and y-direction displacement data are extracted from the Lorenz equation as an iterative sample of the model, and the iterative results are shown in Figure 7. The dots in Figure 7 represent the extracted sample points, and the straight line represents the regression curve obtained after the iteration of the sample data, with a slope of 0.996; the iterative regression model reflects the basic characteristics of the data well.

5. Conclusion

The solution and simulation of scientific or engineering problems often boil down to the solution of mathematical models and the fitting of experimental data, while nonlinear differential equations, as an important mathematical terminal model, can only be solved numerically. Through the systematic analysis of the fourth-order fixed-step Runge-Kutta algorithm and the Lorenz model algorithm, the author established a variable-step adaptive algorithm based on nonlinear differential equations and the MATLAB program structure under the explicit function description; the key elements such as step size, error, and numerical solution verification are analyzed; and the influencing factors are analyzed, and relevant conclusions are drawn. It provides an effective numerical solution method for solving engineering problems with differential equations as mathematical models, and further discussion on the numerical solutions of partial differential equations is also of great significance.

Data Availability

The data used to support the findings of this study are available from the corresponding author upon request.

Conflicts of Interest

The author declares that they have no conflicts of interest.

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Retraction

Retracted: Building a Space Model Method Based on the Big Data Map Visual Design

Wireless Communications and Mobile Computing

Received 18 July 2023; Accepted 18 July 2023; Published 19 July 2023

This article has been retracted by Hindawi following an investigation undertaken by the publisher [1]. This investigation has uncovered evidence of one or more of the following indicators of systematic manipulation of the publication process:

(1) Discrepancies in scope
(2) Discrepancies in the description of the research reported
(3) Discrepancies between the availability of data and the research described
(4) Inappropriate citations
(5) Incoherent, meaningless and/or irrelevant content included in the article
(6) Peer-review manipulation

The presence of these indicators undermines our confidence in the integrity of the article's content and we cannot, therefore, vouch for its reliability. Please note that this notice is intended solely to alert readers that the content of this article is unreliable. We have not investigated whether authors were aware of or involved in the systematic manipulation of the publication process.

Wiley and Hindawi regrets that the usual quality checks did not identify these issues before publication and have since put additional measures in place to safeguard research integrity.

We wish to credit our own Research Integrity and Research Publishing teams and anonymous and named external researchers and research integrity experts for contributing to this investigation.

The corresponding author, as the representative of all authors, has been given the opportunity to register their agreement or disagreement to this retraction. We have kept a record of any response received.

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[1] L. Yang, "Building a Space Model Method Based on the Big Data Map Visual Design," *Wireless Communications and Mobile Computing*, vol. 2022, Article ID 6774922, 8 pages, 2022.

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Research Article

Building a Space Model Method Based on the Big Data Map Visual Design

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In order to explore how to realize visual design of building space model, this paper proposes a method of building space model based on big data map visual design. This method explores the research on how to realize the visual design of map by building space model through the key technical problems and solutions of information recommendation based on big data map. The research shows that the building space model method based on big data map visual design can effectively solve the shortcomings of traditional methods, and the work efficiency is about 65% higher than that of traditional methods. From the perspective of big data, apply the thinking and technology of big data to the field of architectural planning, and promote the innovation and development of architectural planning through the data acquisition, analysis, feedback, and evaluation technology of big data.

1. Introduction

Since the study of urban space and morphology was introduced into China in the 1980s, it has been widely concerned by Chinese scholars. Especially since 2000, related disciplines and fields have developed greatly and show interdisciplinary characteristics [1]. From the macrohuman geography to the microarchitectural space, they are all studying the evolution and development law of urban spatial form. With the coming of the era of rapid urbanization in China, the rapid development and changes of cities have led to the changes of urban morphology. Therefore, studying the composition logic and laws of urban spatial form can provide scientific theoretical basis and reference for urban planning and design. Especially at the moment of the development of digital technology, the support of big data provides technical and methodological support for the high-precision quantitative research of urban form.

As an important carrier of urban quality and vitality, the research on urban morphology has become an important problem to be solved in the process of urbanization of new towns in China, and in-depth research on it is of profound significance [2]. However, looking back on the world, most of the studies focusing on spatial form are qualitative, and few are quantitative; Most of the research data are obtained by the traditional methods such as actual survey, sampling questionnaire, and expert interview, and these research methods and data are not enough to meet the urgent requirements of improving the quality of urban morphology.

In the process of the promotion and popularization of digital technology, big data, as a new technical means, has been widely used by academia and industry, and has been rapidly promoted, which has brought a certain impact on the traditional discipline of urban planning. However, this does not mean that the traditional planning discipline is outdated. On the contrary, big data has greatly promoted the further development of the traditional planning discipline, especially in the field of scientific research and project practice. The two complement each other to form complementary advantages [3, 4]. Compared with traditional planning and research methods, big data has its unique advantages. Due to its large amount of data, high precision, and timeliness of data content, big data can complete many studies that could not be completed in the past. Especially for the complex giant system of city, big data can reduce the error caused by the subjective judgment of planners in actual operation, control the results within a certain threshold range, and ensure the correctness and objectivity of research results and data [5].

The building planning program based on big data mainly includes three stages: data acquisition, storage, and analysis and prediction. Among them, for the data storage stage, the interdisciplinary intersection enables us to use the database technology in the computer field for reference to store the data required for the building planning project. For example, the Hadoop system, which has developed the ecosystem for decades, is used to store the project information, and the BIM closely related to the building is combined to further cross integrate [6]. Big data and architectural planning are shown in Figure 1.

2. Literature Review

Chen and Li said that American architectural planning originated in the 1860s. They introduced the theoretical monograph of architectural planning [7]. It can be seen from William Penner's "Problem Search Method - Introduction to Architectural Planning." His planning method is based on the idea of finding and solving problems. The planning is divided into five categories, objectives, current situation, concepts, needs, and problems, and solves the problems of various subcategories such as function, form, economy, and time in each category. After continuous development and improvement, this method has been greatly applied and expanded in the United States. Lv et al. added the relationship between people on the basis of problem search method, emphasizing the value of people [8].

Daissaoui et al. believe that the task of architectural planning is to help architects reflect the values of eternity, institution, and environment [9]. He divided these value orientations into eight aspects, namely, people, environment, culture, technology, time, economy, aesthetics, and safety. Through further research on the projects listed in the list of value levels, architectural planners can have a comprehensive understanding of the respective topics of different planning projects. The "architectural planning" written by Salisbury, a British scholar, mainly expounds the work to be undertaken by various stakeholders in the actual project and the available methods from the perspective of the owner, which has a very useful reference for the operation of the architectural planning method system.

The "big data era" written by scholar Victor Mayer Schoenberg is the first work of big data research in the United States. Mixajlovna et al. believe that the core of big data is reflected in three aspects: the sample of data is equal to the total cost, and there is no need to pursue accuracy and pay attention to the correlation between data [10]. The "big data era" introduces in detail the great changes brought about by big data to life, work, and thinking through a wealth of practical cases, emphasizing the thinking and application of big data, but rarely involving its specific supporting technologies. Santana et al. created the concept of "forgotten rights" that has been widely used in the media and legal circles [11]. This book focuses on the issue of information security, that is, how people should make reasonable choices about the information they have in the era of big data. Radhakrishnan et al. believe that human behavior factors are not accidental but also have the nature of "outbreak" behind them [12]. In the era of abundant data and information, the expected behavior of human beings can be predicted by using Internet resources, mobile phone data, email text content, and other means. Priyadarshani et al. believe that China's architectural planning started relatively late compared with Europe and the United States. Since the 1980s, China has just begun to study the theories and methods of architectural planning [13]. In the "modern architecture theory" edited by Chinese scholar Liuxianjue, it gives a general introduction to the theory of architectural design planning.

Vasistha and Ganguly believe that the architectural planning theory is mainly based on the Japanese architectural planning theory. In 1990, Vasistha went to Chiba National University to study abroad. After returning home, he wrote the "Introduction to Architectural Planning" according to his doctoral thesis [14]. In the book, the procedure of architectural planning is summarized into seven stages: determination of objectives, investigation of external environment, investigation of internal conditions, space conception, technical conception, economic planning, and report formulation.

3. Method

3.1. Spatial Data Characteristics. According to the first law of geography, the characteristics of spatial data are spatially dependent: geographical objects with near spatial location are more similar than those with relatively far spatial location, which reflects the spatial dependence of spatial parameters, that is, the value of a variable at a certain location K is related to the observed value at its nearest neighbor location J. Because spatial data are often affected by these two essential characteristics, which leads to the invalidity of the regression analysis model whose error obeys the assumption of normal distribution, some global statistical analysis methods cannot be directly applied to spatial modeling. The first law of geography by Tobler can be described as shown in the following equations [15].

$$y(k) = f(y_k), \tag{1}$$

$$y_k = p_k \beta_k + \sigma^2. \tag{2}$$

The global spatial autocorrelation index is mainly used to explore the spatial characteristics of attribute values in the whole region. Indicators indicating global spatial autocorrelation mainly include GlobalMoran's index I, Global Geary's index, and Geti's index G. The Moran index is usually used to measure the relationship between spatial elements. Its value is similar to the correlation coefficient in general statistics, with a value of ±1. Judging the global Moran index can conduct quantitative analysis on the spatial pattern. For example, the position of the observation index between ±1 can judge the spatial correlation of the observed

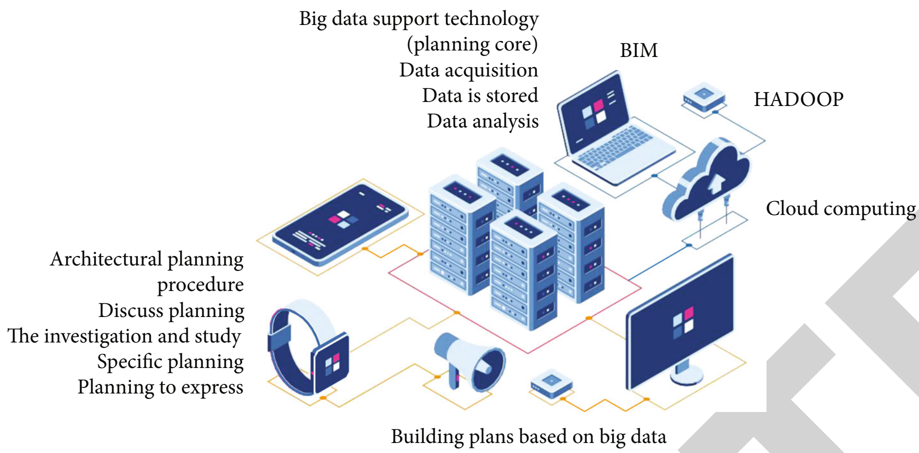

Figure 1: Big data and architectural planning.

data attributes, which is usually divided into three relationships: clustering, discrete, and random [16]. Approximately 1 indicates that the positive correlation of data spatial attributes is in a concentrated state, while the negative correlation is in a discrete state. When the index is equal to 0, the noncorrelation is in a random state. The calculation is shown in the following equations.

$$I = \frac{1}{p} \frac{\sum_i \sum_j w i_j (z_i - \bar{z})(z_j - \bar{z})}{\sum_i (z_i - \bar{z})^2}, \tag{3}$$

$w_{ij} = 1$When space unit i is adjacent to space unit j,

$w_{ij} = 0$When space unit i is not adjacent to space unit j.

Due to the multidimensional concept involved, it is also necessary to define concepts such as spatial weighting matrix of adjacent spaces in the research process. Its form is shown in the following:

$$w = \begin{matrix} w11 & w12 & w1n \\ w21 & w22 & w2n \\ wn1 & wn2 & wnn. \end{matrix} \tag{4}$$

Compared with the global autocorrelation, the local spatial autocorrelation assumes that the space is homogeneous. However, in fact, from the internal point of view of the study area, it is rare that the spatial autocorrelation of each local area is completely consistent. There are often spatial autocorrelations of different levels and properties. This phenomenon is called spatial heterogeneity. The spatial heterogeneity of regional elements is very common. The global spatial autocorrelation analysis focuses on studying the spatial distribution state of an attribute value in the whole space. Another key point of spatial autocorrelation analysis is to study the spatial distribution state of the attribute value of a spatial unit in some local locations. The local spatial autocorrelation analysis can effectively detect the spatial differences caused by spatial autocorrelation [17]. The spatial heterogeneity of spatial autocorrelation can be expressed by LISA. LISA is the general name of a group of indexes. Most studies use the Local Moran's I index. In essence, the index local I decomposes the global index I into various spatial units. For a certain space I, the local relationship index can be expressed as shown in the following.

$$I = \frac{z_i - \bar{z}}{p} \sum_{j=1} w(i, j)(z_i - \bar{z}). \tag{5}$$

The SAR model has three main functions for the quantitative study of spatial phenomena: first, to deeply understand the spatial phenomena, and it is possible to evaluate the formulation of policies and determine the corresponding spatial planning measures based on the interpretation of the phenomena. Secondly, predict the development level, and model a certain phenomenon to predict the future development value of the spatial region or the value of other regions with similar spatial characteristics. The basic content is to build a continuous and accurate prediction model [18]. Third, evaluate policies, use regression analysis to explore the development of some assumptions or scenarios, better understand spatial phenomena, and evaluate the possible spatial benefits through the implementation of policies or strategies. In a word, through regression analysis, we can model, predict, and evaluate the spatial relationship. Regression analysis can also help us to explain the internal factors of the observed spatial patterns. The model reflects that the influencing factors of dependent variables will be used in other regions or called regional overflow representation through spatial transmission mechanism, as shown in the following.

$$y = \rho W_1 y + X\beta + e, \tag{6}$$

$$e = \lambda W_2 e + \varepsilon. \tag{7}$$

The combination of the Bayesian model and statistical data can make full use of relevant knowledge and the information of previous sample data, especially when the sample data is sparse or difficult to obtain, which is also a common problem in the field of building energy consumption research. The Bayesian model probability distribution table is used to represent the strength of correlation. Considering the combination of sample knowledge and prior information, it can solve the problems of incomplete data such as missing and missing energy consumption data and improve the accuracy of physical model and geographical model in the study of building energy consumption. The Bayesian model interprets a random event A and random event B in the form of conditional probability and likelihood probability. Its basic expression is shown in the following [19]:

$$p(\theta|y) = \frac{f(y|\theta)p(\theta)}{f(y)}. \tag{8}$$

3.2. Intelligent Planning and Analysis. Intelligent planning and analysis refer to the use of computer technology to intelligently and automatically provide the basis for the spatial conception and prediction of architectural design. In the era of small data, the basic information of the project is generally obtained according to the actual investigation and used as the blueprint to formulate the corresponding construction assignment. Among them, the methods involved mainly include the multifactor analysis method and color card paper method. The data comes from the semantic analysis of basic research, so it is not representative in the type of data. Although the planning analysis is supported by corresponding software, it is still not intelligent [20].

In the era of big data, data sources are diverse and rich in types. The relevance thinking of big data can be used to redefine and mine planning knowledge. At the same time, due to the progress of big data storage technology, the demand data of stakeholders can be accumulated continuously. By analyzing these data, we can master the needs of owners or users. Therefore, planning and analysis show the characteristics of intelligence. For example, SouFun can obtain the views of house viewing users and the satisfied house types of potential buyers, and designers can use this as a basis for house type planning and design. For another example, by knowing the behavior data of residents in the room, we can also understand the advantages and disadvantages of streamline form and space configuration by correlation analysis of the data. Mining the correlation between user demand data can provide different perspectives and ideas for planning [21]. In the massive unstructured data, the possibility of mining planning knowledge is formed through the correlation analysis of data and the corresponding clustering mining algorithm.

Intelligent planning analysis is the further development of computer-aided design/planning. With the further development of artificial intelligence, it will play a more beneficial role in building planning. While planning and analysis are becoming more intelligent, methods are particularly important. While being able to expand, methods are particularly important. The introduction of extension, data mining, visualization, deep learning, machine learning, and other methods will promote the further development of building planning and analysis. To sum up, the intelligence of planning and analysis will become a significant feature in the context of the Internet era and will have further development with the help of computer technology [22]. The intelligentization of building planning and analysis is shown in Figure 2.

3.3. System Flattening Principle. Flattening has two meanings, one is the design interface, and the other is the enterprise management mode. The system flattening principle defined refers to the processing method of operation. As for the management mode of the enterprise, one of them is a set of top-down pyramid management system formed with the expansion of the enterprise scale, which is often easy to cause the problem of low response from top to bottom. Therefore, a flat work organization model is proposed. Compared with the former, this model increases not the vertical management level, but the horizontal management dimension. For example, the working mode of Haier is based on the single, and its purpose is to form a connection with the user market to the maximum extent. In the IT field, the system is in high-frequency iteration at any time, so the user's preference parameters for each version are of particular concern in software development [23]. In order to effectively know user needs and interact with users, a flat working system is required. In this mode, better user experience and better user service can increase their market competition chips. At the same time, because software engineers and end users directly participate in the interaction, they can bring a better experience to the audience, that is, truly make "user data sound."

Big data analysis is the process of running analysis algorithms on a powerful supporting platform to discover potential values hidden in big data, such as hidden patterns and unknown correlations. According to the collected function, form, and economic big data, the specific planning stage is carried out from three aspects: (1) semantic analysis of user needs using Internet data, (2) relevance matching of project space-time data, and (3) real-time monitoring of dynamic data such as construction cost and energy consumption. The analysis of building planning data based on big data is shown in Table 1. The corresponding table of spatial distribution and planning analysis of network requirements is shown in Table 2.

Returning to the field of architectural planning, I believe that a third-party supervision system can be introduced into architectural planning, which solves some problems existing in the contemporary architectural planning industry, ensures the neutrality and objectivity of architectural planning, and enables architectural planning to be effectively evaluated and supervised. It is considered that in the data age, this working mode makes the third-party planning organization need to communicate with architects, project owners, and end users, and the requirements for coordination ability are too high. In specific work links, the third-party system needs to coordinate multiple stakeholders, and the planning efficiency is not guaranteed [24].

With the gradual development and improvement of computer technology, it is practical and feasible to create a system interface for direct dialogue with architects. For example, using platforms such as a WeChat official account, QQ group, and questionnaire star, architects can effectively

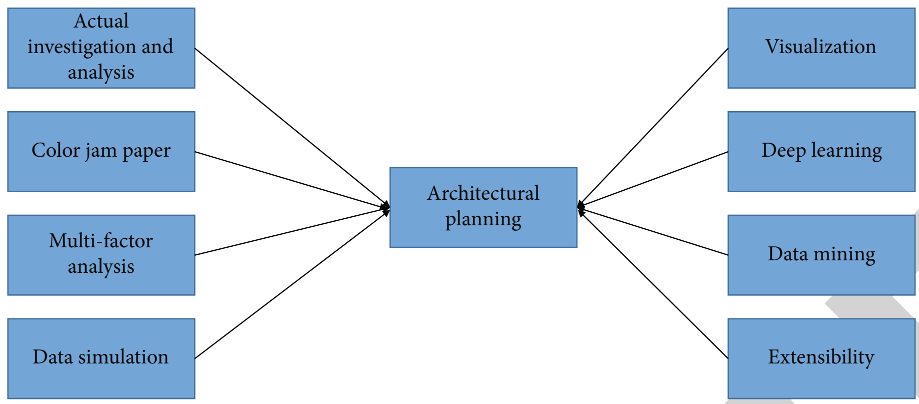

Figure 2: Intelligent building planning and analysis.

Table 1: Analysis of building planning data based on big data.

Category	Analysis content	Analytical method	Coverage planning content
Semantic analysis of user requirements	Mining and analyzing users' needs based on Internet data	Semantic recognition, data mining, and emotion computing	Form planning and function planning
Spatiotemporal data association matching	Behavior space-time correlation degree calculation, user demand space perception correlation degree calculation	Relevance analysis and social calculation	Site planning, scale planning, space planning, function planning, and form planning
Real-time monitoring of dynamic data	Real-time monitoring of construction cost, energy consumption, and other data	Data visualization	Economic planning and technical planning

Table 2: Corresponding table of spatial distribution and planning analysis of network requirements.

Space planning	Concrete content
Entrance selection	Opening towards the place with high density increases vitality and forms positive promotion
Traffic analysis	Based on the real-time road conditions of the site, reasonably select the access between the site and the surrounding area

interact with user owners and other stakeholders. Architects can also discuss the architectural planning scheme through big data analysis at any time. On the one hand, they can understand the needs, and on the other hand, they can get demand feedback to further improve the planning scheme. The whole process forms a loop of continuous circulation, which makes the architectural planning more rational and effective. Through this kind of system construction, architects can really know the needs of users, so as to better formulate design goals [25], as shown in Figure 3.

4. Results and Analysis

Economic planning is an aspect that architects need to consider separately when planning construction projects. William Penner and Mr. Zhuang Weimin both discussed it in their monographs. Economic factors determine the possibility of the implementation of a construction project and will directly affect the quality of the completed buildings [26]. The real estate market pays more attention to premise planning and research. On the one hand, it also considers the economic factors, that is, whether the house price after the comprehensive construction cost can be borne by the target group. For public buildings, the price of building materials and many economic factors are also changing, which will also affect some corresponding factors of the construction industry in real time. In the construction industry, Guanglianda has begun to use big data to integrate the construction market and sort out the real-time project cost of building materials.

The economic analysis of the real estate market is one of the aspects of architectural planning analysis. When making other types of architectural planning, we need to consider not only unilateral issues such as the cost of building materials but also a comprehensive consideration process [27]. The semantic analysis, emotional analysis, and technical planning mentioned above will become part of the comprehensive consideration of economic planning. At the same

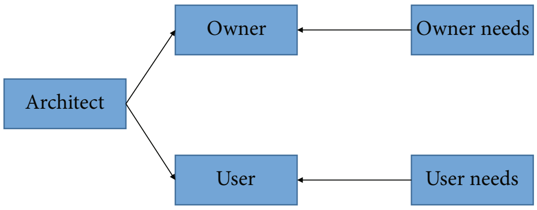

Figure 3: Schematic diagram of flat working mode of building planning.

time, the data of construction economy also needs to be continuously improved, so as to make the big data of construction economy more targeted.

Through real-time monitoring of more than 500 real estate intermediary websites in China, the house price index of the second-hand housing market is compiled. According to this study, it can be gradually extended to many first- and second-tier cities in China. When making specific economic planning, it can provide a good reference for the positioning of construction cost and price [28], as shown in Figure 4.

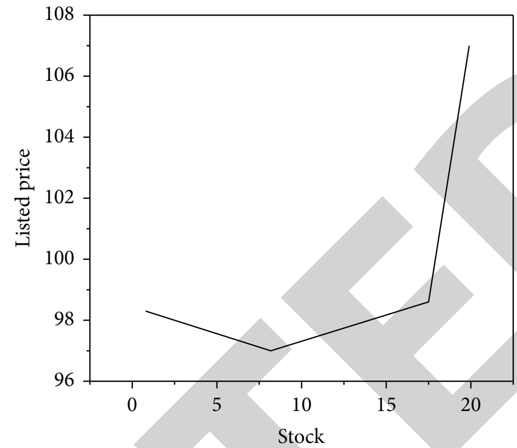

Figure 4: Listing price index of stock housing in four selected first-tier cities.

Understand potential buyers from the demand side. The monitoring and analysis on the activity and attention of the demand side are mainly based on the search proportion, such as the attention of potential buyers on the type of housing supply, geographical location, etc. Among the traces of active Internet users, mining low-density keywords, garden, decoration, and the sense of single family are the three most intuitive perceptions of low-density by Internet users. Therefore, when planning low-density residential types, these three keywords can be used as planning concepts. It can be seen that the second direction is to carry out real-time mining and analysis on the needs of users, so as to provide reference for the construction economy.

Architectural planning has been able to preliminarily support site planning, space planning, image planning, technical planning, and economic planning. In the analysis stage, building planning analysis based on big data should also take the visualization of data as the basis for analysis. Under the intuitive interface, the architect makes corresponding judgments, so that the decision-making stage can be further carried out. For example, in the interface of site visual analysis, assuming that the land is commercial land, it can be seen from the thermal map that the business should gather people as much as possible, and the thermal map can better show the activity of people. Therefore, the planning of commercial land can be based on this. The planning and analysis of space, image, technology, and economy are also based on visual operation, so no more discussion will be made.

From the use of building materials in various countries, concrete is the most frequently used building materials. This is because reinforced concrete plays a structural role in many high-rise residential buildings, so it is widely used in various countries. Steel is commonly used in European and American countries, such as France and the United States. From the case, glass is a material that must be used in all residences. The label refers to the buildings dominated by glass curtain walls and other glass. As the birthplace of high-rise modern buildings, the United States has become the largest country in the use of glass in its residential buildings. As for the use of wood, it is commonly used in various countries, and the gap is not large, which shows that wood as a building material not only is beneficial to create a building atmosphere but also gives the character of being close to the environment. The use of bricks shows the national character of taking bricks as a historical tradition, such as European countries and American countries.

From the published cases, the use of concrete has shown an upward trend in the past 10 years, reaching two peaks in 2017 and 2018 and then declining after 2021. Steel has the same upward trend, reflecting the demand change of housing construction. The use of wood peaked in 2019 and then fell to the level around 2017 in 2019. The use of glass building materials shows the law of scattered use from top to bottom. The use of bricks has increased and maintained a certain gentle trend. From the use of these materials, concrete and steel, as the main building materials, maintained an upward trend, only slightly decreased in 2016, which may be related to the fact that this year's case has not been released. The use of wood has a downward trend in recent years, and glass also shows an unstable trend, indicating the randomness of glass as a large curtain wall in residential design. Brick is related to the planning concept of housing renovation and housing design in specific countries, so there will be certain practice cases every year.

5. Conclusion

With the further development of the Internet, cloud computing, and the Internet of things in the information age, the total amount of data in various industries is growing at an unprecedented rate. The traditional data statistics and analysis methods have been unable to deal with the structural and unstructured data information with "Pb" as the unit, thus giving birth to the big data technology. As a material construction process, the construction industry also continuously produces various types of relevant data in the whole life cycle of its planning, design, construction, and operation stages, such as survey data, design data, construction data, and operation data. However, the massive and diversified characteristics of construction data have not re integrated the current resource allocation of the construction industry, and the insufficient attention to network data information has made the planning, design, and construction stages more and more tired. How to integrate these big data and store, analyze, and mine knowledge to promote the transformation and development of the construction industry, especially whether reasonable and correct decisions can be made in the planning stage, is an urgent problem for the construction industry.

In this paper, the quantitative research of urban form supported by big data has changed the traditional research ideas, accurately described the characteristics of urban form, and accurately defined the boundaries of various elements of urban form. The traditional qualitative research on the complex spatial form of the city lacks sufficient accuracy. At the same time, because the data is not easy to obtain, it also lacks the grasp based on the overall perspective. The inaccuracy and incompleteness of research and analysis have also led to the lack of understanding of the complexity of urban morphology in urban theoretical research.

Data Availability

The data used to support the findings of this study are available from the corresponding author upon request.

Conflicts of Interest

The author declares that they have no conflicts of interest.

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Retraction

Retracted: Control Optimization of Scenic Spot Navigation System Based on Map Matching Algorithm

Wireless Communications and Mobile Computing

Received 18 July 2023; Accepted 18 July 2023; Published 19 July 2023

This article has been retracted by Hindawi following an investigation undertaken by the publisher [1]. This investigation has uncovered evidence of one or more of the following indicators of systematic manipulation of the publication process:

(1) Discrepancies in scope
(2) Discrepancies in the description of the research reported
(3) Discrepancies between the availability of data and the research described
(4) Inappropriate citations
(5) Incoherent, meaningless and/or irrelevant content included in the article
(6) Peer-review manipulation

The presence of these indicators undermines our confidence in the integrity of the article's content and we cannot, therefore, vouch for its reliability. Please note that this notice is intended solely to alert readers that the content of this article is unreliable. We have not investigated whether authors were aware of or involved in the systematic manipulation of the publication process.

Wiley and Hindawi regrets that the usual quality checks did not identify these issues before publication and have since put additional measures in place to safeguard research integrity.

We wish to credit our own Research Integrity and Research Publishing teams and anonymous and named external researchers and research integrity experts for contributing to this investigation.

The corresponding author, as the representative of all authors, has been given the opportunity to register their agreement or disagreement to this retraction. We have kept a record of any response received.

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[1] W. Cui, “Control Optimization of Scenic Spot Navigation System Based on Map Matching Algorithm,” *Wireless Communications and Mobile Computing*, vol. 2022, Article ID 5958782, 7 pages, 2022.

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Research Article

Control Optimization of Scenic Spot Navigation System Based on Map Matching Algorithm

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In order to solve the problem that the smart phone GPS positioning technology cannot guarantee the location accuracy in the scenic spot navigation system, a tourist spot matching method based on the improved HMM model was proposed. Firstly, the traditional linear road model is improved in electronic map design. Secondly, the concept of minimum peripheral error rectangle is proposed based on the theory of error ellipse. Then, combined with location data, road data, and scenic spot data, the improved HMM model is used to calculate the matching road. Finally, Matlab simulation experiment and comparison experiment are carried out. The results show that the accuracy of the map matching algorithm based on the improved HMM model can reach 94.5%, and the average accuracy can reach 93.1%, which is 3.6% higher than that of the traditional HMM model. The test results show that the proposed algorithm is correct and practical and has a good application prospect.

1. Introduction

The development of smart tourism in foreign countries is relatively early. The basic information of scenic spots is collected mainly by "3S" technology (Global Positioning System—GPS, Geographic Information System—GIS, and Remote Sensing technology—RS). The collected information is processed and analyzed to provide location services for tourists and staff and realize intelligent monitoring and visual management of scenic spots and intelligent navigation services (Figure 1), so as to properly divert and control the personnel and vehicles in scenic spots [1]. In the past 30 years of reform and opening up in China, with the rapid economic development, cultural tourism industry is also full of vitality. Some large and medium-sized tourist attractions have begun to try to use "3S" technology to establish a relatively perfect intelligent tourism integration network and to connect the tourists around the world via the Internet, which become gradually prominent in the office, ticket, monitoring, map positioning, online tour, and other aspects. However, many small and medium-sized scenic spots are still in the initial stage of comprehensive information construction. The scenic spot portal website has been basically established to introduce and publicize the scenic spot through multimedia and web pages. In general, smart tourism is still in its infancy in China, scenic spots have not fully adapted to the coming Internet thinking, and technological changes have not fully spread to small and medium-sized scenic spots [2]. However, smart tourism is the direction, and Internet thinking is changing traditional industries little by little [3].

Smart tourism has developed rapidly in recent years, and the Touring Navigation Service (TNS) has higher and higher requirements. The high-precision real-time positioning function is very important for walking tourists [4]. However, there is still room for improvement in the positioning and navigation functions provided by existing mobile location service applications in scenic spots. These map applications cannot provide the same schedule as in urban traffic roads. Due to clock synchronization, propagation delay, electromagnetic interference, and other factors, there will be a lot

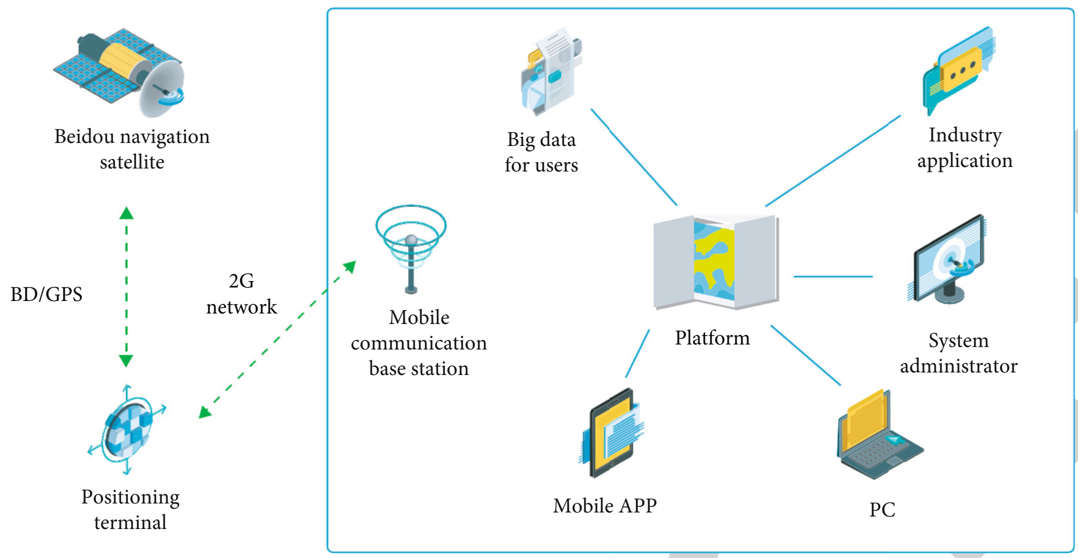

FIGURE 1: Scenic area navigation system.

of errors. The general approach is to use different and various filtering methods to eliminate errors. In spite of this, the horizontal error range for civil standard positioning system is still 20 m~30 m. In order to further improve positioning accuracy and map display effect, map matching technology arises at the historic moment [5].

Navigation and location service is an indispensable part of tourism navigation system. With the development of 3D technology, 3D scenic navigation system has become one of the key development directions. By building 3D virtual scenes, it provides tourists with more intuitive and clearer location and direction, greatly improving the navigation experience [6]. But at the same time, GPS data error and map system error exist in 3D map positioning using mobile phone GPS technology. GPS data quality will be affected by the satellite itself, signal transmission and reception, positioning environment, and other aspects, leading to positioning deviation. However, in the process of manual map design, road information cannot be completely consistent with the reality, and there is conversion error when GPS position is projected onto the map [7]. In the 3D scenic navigation system, positioning points often fall in buildings or trees due to positioning errors, resulting in the inability to judge the location and direction. Therefore, it is of certain significance to introduce map matching technology to improve the positioning accuracy of scenic navigation system [8].

2. Literature Review

GPS positioning technology developed earlier in foreign countries. From the 1970s when the U.S. Department of Defense built GPS satellite navigation system, it has been widely used in many fields after nearly 40 years of application practice and continuous improvement and innovation. Since the US government cancelled the policy of selective availability (SA) in May 2000, the precision of civil GPS positioning has been greatly improved, and other countries in the world have also begun to apply it in space technology, transportation, geological remote sensing exploration, and communication fields on a large scale. In order to further improve GPS positioning accuracy and reduce the impact caused by various errors, various optimization algorithms have been proposed, including filtering algorithm for GPS positioning signal and map matching algorithm with electronic map information [9]. Both have been widely studied in the field of vehicle navigation equipment. In the navigation field of mobile devices, the matching algorithm also needs to consider the real-time positioning under high dynamic conditions, which puts forward higher requirements for the computational complexity and operational efficiency of map matching algorithm. Therefore, in recent years, map matching technology has gradually become a research hotspot [10].

In the past two decades, scholars have developed a large number of map matching algorithms. These algorithms are generally divided into simple methods, topological methods, weight-based methods, probabilistic methods, and advanced theory methods. The simple method mainly considers only one factor, such as the nearest distance (including the nearest distance from point to line segment and the nearest distance from line segment to line segment). This method is simple and fast. The topological method not only considers these geometric relations but also considers the topological relations of the road network. This method has better performance in dealing with parallel and intersection sections than the simple method. The weight-based method also considers other factors, such as speed, direction, and path topology, so as to achieve a good balance between complexity and accuracy. The probabilistic method uses the error ellipse region to determine the candidate road segment, and the error ellipse parameters are derived from the error variance-covariance matrix of positioning equipment. Advanced theoretical methods include evidence theory, fuzzy logic, and neural network. Generally, such methods require more input and sacrifice performance while obtaining higher accuracy [11].

In this article, through the research and summary of GPS positioning technology and existing matching algorithm, map matching technology is introduced to improve the positioning accuracy, so that moving objects can correctly display location information, and a scenic spot map matching algorithm based on improved HMM model is proposed to improve the positioning accuracy of scenic spot navigation.

3. Research Methods

3.1. Overview of Key Technologies

3.1.1. Overview of GPS Positioning Technology. GPS system is a global real-time positioning and navigation system developed by the US military in the 1970s through artificial satellites, which is mainly composed of GPS satellite constellation, ground monitoring system, and GPS signal receiver [12]. The basic principle of GPS positioning is as follows: the user receives signals from the satellite, gets the position and clock data of the satellite, and uses the method of space distance intersection to calculate the user's three-dimensional position. The distance between the user and the satellite can be solved by the product of the time interval between the transmitting and receiving of the satellite signal and the propagation speed of the radio wave and can also be calculated by the distance formula according to the user coordinates and the satellite coordinates [13].

3.1.2. Overview of Kalman Filter Technology. From the positioning principle of GPS system above, it can be seen that the accuracy of GPS is affected by various errors. In essence, there is a probability distribution of GPS errors. On the other hand, GPS signal in map matching can be regarded as a random time series with discrete and Gaussian noise distribution. Therefore, it is feasible to choose a suitable mathematical model to establish GPS error correction model. However, Kalman filter is a state-space time-domain filtering method based on Gaussian linear system. It processes the nonstationary and multidimensional input signals by defining the state model equation and observation model equation and then recursively calculates the minimum mean square error estimation and outputs the corrected value [14].

3.1.3. Map Matching Principle. Kalman filter corrects the position of the original GPS by establishing the data error model; although Kalman filter can reduce the error caused by GPS satellite and signal receiver, it cannot eliminate the error caused by the mapping of anchor points to the map, so map matching technology is used in navigation system. Its working principle is as follows: assuming that the user is always moving on the road, the road data of the electronic map is used to analyze the correlation between the registration point and the road, and the positioning information is associated with the road information by the theoretical algorithm or mathematical model, so as to determine which road the user is most likely to be on and which position on the road [15]. The map matching principle is shown in Figure 2.

3.2. Scenic Area Electronic Map Design and GPS Data Processing. Electronic map is the database of map matching technology, which organically combines the actual geospatial data and nonspatial attribute information to provide users with the required positioning and navigation functions. In the navigation system of scenic spot, the design of electronic map mainly follows the following steps: first, analyze the composition of map data, and build a road model in line with the characteristics of scenic spot, next, an improved model of rectangular road is proposed, and then, the corresponding map database storage structure is designed. Finally, the electronic map of scenic spot is completed to realize the visualization of spatial data of scenic spot. Due to GPS data acquisition process, it will produce errors and affect the result of map matching. Therefore, proper GPS data processing is essential before map matching. Firstly, the drifting or missing data are repaired and processed, and then, the improved Kalman filtering method is used to filter GPS data. Finally, numerical methods are adopted to reduce the error of coordinate transformation in the process of coordinate transformation [16].

Kalman filter has become a mature error correction tool. So this article uses Kalman filter method to denoise GPS data. However, with the increase of observation data, the estimated variance of Kalman filter may produce infinite results, which causes the filter to diverge. In order to solve the problem of filtering divergence, this article proposed improvements based on Kalman filter by adding fading factor method [17]. The fading factor $\lambda(k+1)$ is defined in the following formula.

$$\lambda(k+1)=\begin{cases}1 & (\lambda_0 \geq a),\\ \dfrac{1}{\lambda_0}+b & \&\&(\lambda_0 < a).\end{cases} \tag{1}$$

Meanwhile, λ_0 satisfies the following equation:

$$\lambda_0=\sum_{j=0}^{3}\sum_{i=0}^{3} fabs\left(k_{ij}\right). \tag{2}$$

Then, in the equation of one-step prediction variance, the fading factor $\lambda(k+1)$ is introduced, and equation (3) is obtained.

$$\mathrm{P}_{k+1/k}=\lambda(k+1)\Phi_{k+1,k}\mathbf{P}_k\Phi_{k+1,k}^T+\mathrm{Q}_k. \tag{3}$$

Among which, a is the given system threshold value, b is the compensation coefficient, $fabs(.)$ is taking the absolute value, k_{ij} is the gain value of the gain matrix of the ith row and j column. By adjusting a, b values to ensure that the fading factor increases the gain, it reduces the divergence of filtering. As GPS data is collected in a relatively low-speed environment, the values of a, b can be taken as $a=2, b=0.5$.

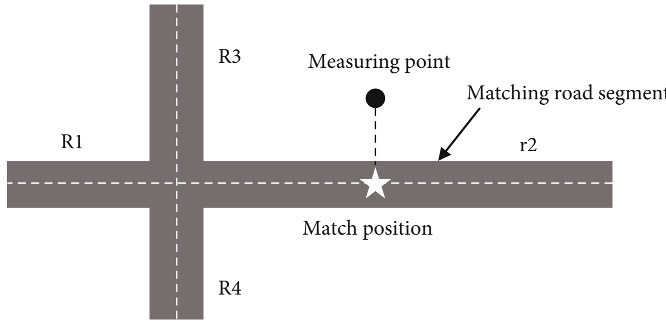

Figure 2: Map matching principle.

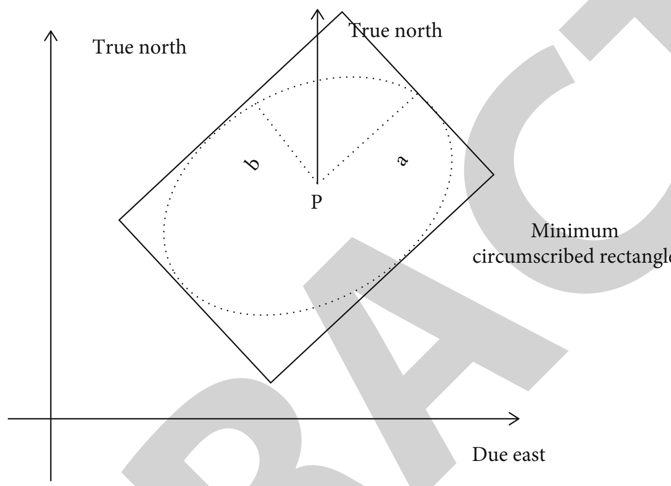

Figure 3: Minimum peripheral error rectangle.

Table 1: Experimental track data.

	Total number of original registration points	Total number of registration points after data preprocessing	Sampling interval
Track 1	159	151	5 s
Track 2	173	165	5 s
Track 3	215	202	5 s

3.3. Design and Implementation of Scenic Spot Map Matching Algorithm

3.3.1. Overall Framework of the Algorithm. The input data of the algorithm includes map data and location data. Map data includes road, road topology, and landscape feature information, and location data includes GPS latitude and longitude and time information. In order to reduce the impact of data on the matching process, it is necessary to conduct error correction preprocessing and coordinate transformation processing for data to provide effective data sources for map matching and ensure the feasibility of map matching algorithm [18]. The error area is used to reduce the number of candidate sections, and the calculation is related to the positioning accuracy of GPS. In this article, the minimum peripheral error rectangle is proposed based on probability and statistics method to determine the error region. Then, the section intersecting the error rectangle is calculated as the candidate section. The selection of the candidate section is not only related to the error area but also related to the width of the road. After the candidate road section is determined, the improved HMM model is used to select the optimal matching road section [19]. In order to improve the matching accuracy, historical anchor points and scenic spot information are added in the calculation of transfer probability and observation probability. Finally, the vertical projection method is directly selected to calculate the position of projection points on the matched section, and the anchor points are matched to the road [20].

3.3.2. Selection of Error Area. In order to improve the efficiency of map matching, reducing the search scope of road is a fast and effective method. The emergence of the concept of error ellipse makes many researchers take it as one of the search methods for candidate sections. The basic idea of this method is that there are positioning errors in the measurement of anchor points, and the distribution of anchor points is always scattered in the error area with a certain probability, that is, in this error area, it is very likely to

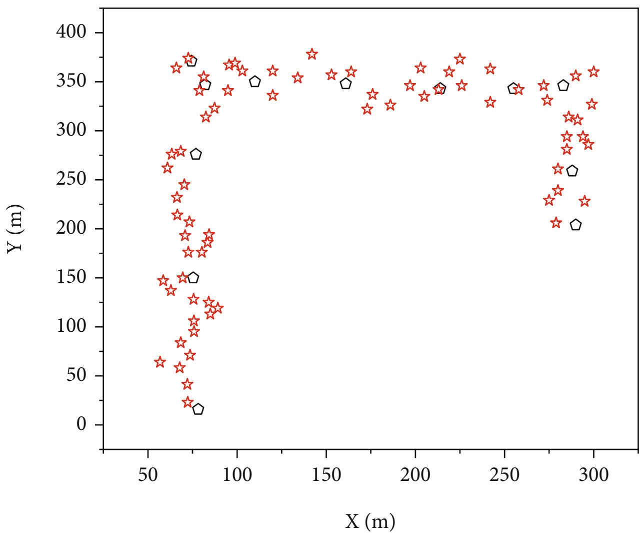

Figure 4: The experimental results of track 1.

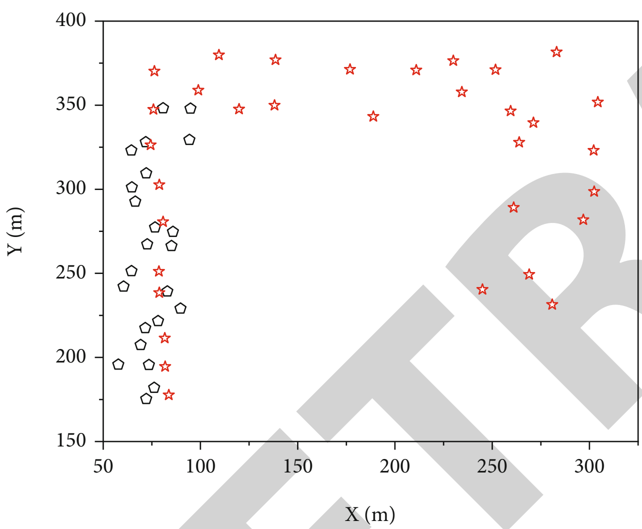

Figure 5: Map matching results of track 2.

contain the real location of the anchor points. Therefore, sections appearing in the error region can be selected as candidate sections. According to the law of probability and statistics, the distribution of registration points is elliptic, so it is called error ellipse. Formula (4) is defined as follows:

$$\begin{cases} a = \widehat{\sigma}_0 \sqrt{\dfrac{1}{2\left(\sigma_x^2 + \sigma_y^2\right)} + \sqrt{\sigma_x^2 - \sigma_y^2 + 4\sigma_{xy}^2}}, \\ b = \widehat{\sigma}_0 \sqrt{\dfrac{1}{2\left(\sigma_x^2 - \sigma_y^2\right)} + \sqrt{\sigma_x^2 - \sigma_y^2 + 4\sigma_{xy}^2}}, \\ \Phi = \dfrac{\pi}{2} - \dfrac{1}{2} \arctan\left(\dfrac{2\sigma_{xy}}{\sigma_x^2 - \sigma_y^2}\right). \end{cases} \tag{4}$$

a and b distributions are represented as the major axis and the minor axis of the error ellipse. σ_x^2 is the error variance in the east-west direction, σ_y^2 is the error variance in the north-south direction, $\widehat{\sigma}_0$ is the adjustment error of the weight, σ_{xy} is the covariance of the error, and Φ is the angle between the major axis of the ellipse and the y-axis, by adjusting the size of $\widehat{\sigma}_0$ to obtain different confidence, so as to control the range of error region. When $\widehat{\sigma}_0 = 3.03$, the error ellipse can obtain 99% confidence [21].

In this article, linear roads are extended to rectangular roads, so the complexity of calculating candidate roads needs to be considered. In order to reduce the calculation effort, an improved minimal peripheral error rectangle (MEER) is proposed based on the error ellipse, as shown in Figure 3. The rectangle is tangent to the vertices of the long and short axes of the error ellipse, and its length and width can be calculated by formula (5) as follows:

$$\begin{cases} l = 2\widehat{\sigma}_0 \sqrt{\dfrac{1}{2\left(\sigma_x^2 + \sigma_y^2\right)} + \sqrt{\sigma_x^2 - \sigma_y^2 + 4\sigma_{xy}^2}}, \\ w = 2\widehat{\sigma}_0 \sqrt{1/2\left(\sigma_x^2 - \sigma_y^2\right) + \sqrt{\sigma_x^2 - \sigma_y^2 + 4\sigma_{xy}^2}}. \end{cases} \tag{5}$$

In general, the center of the error area is the user's GPS anchor point obtained. In the preprocessing stage of GPS data, the location of the anchor point is modified to correct the obtained GPS information to a more close to the real position. Therefore, the corrected position is taken as the center of the error region when calculating the error rectangle.

3.3.3. Improve Matching Algorithm of HMM Model. The map matching process has two basic steps: one is to determine which road the location point is on. The second is to determine the exact location of the position point on the road. Therefore, the key of map matching is the correct matching of the lock-in section. Considering the matching efficiency and matching accuracy of the algorithm, as well as the behavior characteristics of tourists in scenic spots, this article proposes a matching algorithm based on the improved HMM model. The most important thing in HMM model construction is to define state transition probability and observation probability. The specific innovation points of the scenic spot matching algorithm include the following two points: the activity characteristics of tourists are taken into account in the calculation of the transfer probability, and the correlation factor between sections and scenic spots is added to reduce the error of intersection matching. When calculating the observation probability, the influence of historical anchor point on the current observation variable is considered in HMM model for the first time, so as to improve the accuracy of road matching [22].

The traditional HMM model consists of five basic elements, which are implicit state set, observation variable set, state transition probability, observation probability, and initial state probability. In the improved HMM algorithm for

Table 2: Matching accuracy of the three trajectories.

	Track 1	Track 2	Track 3	Average accuracy
Improved algorithm in this article	94.5%	91.1%	93.8%	93.1%
Traditional algorithm	90.1%	89.8%	88.6%	89.5%

scenic spot map matching, GPS track sequence $P = \{p_t | t = 1, 2, 3, \cdots, m\}$ is the set of observation variables. According to each GPS track point p_t, the corresponding candidate road section set $R_t = \{r_t^i | i = 1, 2, 3, \cdots, n\}$ is the recessive state set. State transition probability $\{P(r_t^j | r_{t-1}^i)\}$ represents the probability that the recessive state of $t-1$ at the previous time will transfer to the recessive state of t at the next time. In the traditional HMM model, observation probability represents the probability of obtaining observation points in the current recessive state. However, in this article, observation probability not only depends on the state at the current moment but also depends on the influence of historical observation points at the previous moment on the current observation point, denoted as $P(p_t | r_t^j, p_{t-1})$. Finally, Viterbi algorithm is used to obtain the sequence of road sections with the maximum joint probability corresponding to trajectory P, which is called the optimal matching road section, denoted as $R^* = \{r_t^* | t = 1, 2, \cdots, m\}$.

4. Result Analysis

This article has introduced the scenic spot map matching algorithm based on the improved HMM model in detail. In this section, GPS data will be selected to verify the algorithm in the Matlab simulation environment. The validity of the data, the availability of the algorithm, and the correctness of the matching results are tested and analyzed [23].

In order to verify the matching accuracy of the proposed algorithm, this article selects a map matching algorithm based on HMM model for comparative experiment. The traditional algorithm is also used to correct and match the location of low-speed moving objects, which mainly considers the information of registration points, distance of sections, and topology information of roads. Based on these characteristics, the traditional algorithm has a good comparison with the improved algorithm in this article.

In the experiment, this article chooses three different paths for the experiment: (1) path 1 passes near a tall building, but the signal effect is not particularly ideal; (2) path 2 passes through many intersections; (3) path 3 passes through many scenic spots [24]. Through these three experiments, not only the accuracy of the algorithm, but also the adaptability of the algorithm is verified. In the simulation experiment, the data contents of three groups of positioning tracks are shown in Table 1.

The experimental results of track 1 are shown in Figure 4. The weak GPS signal leads to a large positioning offset, and the traditional algorithm makes errors in the matching process. However, the improved algorithm in this article shows better matching effect.

Figure 5 shows the experimental results of track 2. At the intersection, the improved algorithm in this article not only considers the topological information of the road, but also the similarity between the track direction and the road direction. Therefore, considering the trajectory direction can improve the matching accuracy [25].

The matching accuracy of the improved algorithm and the traditional algorithm in this article is shown in Table 2, which, respectively, shows the matching accuracy of the three trajectories.

It can be concluded from Table 2 that the accuracy rate of the scenic spot map matching algorithm using the improved HMM model can reach 94.5% and 93.1% on average, which is 3.6% higher than the map matching algorithm of the traditional HMM model. Experimental results show that the proposed algorithm has good accuracy and adaptability.

5. Conclusion

Aiming at the problem of inaccurate positioning in the navigation system of scenic spots, this article introduces map matching technology to improve the accuracy of positioning, so that the moving object can display the location information correctly. By studying the development status of map matching technology at home and abroad, combining the characteristics of scenic spot location and the source of location error, this article proposes a scenic spot map matching algorithm based on hidden Markov model (HMM). The algorithm extends the design of road model and location error area, improves the probability calculation function of HMM model, and evaluates the location effect of map matching algorithm by using GPS data collected. Experiments show that the algorithm in this article has good adaptability and correctness.

Although the map matching algorithm studied in this article has been verified in simulation experiment and system application, showing good accuracy and practicability, there are still many shortcomings, mainly manifested as the following points:

(1) The algorithm proposed in this article adopts fixed window size to segment GPS sequence in HMM model modeling. In the application, the window size should be dynamically adjusted according to the actual data to achieve adaptive matching process. On the other hand, tourists' behavior patterns can be further studied, which is conducive to further improving the accuracy of matching

In the final matching point projection stage, this article adopts the direct vertical projection method to project the

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Retraction

Retracted: Application of Automatic Motor Control System Based on Sensor Technology

Wireless Communications and Mobile Computing

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This article has been retracted by Hindawi following an investigation undertaken by the publisher [1]. This investigation has uncovered evidence of one or more of the following indicators of systematic manipulation of the publication process:

(1) Discrepancies in scope
(2) Discrepancies in the description of the research reported
(3) Discrepancies between the availability of data and the research described
(4) Inappropriate citations
(5) Incoherent, meaningless and/or irrelevant content included in the article
(6) Peer-review manipulation

The presence of these indicators undermines our confidence in the integrity of the article's content and we cannot, therefore, vouch for its reliability. Please note that this notice is intended solely to alert readers that the content of this article is unreliable. We have not investigated whether authors were aware of or involved in the systematic manipulation of the publication process.

Wiley and Hindawi regrets that the usual quality checks did not identify these issues before publication and have since put additional measures in place to safeguard research integrity.

We wish to credit our own Research Integrity and Research Publishing teams and anonymous and named external researchers and research integrity experts for contributing to this investigation.

The corresponding author, as the representative of all authors, has been given the opportunity to register their agreement or disagreement to this retraction. We have kept a record of any response received.

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[1] D. Qi, "Application of Automatic Motor Control System Based on Sensor Technology," *Wireless Communications and Mobile Computing*, vol. 2022, Article ID 2261653, 6 pages, 2022.

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Research Article

Application of Automatic Motor Control System Based on Sensor Technology

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In order to solve the application problems in motor automation control, a motor automation control system based on sensor technology is proposed. Sensor technology has been widely used in the field of automation. Therefore, when studying sensor technology, we should also study its specific application in the process of motor automation control. This paper briefly introduces the sensor technology in electromechanical automation control, discusses the application of this technology in various fields, and analyzes the development trend of sensor technology in electromechanical automation control in the future. The experimental data show that in the motor starting phase, the sensorless SRM using the observer can quickly identify the given speed, quickly approach the given speed in 0.05 seconds, and make the motor run faster and reach a stable state. The application of sensor technology has greatly improved the quality and production efficiency of mechanical manufacturing.

1. Introduction

Sensor technology first belongs to an intelligent technology. Sensor technology can timely perceive various changes in the external environment and can timely transmit the perceived situation to the computer. This process is very rapid and timely. Therefore, the computer can timely collect the signals sent by the sensor, process the data accordingly, and then issue other instructions [1]. This process is an electromechanical automatic control process and also has the trend of intelligent development. Generally speaking, sensors only have the function of sensing. However, with the continuous development of science and technology, sensors can not only receive signals but also send signals to transmit signals. In the past, in the process of electromechanical automation control, due to the imperfect development of sensor technology, data transmission errors often occur, which makes the follow-up work very inaccurate. However, the use of sensor technology can well resist this problem, because the sensor first has the function of transmitting information. Therefore, the sensor can avoid errors in the transmission process [2]. For example, in the automatic welding of the machine by relevant personnel, the reasonable application of the arc sensor can facilitate the correct acquisition of machine information and can also convert the physical information sensed by the sensor into specific electricity, which can greatly improve the working efficiency of the robot. Through the application of external sensor technology, the external environmental information can be timely monitored and collected, and the working environment of the machine can also be identified to a certain extent [3]. The application of sensor technology can provide more reliable information for the operation of the machine, so as to ensure the correct operation of the machine. On the other hand, due to the continuous application of internal sensor technology, the machine can be controlled through sensor technology. In addition, the sensor technology can also facilitate the timely monitoring of the operation of the machine. It can not only timely transmit the valuable information generated by the machine system during operation but also ensure that the machine can timely detect the changes in the external environment, so as to take corresponding protective measures [4]. In the process of machining, the sensor technology can not only facilitate the vibration of machinery but also accurately measure the components with dynamic characteristics, which can greatly improve the quality of corresponding products. It can also timely feedback the abnormal conditions in the mechanical aspects of the system during operation to the control system and solve the adverse effects caused by the abnormal conditions. In the actual production process, we should take the product demand as the main purpose to deeply adjust the control mode, which can greatly improve the safety of machining. Therefore, the application of sensing connection technology can not only ensure the safety of machining technology but also reduce the adverse effects in case of negative conditions [5]. First of all, for the application in the production site, the sensor technology can facilitate the new and accurate measurement of the position of the machine tool and the corresponding running speed and can also master other factors of deformation or vibration, which can greatly improve the accuracy of machining and can also timely reduce the manual workload, in order to give full play to the application of the sensor technology in machining. In the actual application process, the staff can also further monitor the processing process in time, so as to make sure that the processing process is in the correct process without errors. In addition, the final application description of machining accuracy is also an important application of sensor technology [6]. Machining accuracy control is a very important content for machining. By using the scanning sensor, the related work of workpiece contour measurement can be solved as soon as possible. At the same time, it can make the obtained data very accurate. The third application is the application of automotive automation control. At present, automated vehicles are being developed in an orderly manner. The sensor technology is the most important technology in the electronic control system. In general, the sensor will be installed in the vehicle's control system and engine control system [7]. At present, sensor technology has been attached importance by many industries. The reasonable application of sensor control technology to office equipment and factory assembly lines can not only significantly improve the production effect but also accelerate the development of enterprises. Sensors have a great impact on the operation of electromechanical automatic control system, so in order to better play the effect of sensor technology. Relevant personnel of the electromechanical automation control system must timely inspect and maintain the electromechanical automation system according to specific conditions, so as to improve the automation system level [8]. Therefore, strengthening the application and research of sensor technology can make it very useful in mechanical automatic control.

2. Method

2.1. General. Generally speaking, the sensor is composed of conversion circuit, conversion element, sensitive element, etc., as shown in Figure 1.

Among them, the conversion circuit is a circuit that converts the output of the sensor into a circuit that can transmit and process electricity. The conversion element refers to an element that converts the information detected by the sensitive element into a circuit or electricity parameter. The sensitive element refers to an element that can sensitively sense and detect information and respond according to the specified relationship [9]. In practice, some sensors are only composed of a sensing element and a conversion element, while others are combined into one. The simplest one must be composed of a sensing element, which can convert the output power when detecting information, such as a thermocouple. According to the working principle, there are many types of sensors, including resistance, capacitance, inductance, piezoelectric, hall, and photoelectric. It is classified according to the detected physical quantity, including displacement, proximity, speed, temperature, force, torque, pressure, acceleration, and other types of sensors. The second classification method intuitively shows the purpose of the sensor, which is the most concerned by customers and is easy to select; sensors are divided into proximity sensors, inductive sensors, capacitive sensors, photoelectric proximity sensors, temperature sensors, magnetic sensors, optical fiber sensors, photoelectric encoders, etc. As the name suggests, proximity sensor means to detect the proximity of the detected object without contacting it and send the specific results in the form of switch signals. There are usually inductive, capacitive, photoelectric, hall, and other sensors [10]. Inductive sensor is mainly used to detect objects with metal properties. It is characterized by high repeatability, high positioning accuracy, high action frequency, convenient installation, applicable to various environments, and can be widely used in industrial production [11]. It is mainly composed of LC high-frequency oscillation, signal processing, and switch amplification circuits, as shown in Figure 2.

Capacitive sensor is mainly used to detect metal objects, insulating liquid, or powder objects; its main working principle is to use the electrode plate of the capacitor as the detection surface, while the external material is the insulating medium between the two electrode plates of the capacitor. If the insulating medium changes, the electrical capacity will also change [12]. No matter what object, as long as it accepts or leaves the capacitive sensor, the dielectric constant of the sensor will change, making it output the corresponding switching signal. Figure 3 is a schematic of the sensor.

Photoelectric proximity sensor is mainly used to convert photoelectric signals into electrical signals. Its core sensitive element is photoelectric devices, using photoelectric effect as the working principle [13]. Sensor technology refers to a new type of intelligent technology. The principle of this technology lies in the "perception" of the external environment. By acquiring information and transmitting it to the computer, we can make corresponding actions based on this. In the electromechanical automation control, the function of sensor technology is mainly to collect information, acquire and process the measured nonelectric signal, then convert it into electrical signal, and finally provide corresponding support for the system operation.

Switched reluctance motor (SRM) is widely used in aerospace, electric vehicles, and other fields because of its simple structure, strong fault tolerance, many control modes, suitable for high-temperature, and high-speed environment [14]. The rotor position must be measured during the control and operation of the SRM. The existing position sensors such as photoelectric position sensor and magnetic sensitive

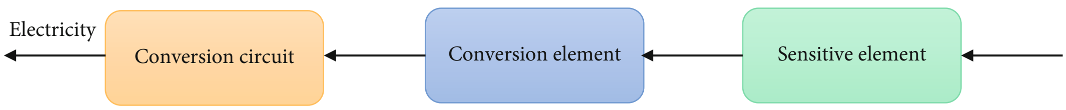

Figure 1: Schematic diagram of sensor composition.

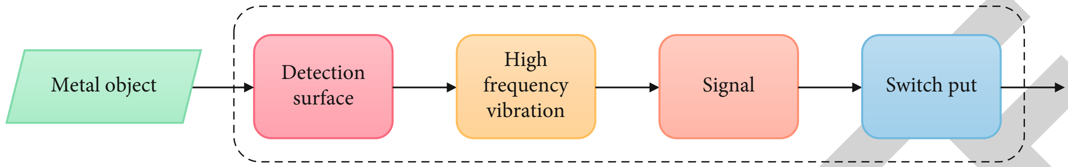

Figure 2: Schematic diagram of inductive proximity sensor.

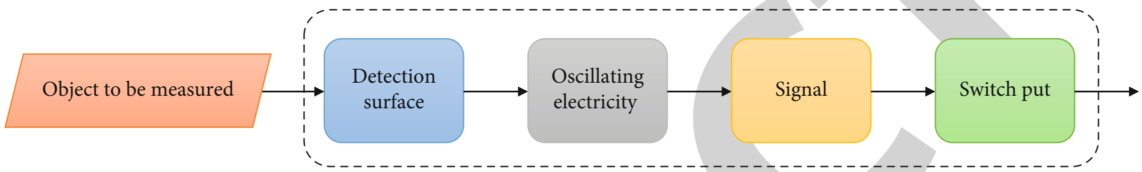

Figure 3: Schematic diagram of capacitive proximity sensor.

position sensor have some problems. Their accuracy is easy to be disturbed by the external environment. When the number of motor phases increases, the number of components used will also increase, making the system circuit more complex and increasing the volume of the system. They are not suitable for applications in aircraft and other occasions with strict volume requirements. At the same time, too many sensors reduce the reliability of the system. Therefore, the sensorless rotor position estimation based on the electrical parameters of the motor has become a research hotspot. At present, a variety of sensorless technologies have been proposed, each of which has its corresponding speed application limit range, which can be divided into two categories: low-speed starting and medium high-speed starting. There are phase current waveform method, pulse injection method, and modulation and demodulation method for sensorless technology during start-up and low-speed operation, and the main methods are conducted phase injection pulse method and nonconducted phase injection pulse method. During medium- and high-speed operation, the interval of conducting phase current in an electrical cycle is large, and the interval of nonconducting phase detecting injection pulse is small. Therefore, observer method, flux linkage current method, neural network method, etc., are mainly used [15]. In addition, there are additional capacitance and additional inductance coil detection methods. Because the installation of additional components reduces the reliability of the system, these two methods are rarely used. The rated parameters of the switched reluctance motor prototype studied in this paper are shown in Table 1.

Each type of sensorless has its speed application limit. In order to cover the whole speed range, two or more technologies must be combined to estimate the rotor position by using the observer method. The effect is good. However, the tracking accuracy of the rotor position angle in the motor starting phase is low, which is easy to make the winding turn on and off not in time, resulting in torque fluctuation [16]. In view of this shortcoming, this paper combines the sliding model observer (SMO) with the phase current gradient method, adds the position error correction module in the traditional SMO, and sets the threshold. When the motor starts and runs at low speed, the error detected by SMO method exceeds the threshold, and the phase current gradient method is used to detect the rotor position. When the motor is running at medium high speed, the error detected by SMO method is less than the threshold value. SMO method is used to detect the rotor position, which expands the speed application range of sliding mode observer method, ensures that the accurate estimation of rotor position can be realized in the starting stage, avoids large torque ripple, and realizes the estimation of rotor position in the full speed range.

2.2. Principle of Rotor Position Detection Based on Sliding Mode Observer. The schematic diagram of rotor position detection based on sliding mode observer method is shown in Figure 4. In the system, the speed difference obtained by the difference between the given speed ω and the speed $\check{\omega}$ detected by SMO is transformed into the given control quantity through the speed regulator composed of PI control or fuzzy control. This paper temporarily analyzes it with reference current [17]. The difference between the reference current and the actual current is used to control the on-off of the power converter. The actual phase voltage and phase current obtained from the motor operation can observe the phase winding flux linkage of the motor through the flux observer. The observed values of the flux linkage and rotor position angle can be obtained through the SRM model.

The difference between the actual value and the observed value of the phase current is set as the input of SMO, and its output is the estimated value of the motor speed and rotor position angle.

According to the basic principle of switched reluctance motor, its state equation (1) is

$$\begin{cases} \dot{\Psi} = U - Ri, \\ \dot{\omega} = -\dfrac{F}{J}\omega + \dfrac{T_e - T_L}{J}, \\ \dot{\theta} = \omega, \\ T_e = \displaystyle\sum_{j=1}^{N_{ph}} T_j(i, \theta). \end{cases} \tag{1}$$

The state equation (2) of the sliding mode observer is

$$\begin{cases} \dot{\omega} = -\dfrac{F}{J}\omega + \dfrac{T_e - T_L}{J} + k_\omega \operatorname{sgn}(e_\omega), \\ \dot{\theta} = \omega + k_\theta \operatorname{sgn}(e_\theta), \\ T_e = \displaystyle\sum_{j=1}^{N_{ph}} T_j(i, \theta), \end{cases} \tag{2}$$

where k_θ and k_ω are the switching gains and sgn is a symbolic function.

When k_ω is large, other terms can be ignored. Rewrite the speed equation in equation (2) as

$$\dot{\omega} = k_\omega \operatorname{sgn}(e_\omega). \tag{3}$$

3. Results and Discussion

The proposed sensorless torque ripple suppression is verified by using the established MATLAB/Simulink simulation platform [18]. The motor adopts three-phase 12/8 pole SRM with rated voltage of 514 V and rated power of 18.5 kW. Set the opening angle of the motor as 2, the closing angle as 32°, the given speed as 1000 r/min, and the load torque as 4.6 n·M. Firstly, the SMO method is used to simulate the nonposition sensor. When starting, the current chopping limit is 60 A. After starting, the cosine torque distribution function control mode is adopted. The torque comparison results before and after the application of the observer are shown in Figure 5. It can be seen that in the motor starting stage, the sensorless SRM using the observer can quickly identify the given speed, quickly approach the given speed within 0.05 seconds, and make the motor run faster and reach a stable state.

When the rotor position estimation error correction module is added, the position where the stator and rotor of the motor begin to overlap is obtained by detecting the jump edge of P3 pulse from low level to high level, and the speed is obtained. The inductance of the motor is calculated by establishing an accurate inductance model for P2 pulse detection. It can be seen from the working principle of switched reluctance motor that the inductance changes little with the current when the stator and rotor begin to overlap, so it is approximately considered that the inductance at the position where the stator and rotor begin to overlap, i.e., the inductance at θ_μ, is a constant value, and the inductance threshold is slightly larger than the inductance when the stator and rotor overlap, but it cannot be too large, because the significance of P2 pulse eliminating multiple zero crossings of the current gradient will be lost if it is too large. Therefore, the inductance threshold should be properly selected, where LP is taken as 0.008 H. Set the simulation step size as 10-5 s, take phase a as an example, get the actual phase current of the motor, the phase current and current gradient filtered by the low-pass filter, P1 pulse signal, and get the phase a inductance, filtered inductance, P2 pulse signal, and P3 pulse signal [19]. The simulation results show that P3 pulse can well detect the sudden change of current slope and obtain the position where the stator and rotor of the motor begin to overlap. However, this method also has certain limitations. When the current has high-order harmonics, it is difficult to completely eliminate the harmonic influence after filtering. At the same time, the filtered signal has small changes in amplitude and phase compared with the original signal; that is, it is difficult to have both good filtering effect and small distortion. In addition, it is considered that the speed is unchanged before P3 pulse jump, and there is also a certain error. Using the phase current gradient method and sliding mode observer method, the phase a rotor position angle of the motor and the comparison error between them are obtained. During the motor starting process, when the error is less than 2°, the rotor position estimation error correction module is cut off, and the rotor position angle obtained by the observer is used to determine the on-off of the power tube of each phase winding. The rotor position estimation error correction module can eliminate the torque ripple caused by the large observer estimation error during motor starting. After the motor enters the stable operation stage, the large torque ripple will lead to the change of the electromagnetic characteristics of the motor, which is not conducive to the estimation of the rotor position. In the simulation, it can be seen that the control mode of cosine torque distribution function has large torque fluctuations. When the torque distribution mechanism is improved and the current loop and torque loop control are adopted (the allowable current error is set to 0.3 A, and the allowable torque error threshold is 0.5 n·m), the motor speed, torque, phase torque,

Table 1: Prototype parameters.

Parameter	Numerical value
Motor model	Three phase 12/8 pole SRM
Rated power/kW	18.5
Power supply voltage/V (DC)	514
Load condition	50% rated load
Rated speed/(r/min)	1000
Maximum speed/(r/min)	1350

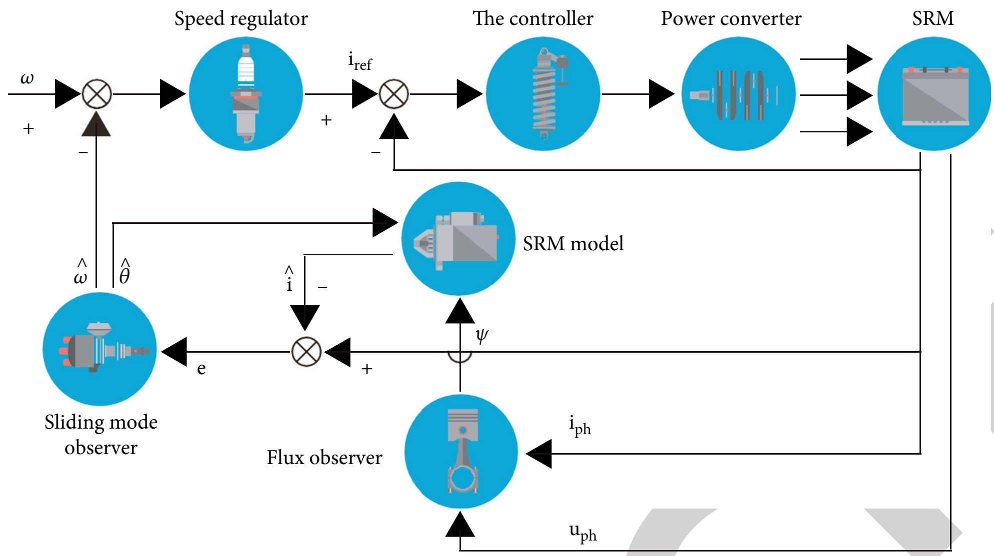

Figure 4: SRM sliding mode observer control system block diagram.

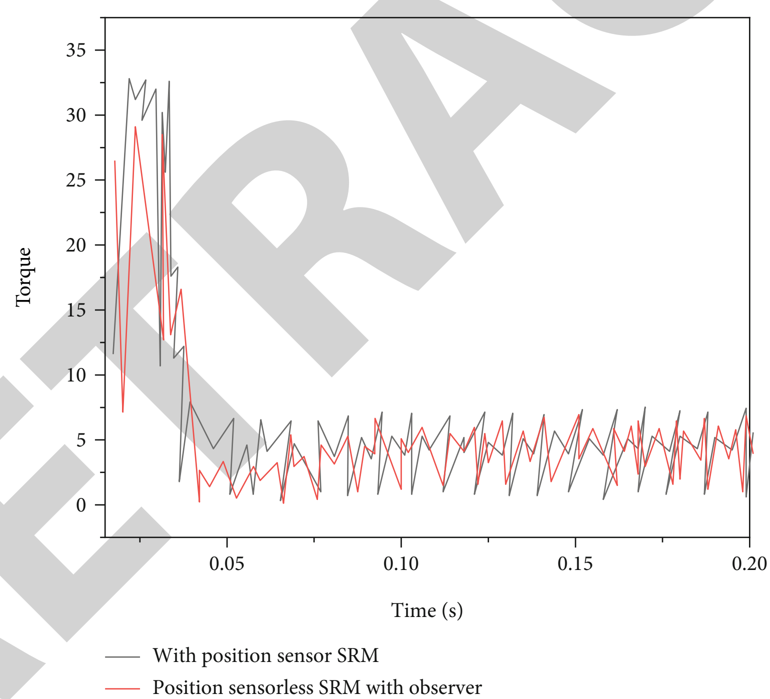

Figure 5: Torque comparison results of switched reluctance motor before and after observer application.

and phase current after the motor runs stably are obtained [20]. It can be seen from the simulation analysis that by adding the rotor position estimation error correction module, the flexible switching between the phase current gradient method and the sliding mode observer estimation method is realized, which ensures the rotor position estimation accuracy in the motor starting stage and effectively suppresses the torque fluctuation caused by the low estimation accuracy of the rotor position angle in the starting stage.

4. Conclusion

With the rapid development of science and technology, as an important link, the development of sensors is very extensive, especially in the field of electromechanical automatic control. Therefore, we should attach great importance to the development of sensor technology, promote faster information exchange, and better serve human production and life. This paper presents the application of motor automation

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Retraction

Retracted: International Logistics Management System Based on Cloud Computing Technology

Wireless Communications and Mobile Computing

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[1] M. Fan, "International Logistics Management System Based on Cloud Computing Technology," *Wireless Communications and Mobile Computing*, vol. 2022, Article ID 4317578, 8 pages, 2022.

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Research Article

International Logistics Management System Based on Cloud Computing Technology

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In order to solve the problems of slow matching between supply and demand, information authenticity and security, and lack of trust in traditional logistics platforms, the author proposes an international logistics management system based on cloud computing technology. The system uses blockchain as the underlying technology, combined with related technologies such as smart contracts and NSGA-II algorithms, matches the supply and demand sides of cross-border logistics resources, writes the important information generated in the platform transaction into the blockchain, and carries out network-wide broadcast and consensus, so as to realize the intelligence of the transaction and the nontampering and traceability of the information. The experiment found that in the case set by this example, max $Z_1 = 57.139$, and max $Z_2 = 54.679$, meaning that the final matching result is as follows: P2, the cross-border logistics provider, is matched with U5, the consignor; P3 matches U9, P8 matches U4, P9 matches U3, P1 matches U6, P5 matches U1, P7 matches U2, P4 matches U7, P10 matches U8, and P8 matches U10. Satisfactory matching results show that the algorithm is effective. Experimental results show that the system can increase the transparency and sharing of cross-border logistics information, help to reduce forged data information, improve the level of automation and intelligence, and provide a reference for the application of blockchain technology in the field of cross-border logistics.

1. Introduction

With the development of information technology, the development of science and technology has been greatly promoted, and complex problems may have taken decades or even longer to be solved before; now, it only takes a few minutes or even seconds to complete, using the system simulation technology of the computer, and it can also simulate and reproduce various scenarios in reality and before, so that people can verify various scientific hypotheses in advance [1]. With the development of information technology, the integration stage of computer information technology and all walks of life has appeared, so many emerging industries have also emerged, such as the combination of man and machine, through the control of computer and artificial intelligence, the combination of modern business and information technology, and the emergence of e-commerce; information technology has greatly improved production efficiency and promoted the rapid development of various industries; at the same time, all walks of life have also undergone earth-shaking changes, and the "myth" that people could not imagine before has become a reality.

The development of information technology has not only promoted the development of science but also changed people's production and lifestyle; people can know the world's affairs without leaving home and handle various businesses that could only be done on-site before; it can realize online consultation, online learning, online conference, online shopping, online business talk, online entertainment, etc.; the Internet provides 24-hour uninterrupted service; it has greatly improved work efficiency and quality of life and enriched people's lives; the world is no longer square, and the world has become a global village; through the connection of network technology, people who have gathered thousands of miles can meet in front of the screen. The development of information technology has greatly improved production efficiency and quality of life [2, 3], and with the in-depth development of information technology, people have put forward higher requirements for information technology; people want efficiency, quality, service, and convenience; this also puts forward better requirements for us in the information technology industry.

2. Literature Review

Zhao, X. et al. pointed out that, as an important part of e-commerce, logistics realizes the commodity distribution link of e-commerce transactions, so that the entire e-commerce transaction can be completed [4]. Chen et al. believe that for the new business activity of e-commerce, the logistics industry should provide new service items, and at the same time, with the improvement of information transmission speed, the distribution speed is also accelerated [5]. Bradha et al. believe that e-commerce logistics is the future development trend of logistics; the author integrates logistics services and e-commerce application services based on integration theory, proposes the concept of e-commerce logistics, and studies the development direction of international logistics enterprises [6]. Le et al. believe that how to minimize the cost of reverse logistics and help enterprises to obtain more profits has become the most important issue in e-commerce, at home and abroad, more and more attention has been paid to the problem of reverse logistics in e-commerce. The author proposes a new plan to solve the problem of reverse logistics by integrating supply chain resources to build an authorization center [7]. Zhu et al. pointed out that due to the importance of commodity circulation, modern logistics has become the focus of government and enterprises; at the same time, as e-commerce has had a significant impact on the traditional circulation of goods with its brand-new style of business activities, e-commerce has become an important concern of production and distribution enterprises [8]. Rosa et al. believe that e-commerce is closely related to logistics. On the one hand, e-commerce has a huge impact on logistics, so that logistics in the environment of e-commerce needs to adopt a new development strategy. On the other hand, the impact of logistics on e-commerce cannot be ignored. Therefore, the logistics management in the e-commerce environment needs special research [9]. Nie et al. pointed out that logistics is an important and main part of e-commerce activities and the last link in e-commerce activities. They also pointed out that logistics is also an important guarantee for the realization of the entire e-commerce activities [10]. Liu et al. believe that regardless of whether the transaction occurs in the traditional transaction mode, or in the e-commerce environment with information technology as the backbone, in addition to the information commodities that can be transmitted through the Internet (such as electronic publications and software), the smooth progress of commodity trading activities needs to be supported by various logistics activities. Logistics is an integral part [11].

By summarizing the views and research results of the previous scholars and analyzing the current development status of cross-border logistics in my country, the author builds a cross-border logistics platform based on blockchain technology. In the research and construction of this platform, blockchain technology will be used as the underlying technology of the platform, and corresponding smart contracts will be written for the order generation and settlement process, so as to realize the nontampering and decentralization of the whole process of cross-border logistics transactions, realize data recording and calling through corresponding interfaces and scripts, write important information such as user matching and orders in the cross-border logistics process into the blocks of the blockchain, and store other information in the database of the platform server. The author uses the Ethereum application platform as the basic platform; on the basis of realizing cross-border logistics transaction matching and information storage, the author makes use of the characteristics of nontampering, decentralized storage, and full traceability in blockchain technology; it can effectively solve the problem of using traditional cross-border logistics platforms.

3. Research Methods

3.1. Blockchain Principle and Related Technologies. The blockchain is essentially a chained ledger database composed of a distributed peer-to-peer network, which is composed of multiple completely peer-to-peer nodes, and through the corresponding consensus algorithm to ensure the consistency of block data and transaction data. As shown in Figure 1, a complete blockchain system structure is a chained data structure that connects data information blocks in sequence according to time series, and the integrity and authenticity of the data are verified through a hash consensus algorithm. In order to establish trust between each node, the blockchain adopts a consensus mechanism to check the consistency of the data. In addition, smart contracts consisting of automated script code without human involvement provide an unprecedented distributed infrastructure and computing paradigm for blockchain technology [12].

In the underlying network model of blockchain technology, due to the use of distributed data storage to ensure the efficiency and stability of the network model between nodes and using asymmetric encryption cryptography technology for digital signature authentication, the information of each account is highly encrypted, and this ensures the security and privacy of data during transmission and access. At the same time, the distributed storage party replaces the third-party intermediary platform organization, providing relevant underlying technical support for the secure storage of transaction information and user trust. In the blockchain system, the smart contract packages the data generated by the participants into a data block, and each data block will be superimposed and arranged in chronological order, a chain database consisting of a data block is formed, and each node on the blockchain jointly participates in the data verification, storage, and maintenance of the main chain.

3.1.1. Ethereum. Ethereum is a decentralized application platform with open source technology and capable of running smart contracts, and it runs deployed smart contracts through its virtual machine and has a built-in Turing-complete scripting programming language. At the same time, Ethereum also has the characteristics of blockchain

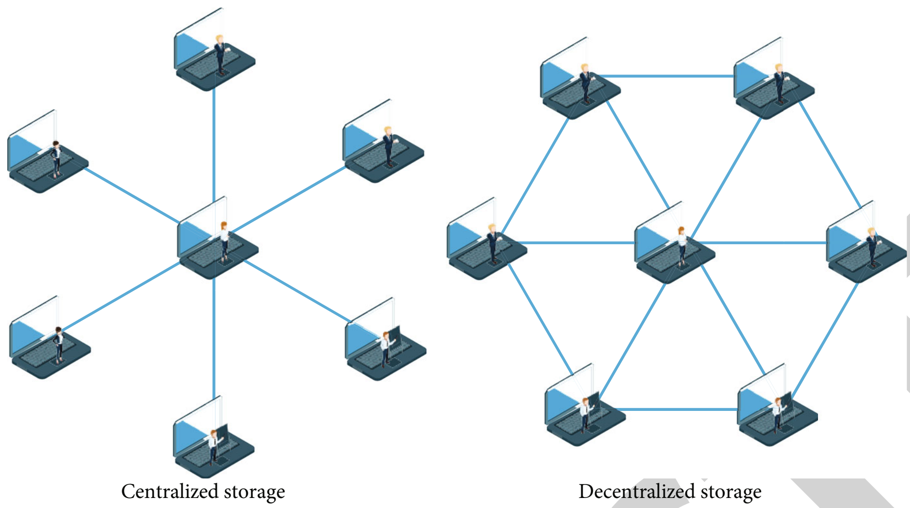

Figure 1: Comparison of storage methods.

decentralization, and multiple nodes jointly maintain and update the main chain data, so that the data blocks stored in it cannot be tampered with. The core concepts in Ethereum mainly include nodes, accounts, Ethereum virtual machines, data packaging, gas, and transactions.

An Ethereum transaction is a signed packet that stores a message; in the process of sending from one account to another, the data packet contains information such as recipient, account balance, sender's digital signature, and sent data [13]. In the process of transaction, it includes the state transition of the Ethereum system, and the state of the Ethereum system is composed of information and value transfer between two accounts; in the process of each transaction, Ethereum will ensure that the contract account and the external account have the same rights, so that anyone can participate in the operation of Ethereum.

3.1.2. Smart Contract. Smart contract refers to the use of computer language, a series of commitments, defined in digital form, without the need for human intervention, and a computer protocol that can be automatically executed in the Ethereum system when preset conditions are met. Although the relevant principles have long been mature, it was not widely promoted until the emergence of blockchain technology and Ethereum [14]. Blockchain technology provides the operating environment and database for smart contracts, and Ethereum provides a complete basic operating system for the writing and implementation of smart contracts. The Ethereum smart contract integrates software engineering, compound verification methods, and the systematic and large-scale development process of computing laws. Its architecture is shown in Figure 2.

The Ethereum smart contract is similar to the contract system, but it is different from the general contract we know. First of all, smart contracts are implemented by programming computer code, which can be applied in a wider range, but only require a lower cost. Secondly, the "intelligence" in smart contracts is mainly reflected in the fact that it can automatically identify the external operating environment and at the same time can automatically control the operating process without manual intervention, which can greatly reduce human factors and external environment interference and increase the accuracy of processing and operation in the operational process. Finally, the intelligence of smart contracts can further simplify the process and reduce input costs; on the one hand, it realizes the seamless connection between various links in the operation process, and at the same time, it also reduces other variable costs such as labor.

The premise of the smooth execution of the Ethereum smart contract must be that the content of the compiled contract cannot be changed, and the process of execution must be open and transparent, and the whole process can be traced [15]. Combined with the features of decentralization, immutability, common maintenance, and traceability in blockchain technology, it forms a natural symbiotic environment with smart contracts. When Ethereum and smart contract technology began to be closely integrated, the scenarios and scope of application of blockchain technology were greatly increased. In Ethereum, a smart contract that has been created can be automatically executed by the internal program of Ethereum, and its operation cannot be terminated before the end of the operation.

The smart contract also has its own contract public key address in the blockchain system; it can trigger the node to execute the contract code by creating a new contract and broadcast the account message to the contract account of all nodes in the entire network to execute the new contract. When the contract account receives the signed transaction information, it will immediately trigger the code in the contract account; this code can read and write the internal commands of the Ethereum system, send the transaction amount to another account in the Ethereum network, or to another contract account, and get network-wide broadcast and consensus.

3.2. Construction and Design of Cross-Border Logistics Platform Based on Blockchain. Logistics platform refers to a public organizational structure for interaction between logistics enterprises and related departments and uses information technology and communication technology to carry

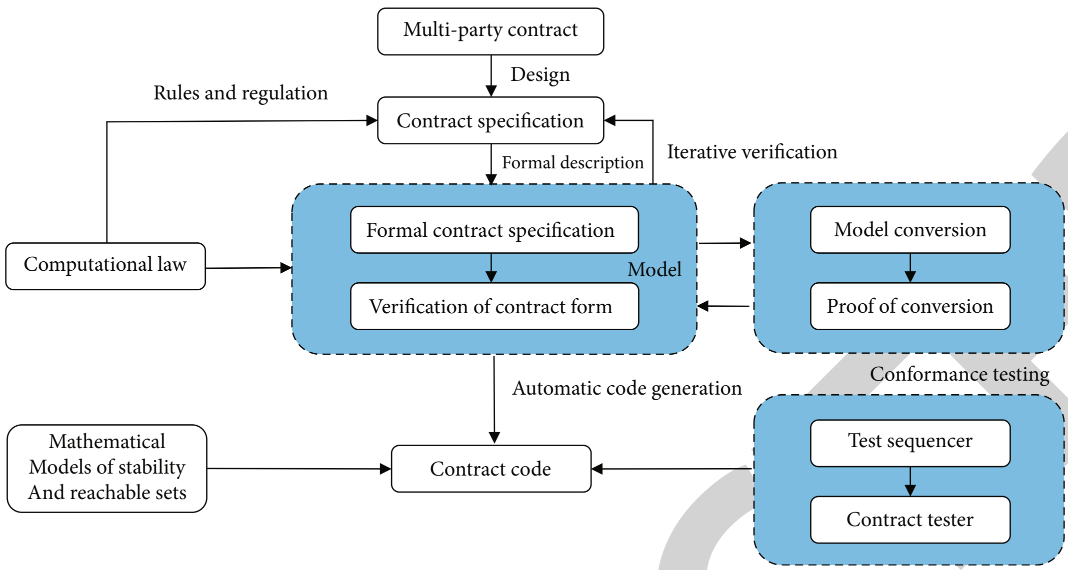

Figure 2: Smart contract architecture.

out cross-organizational logistics operations, and its ultimate purpose is to improve the coordination mechanism between various organizations, thereby improving the operational efficiency of logistics operations. In recent years, with the gradual promotion of the cloud service model in the logistics industry, some logistics platform companies use the logistics platform to provide corresponding logistics services to the society, which are gradually being accepted and used by more and more logistics industry players. At the same time, with the increasingly diversified and specialized requirements of the society for logistics services, the logistics platform market has become more and more refined and targeted, product functions have been continuously improved, and logistics services have been continuously improved [16].

3.2.1. System Model Analysis of Cross-Border Logistics Platform. The cross-border logistics information platform is not only limited to the provision of transportation services but also has information on the shipper, including credit level, transportation progress tracking, vehicle and cargo matching, and other services. The shipper interacts, and user information management is set up at the back end, and the platform database is used to store and use general data [17]. By constructing the system structure diagram of the cross-border logistics information platform based on blockchain, the system functions of the platform are analyzed, as shown in Figure 3.

The information model of cross-border logistics information platform based on blockchain technology is to use information and information flow to reflect the relationship network between various components in the logistics system and to describe abstract logistics by using information, information flow, data processing, system, and its essential characteristics [18]. In the whole cross-border logistics activities, the various elements and the relationship between them are relatively complex. By using logistics information technology to construct a cross-border logistics information platform, the information collection, sharing, and use of various elements can be realized. This section builds the information model of the cross-border logistics information platform based on blockchain technology, which connects different subjects in the cross-border logistics process to carry out coordinated logistics activities.

3.2.2. Analysis on the System Architecture of Cross-Border Logistics Platform. The author builds a cross-border logistics platform based on the blockchain technology architecture, which has a positive impact on promoting ecological collaboration among various entities on the chain and establishing and improving the value chain. This platform is based on blockchain technology. Through blockchain technology, it exchanges and transmits real-time information with multiple entities on the chain. In the platform, transactions are carried out according to the corresponding consensus mechanism to realize intelligent integration, quality certification, and other applications; ultimately, the service capability and customer satisfaction of the cross-border logistics platform will be improved. Therefore, the author divides the blockchain-based cross-border logistics platform into five dimensions: data layer, contract layer, network layer, consensus layer, and application layer; the author will use this model to run the blockchain-based cross-border logistics platform; the interaction between each link in the process is described.

The functional modules of the cross-border logistics platform are mainly divided into three parts, which are the information management module, the system management module, and the underlying decentralized application module based on blockchain technology [19].

3.2.3. Database Design. Depending on the type of data, the cross-border logistics platform stores important transaction information and general information in the blockchain block and platform database, respectively. Among them, the order information in the cross-border logistics transaction process,

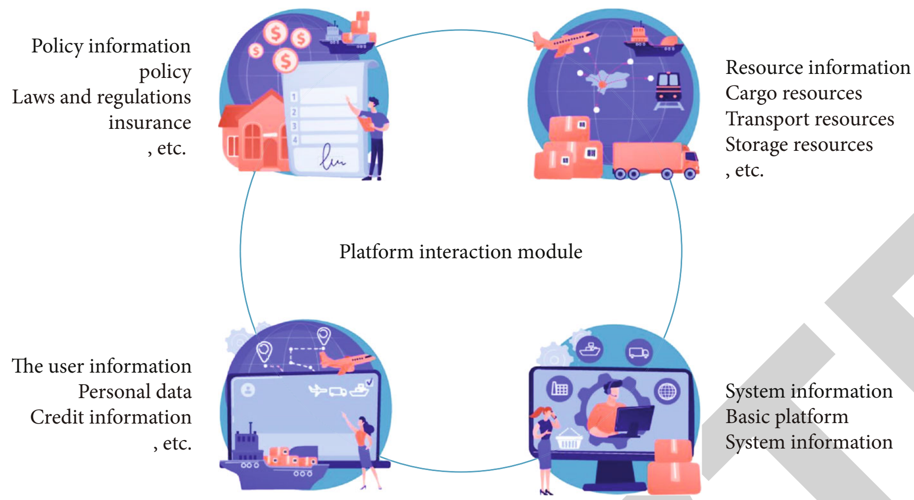

FIGURE 3: System function model diagram.

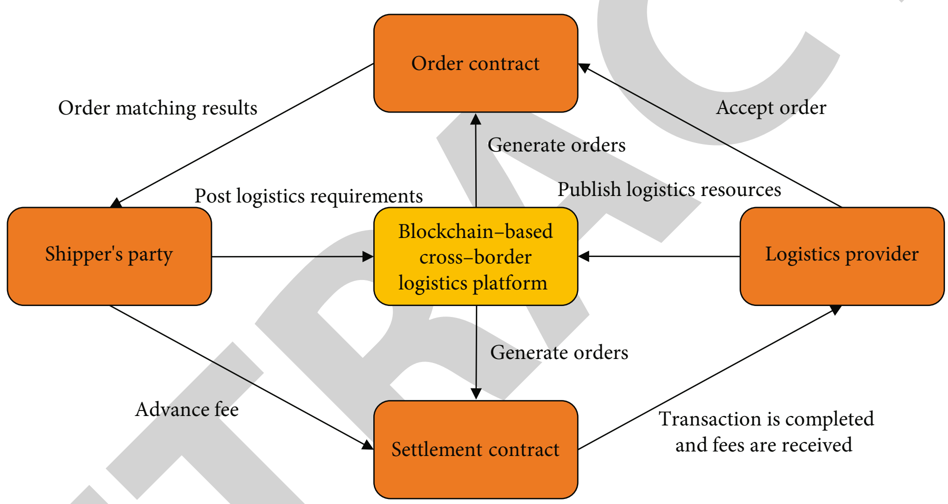

FIGURE 4: Smart contract interaction diagram.

such as the blockchain addresses of both parties, matching information, time stamps, transaction fees, logistics process information, and order status, is stored in the data blocks of the blockchain by deploying smart contracts. It enables the blockchain to record the detailed information of the entire cross-border logistics process and effectively ensure that the whole process of logistics transaction information is traceable and cannot be tampered with, which improves security. The platform database mainly stores basic information, such as user personal information, contacts, contact numbers, contact addresses, and storage resource information; the platform database is used for writing, storing, reading, and other functions, and important information is stored separately from ordinary information; it is beneficial to reduce the pressure of blockchain storage and improve work efficiency. The author will describe in detail the data type information stored in the platform database and the blockchain block and analyze the main users of the cross-border logistics information platform database from the perspective of the entity and business functions of the logistics platform, which are mainly divided into user data tables and logistics resource information tables, warehousing resource table, cargo information table, blockchain block data table, etc.

3.3. Based on Ethereum Smart Contract Design. The author mainly studies the writing of the order contract and the settlement contract into the blockchain, and the design is written in the Solidity language, so that the logistics supplier and the shipper can interact and trade using the blockchain smart contract at the bottom of the platform web page. In terms of design ideas, the smart contract mainly stores different shippers on the cross-border logistics information platform in the contract through a structure and mapping organization and connects different shippers to realize the decentralization of the entire cross-border logistics transaction process and improve the overall transaction efficiency of cross-border logistics. The smart contract interaction diagram is shown in Figure 4.

The author will write and design smart contracts from two different aspects according to the platform and smart contract characteristics. On the one hand, it is designed for the state of smart contracts, and research and design are

Table 1: Program operating environment.

Surroundings	Hardware and software name	Parameter
Hardware environment	CPU	i5-4210U@2.40GHz
	Memory	8.00G
System environment	Virtual machine	VMware Workstation Pro
	Operating system	Linux Ubuntu 16.04
	Development language	MATLAB, Solidity
	Blockchain simulation platform	Remix

carried out according to the different states of the shipper in the platform. On the other hand, for smart contract function design, order contract and settlement contract are written, respectively, for order function and settlement function, which mainly include operations such as creating orders, obtaining order information, settlement, and payment, and using web3.js interface for cross-border logistics platform and cross-border logistics platform. In addition, web3.js interface is used for the interaction between cross-border logistics platform and Ethereum smart contract.

4. Analysis of Results

The author uses the Solidity programming language to write the smart contract program and deploys the NSGA-II algorithm program of the matching link in the smart contract to the Ethereum DApp, providing algorithms for matching transactions of cross-border logistics platforms based on blockchain technology [20]. Through the operation of the program, the rationality and scientificity of the NSGA-II cross-border logistics supply and demand matching algorithm based on blockchain technology researched and constructed by the author is proved. Table 1 shows the operating environment of the NSGA-II algorithm program.

The calculation example used by the author is not a special calculation example; after selecting the classic calculation example through the research and reference of the actual situation, the author's calculation example is reasonably randomly generated. The number of selected cross-border logistics providers is 10, which is represented by $(P_1, P_2, P_3 \cdots P_{10})$, and the number of shippers is 10, which is represented by $(U_1, U_2, U_3 \cdots U_{10})$. The blockchain account addresses of the cross-border logistics provider and the shipper are used for consensus verification on the blockchain. In addition, the actual level of cross-border logistics providers and shippers needs to be measured.

In this example, a one-to-one matching example will be used to describe in detail. Let $\theta_j = 1, \varphi_i = 1$, which means a shipper and a cross-border logistics provider for transaction matching. Similarly, the case of one-to-many matching and many-to-many matching is similar to the principle of one-to-one matching, which only need to change the value of θ_j, φ_i, as shown in the following formulas:

$$\max Z_1 = \sum_{i=1}^{m} \sum_{j=1}^{n} \left(10.865 - I\left(U_i, P_j\right)\right) x_{ij}, \quad (1)$$

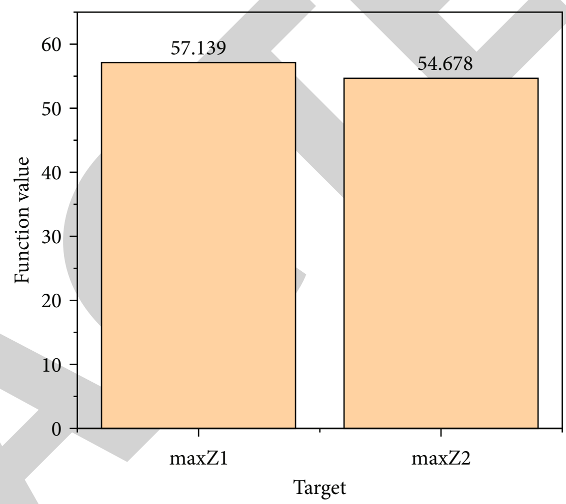

Figure 5: Solution result of cross-border logistics transaction matching scheme based on blockchain technology.

$$\max Z_2 = \sum_{j=1}^{n} \sum_{i=1}^{m} \left(12.292 - I\left(P_j, U_i\right)\right) x_{ij}, \quad (2)$$

$$\text{s.t.} \sum_{i=1}^{m} x_{ij} \le 1, j = 1, 2, \cdots, n, \quad (3)$$

$$\sum_{j=1}^{n} x_{ij} \le 1, j = 1, 2, \cdots, m, \quad (4)$$

$$x_{ij} = \{0, 1\}, i = 1, 2, \cdots, m, j = 1, 2, \cdots, n. \quad (5)$$

Let the number of chromosomes be 100, the crossover probability is 0.9, the mutation probability is 0.1, and the maximum number of iterations is $NC = 200$. Use the NSGA-II algorithm to solve it, and the solution results are shown in Figure 5.

It can be concluded from Figure 5 that in the setting of this example, $\max Z_1 = 57.139$ and $\max Z_2 = 54.678$, it means that the final matching result is that the cross-border logistics provider P2 matches the shipper U5, P3 matches U9, P8 matches U4, P9 matches U3, P1 matches U6, P5 matches U1, and P7 matches U2, P4 matches U7, P10 matches U8, and P8 matches U10. From the final matching result, first from the perspective of the cross-border logistics provider, the cross-border logistics provider 2 and the consignor party 5 carry out, and it can be concluded that the information values of the cross-border logistics provider 2 and the consignor party 5 are both very low and ranked third, and compared with the difference between the first and second satisfaction, the gap is very small, indicating that it is closer to the optimal solution. The information value of shipper 9 and cross-border logistics provider 3 is 2.785, ranking second, and the difference compared with the first information value is also small. The cross-border logistics provider 8 and the consignor 4 have the lowest information values, and the cross-border logistics provider 9 and the consignor 3 have the lowest transaction information values. In addition, cross-border logistics provider 1 is matched with shipper 6, cross-border logistics provider 5 is matched with shipper 1, cross-border logistics provider 7 is matched with shipper 2, and cross-border logistics provider 4 is matched with shipper 7 is matched, and the information values of the cross-border logistics provider 10 and the shipper 8 for matching are relatively low. In the same way, for the shipper, the information value of the matched cross-border logistics provider is relatively low. The information value has been explained above, and the low level of the information value means that the satisfaction is high. It can be seen that the author's multiobjective optimization model of cross-border logistics supply and demand transaction matching in the cross-border logistics platform based on blockchain technology can have relatively satisfactory matching results, indicating that the algorithm used is effective.

5. Conclusion

Through the analysis of the existing traditional cross-border logistics platform, a cross-border logistics platform framework based on blockchain technology is constructed, so that users can publish their own needs or resources online, and the platform will automatically match the supply and demand sides according to the conditions, thereby improving transportation, resource utilization, and reduction of shippers' search time, in order to maximize the benefits of social logistics resources; it can effectively solve the problems of information asymmetry between the two sides of the traditional cross-border logistics platform transaction, difficulty in tracing logistics information, confusion of industry standards, and lack of trust foundation. When comparing the cross-border logistics platform based on blockchain technology with the traditional cross-border logistics platform, it is concluded that it has certain advantages in terms of cost, information, customs clearance, safety, and efficiency. In addition, combining blockchain technology with a cross-border logistics platform to improve the efficiency of cross-border logistics can not only solve some difficulties in the traditional cross-border logistics trading platform but also realize technological innovation.

Data Availability

The data used to support the findings of this study are available from the corresponding author upon request.

Conflicts of Interest

The author declares that there are no conflicts of interest.

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Retraction

Retracted: Laboratory Virtualization Management Based on Deep Integration of Cloud Desktop

Wireless Communications and Mobile Computing

Received 25 July 2023; Accepted 25 July 2023; Published 26 July 2023

This article has been retracted by Hindawi following an investigation undertaken by the publisher [1]. This investigation has uncovered evidence of one or more of the following indicators of systematic manipulation of the publication process:

(1) Discrepancies in scope
(2) Discrepancies in the description of the research reported
(3) Discrepancies between the availability of data and the research described
(4) Inappropriate citations
(5) Incoherent, meaningless and/or irrelevant content included in the article
(6) Peer-review manipulation

The presence of these indicators undermines our confidence in the integrity of the article's content and we cannot, therefore, vouch for its reliability. Please note that this notice is intended solely to alert readers that the content of this article is unreliable. We have not investigated whether authors were aware of or involved in the systematic manipulation of the publication process.

Wiley and Hindawi regrets that the usual quality checks did not identify these issues before publication and have since put additional measures in place to safeguard research integrity.

We wish to credit our own Research Integrity and Research Publishing teams and anonymous and named external researchers and research integrity experts for contributing to this investigation.

The corresponding author, as the representative of all authors, has been given the opportunity to register their agreement or disagreement to this retraction. We have kept a record of any response received.

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[1] Y. Liu, S. Duan, and B. Wang, "Laboratory Virtualization Management Based on Deep Integration of Cloud Desktop," *Wireless Communications and Mobile Computing*, vol. 2022, Article ID 4487023, 7 pages, 2022.

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Research Article

Laboratory Virtualization Management Based on Deep Integration of Cloud Desktop

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In order to solve the problems faced in the process of laboratory construction and management, the author proposes a complete laboratory cloud desktop virtualization management platform. The platform combines the school's existing experimental teaching environment and teaching mode, through actual deployment and online monitoring; it is further verified that the cloud desktop platform not only provides personalized desktop services but also realizes unified management of resources. Experimental results show that the system function tests are all in line with expectations; during the network bandwidth test, the thin client protocol machine is used to access the cloud platform, and the Thunder player is opened to play the movie application, and then, the thin client machine uses RDP to access the cloud platform; when RDP is playing a movie, the traffic is mainly in the range of 1.2~1.6 Mbps, and the network delay is less than 1.3 s. Through research, it is found that the platform enhances students' learning initiative, improves teaching management level, and has high experimental teaching application value.

1. Introduction

With the continuous improvement of the level of social informatization, as well as the popularization of computer applications, computers have become an indispensable common tool in all walks of life; the ability to operate and use computers has also become one of the necessary skills for contemporary college students. All majors in colleges and universities, whether it is science or literature and history, require students to have the ability to use computers to process and solve problems [1]. To this end, colleges and universities around the world invest a lot of money every year to build, rebuild, and expand computer laboratories, creating good hardware conditions for the cultivation of students' computer practice ability. Cloud desktop is actually a specific application of cloud computing virtualization technology; the biggest difference between it and server virtualization technology is that it focuses on providing customers with virtual desktop services that are not limited by physical venues and physical hosts; compared with traditional PCs, in the case of network connectivity, users can call up their own dedicated virtual desktops at any time in any place such as home, office, and conference room; therefore, it can handle its own work business without interruption, as shown in Figure 1. Cloud desktop first appeared to solve the problem of enterprise mobile office; at present, the actual application scenarios of cloud desktops are not limited to corporate offices but also show good application prospects in the education industry [2]. Cloud desktop technology can also solve the problems of high construction cost of computer laboratory hardware and fast update and elimination. Since cloud computing technology can centrally manage hardware resources and classify them on demand, when it is necessary to improve the configuration of cloud desktops, it is only necessary to upgrade or expand the resources of the cloud server cluster to achieve the purpose of benefiting the old [3].

2. Literature Review

Chen et al. designed and implemented a laboratory management system based on the Internet of Things, which controls the equipment through the network and realizes the

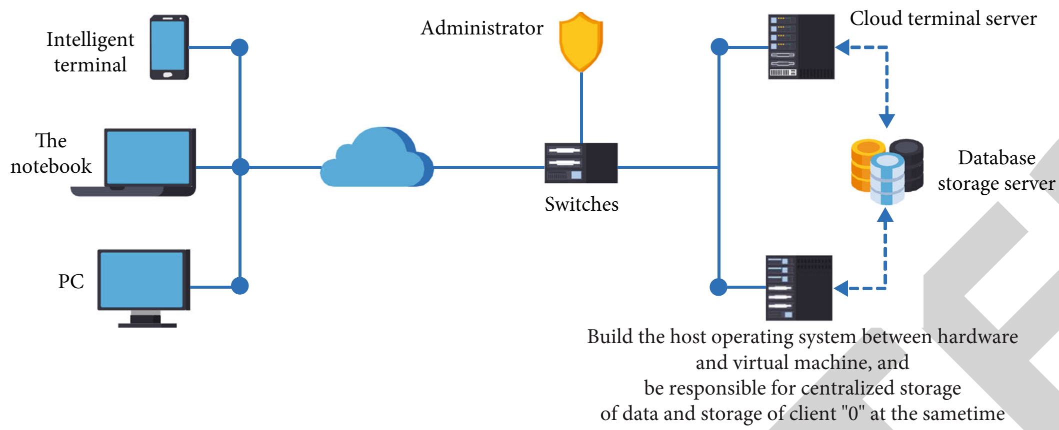

Figure 1: Cloud desktop.

intelligent monitoring of the laboratory [4]. System through wireless nodes (ZigBee module, sensor module, and alarm module) collect data in the laboratory, monitor the temperature, humidity, and other information in the laboratory, adopt automatic alarm mechanism, NFC card reader to verify identity, mobile App to control indoor lighting, etc., realize the automatic management and intelligent monitoring of the laboratory. Applying technologies such as cloud computing, virtualization, and Internet of Things in laboratory management is a new trend in laboratory construction. Build a cloud computing platform and concentrate commercial performance computing resources on the server side; unified management is conducive to the rational allocation of computing resources, improving the quality of computing services. Elshall and others put forward the concept of "smart earth," adding sensors in the fields of transportation, medical treatment, equipment management, etc. and controlling people and things in the system through computer technology [5]. Olaverri-Monreal et al. also used the Internet of Things technology to establish a network perception laboratory and a wireless integrated network sensor laboratory [6]. Du et al. designed the remote experiment function in the cloud, which solved the problem of time and space constraints for on-machine experiments, and the platform runs efficiently and reliably. The existence of the cloud computing platform reduces the computing burden of the client and also gives people new ideas for laboratory construction, that is, provide cloud desktop services, replace the host with a thin client, and "slim down" the client [7]. Zhang et al. conducted research on data-intensive supercomputing and built cloud computer equipment to provide image processing and sharing services, which improved the efficiency of image processing [8]. The author takes building a new generation of smart campus as the long-term goal to carry out the school-level overall education informatization construction; in laboratory teaching, a new generation of information technology such as virtualization and cloud computing is used to create a more advanced environment for teachers' teaching and students' learning, providing unified, open, and shared learning resources for laboratory students through the cloud desktop virtualization platform.

3. Research Methods

3.1. Related Technologies. VDI (virtual desktop infrastructure), virtual desktop infrastructure, also known as centralized computing architecture, is currently the most widely used mainstream cloud desktop virtualization technology [9]. The virtual desktop technology in the VDI mode integrates all client operations, and the server provides the data, software, computing, and other resources required by the user; what the user actually obtains is the remote desktop operating system environment of a virtual machine on the server. Relevant Chinese experts and scholars have also done a lot of research on cloud desktop technology and actively explored the implementation plan of virtualized management of university laboratories [10, 11]. By analyzing the problems faced in the current laboratory construction and management process of the school and closely combining the practical application requirements of the laboratory, the author focuses on the design and implementation process of cloud desktop virtualization technology in laboratory management, in-depth analysis of access control, resource sharing, data security, operation and maintenance, deployment cost, etc.; a complete laboratory cloud desktop virtualization management platform is designed, and the application value of the platform is verified through actual deployment and online monitoring.

3.2. Cloud Desktop Design and Deployment

3.2.1. Design Objectives of Cloud Desktop. The school uses Microsoft RDS virtual desktop technology to improve and manage the laboratory in a centralized manner, and the design is based on the total scale of 800 users and 500 concurrent users in the early stage [12]. The virtual desktop user resource configuration is as follows: 4G memory, 2vCPU, 50 GB system space, 10 GB user data storage space, and resource expansion will be carried out gradually. Under the condition that the management design structure remains unchanged, it will eventually meet the needs of 5,000 people. After the platform is completed, the unified management of the entire laboratory terminal will be realized, the local terminal will only be used for connection use, and the computing tasks will be transferred to the cloud desktop, which can effectively improve the service life of the local terminal, so as to realize the reduction of TCO (total cost of ownership). At the same time, the centralized back-end cloud desktop data center is more conducive to the upgrade, update, and maintenance of the overall architecture, meeting the needs of school information security and improving students' enthusiasm and creativity.

3.2.2. Cloud Desktop Deployment Solution Architecture Design. The design diagram of the laboratory architecture based on the cloud desktop is shown in Figure 2. The overall architecture of cloud desktop includes four layers of modules: network access layer, application delivery layer, virtualization resource layer, and core application layer [13].

Network access layer: users log in to the cloud desktop platform through the access layer component RD Web interface and use SSL encrypted transmission to interact with the data center, including the allocation of cloud desktops, access to virtual applications, and storage of personal data and configuration files. At the same time, the security policy is used to set user rights' grouping, ensuring that users with different permissions have personalized cloud desktop collection login permissions. Application delivery layer: it mainly provides cloud desktop and virtual application services for users. The application delivery layer presents virtualized resources to users in the form of cloud desktops and virtual applications, and all computing operations of users are performed at this layer. At the same time, it is responsible for transmitting the user's personal data and configuration data to the virtualized resource layer, and feeding back the execution result to the current user, it not only ensures the security of user data but also improves the utilization of data center resources [14].

Virtualization resource layer: the virtualized resource layer uses technologies such as server virtualization, storage virtualization, and network virtualization to uniformly and intensively provide hardware resources such as servers, networks, and storage required by various cloud desktop applications; at the same time, it provides an integrated management platform for various virtual desktops, cloud applications, resources, etc. In addition, the virtualization layer also provides some other common basic services and architecture management service components required by the overall architecture. Core application layer: this layer is the carrier platform for the school's existing management systems and teaching systems, such as campus portals, campus cards, and emails; all business systems can run on independent virtualization platforms; these business systems can also be migrated to run on cloud desktop virtualization platforms to improve server utilization [15].

3.2.3. Cloud Desktop Deployment. Cloud desktop deployment mainly includes five modules: hardware deployment, network deployment, storage deployment, system deployment, and component deployment [16].

(1) Hardware Deployment. The entire platform uses 2 H3C UIS tool boxes; each tool box has 16 H3C UIS servers, a total of 32 servers. Create three Hyper-V clusters as the underlying virtualization support platform, including one infrastructure cluster and two virtual desktop hosting clusters. The infrastructure cluster server consists of 2 H3C blades configured with 2-way 2.0 GHz CPU, 256 G memory, and 1 dual-port 20 G converged network card, providing a computing environment for Microsoft RDS infrastructure servers; the running infrastructure includes active directory (active directory), RD connection broker (controller), RD Web (authorized access), RD license (authorization), RD gateway (gateway), file server, database server, and other virtual machine servers. The virtual desktop hosting cluster server consists of 30 H3C blades configured with 2-way 2.0 GHz CPU, 256 G memory, and 1 dual-port 20 G converged network card and hosts a virtual desktop pool with a total scale of 800 users [17].

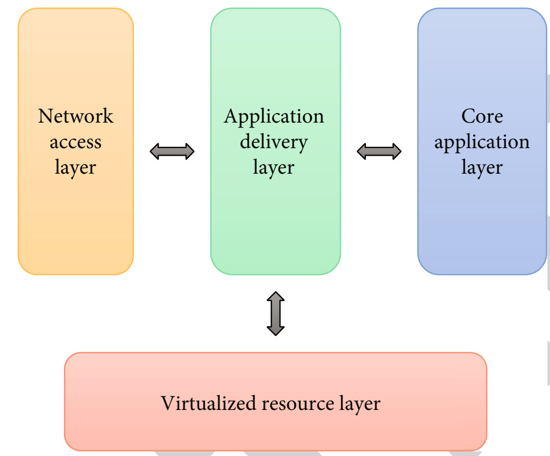

Figure 2: Laboratory cloud desktop architecture design.

The hardware blade server cluster allocation is shown in Table 1.

(2) Network Deployment. The network deployment adopts the principle of separation of three networks; that is, the three networks of "management network," "service network," and "storage network" are separated, and each network uses dual uplinks, which are, respectively, connected to the corresponding switches [18]. Each blade server has two 20GBE converged virtual ports, which are interconnected through the backplane switch inside the blade box, and the external communication is completed through the blade box switch. Therefore, 2 20GBE fusion ports of each blade server are virtualized and 4 ordinary 10 GB ports are mapped to the blade server operating system.

The network deployment of 2 infrastructure servers is as follows. Each server network port: 4 10 Gigabit Ethernet ports, 2 FC ports.

Management network: 2 10 Gigabit Ethernet ports; carry Hyper-V management traffic and traffic during live migration of virtual machines.

Business network: 2 10 Gigabit Ethernet ports; ports that carry infrastructure virtual machines for external communication and services.

Table 1: Blade server cluster allocation.

Knife box	Blade	Host	Remark
	1	HV-Infra01	Infrastructure cluster
	2	HV-VDI-HOST01	
	…	…	VDI cluster 1
1#	8	HV-VDI-HOST07	
	9	HV-VDI-HOST16	
	…	…	VDI cluster 2
	16	HV-VDI-HOST23	
	1	HV-Infra02	Infrastructure cluster
	2	HV-VDI-HOST24	
	…	…	VDI cluster 2
2#	8	HV-VDI-HOST30	
	9	HV-VDI-HOST08	
	…	…	VDI cluster 1
	16	HV-VDI-HOST15	

Storage network: 2 FC ports; Hongshan FC storage is mounted to carry the resources and storage space required for the operation of the infrastructure server.

The network deployment of 30 desktop hosting servers is as follows. Each server network port: 4 10 Gigabit Ethernet ports, 2 FC ports.

Management network: 2 10 Gigabit Ethernet ports; carry Hyper-V management traffic and traffic during live migration of virtual machines.

Business network: 2 10 Gigabit Ethernet ports; ports that carry virtual desktops and virtual applications for external communication and services and data ports for users to access personal disks.

Storage network: 2 FC ports; Hongshan FC storage is mounted to carry 800 virtual desktops and user personal data.

In order to overcome the impact of dynamic network changes on video transmission, network QoS monitoring technology is introduced, and real-time monitoring is used to lay a good foundation for intelligent transmission control [19]. Add timestamps at the protocol layer to monitor network delays, add two fields to each packet, and record the last received timestamp (LRT) and the current sent timestamp (CST). After receiving the packet, the receiving end calculates the local packet sending delay according to the LRT and SCT of the packet. At the same time, according to the last time stamp (LST) that the receiving end has saved and the time when the message is currently received, subtract the processing delay of the peer end to obtain the processing delay of the packet in the network.

As shown in Figure 3, when B end replies to A, it is

$$\begin{aligned} \mathrm{LRT} &= TB+\Delta t1, \\ \mathrm{CST} &= TB+\Delta t1+\Delta t2. \end{aligned} \tag{1}$$

When end A receives the message from end B, its local is

$$\mathrm{LRT} = TA+\Delta t1. \tag{2}$$

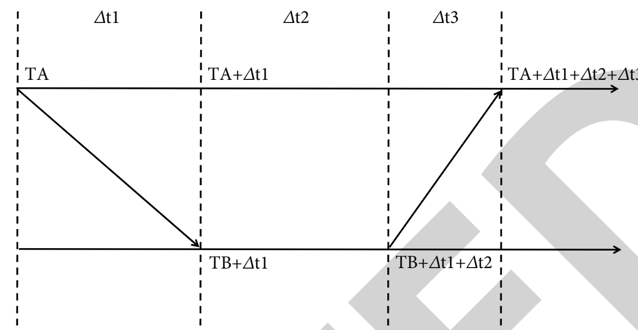

Figure 3: Calculation of packet transmission delay.

And its current time is

$$\mathrm{CT} = TA+\Delta t1+\Delta t2+\Delta t3. \tag{3}$$

At this time, the two-way delay of packet sending can be calculated as

$$\mathrm{CT} - \mathrm{LST} - (\mathrm{CST} - \mathrm{LRT}). \tag{4}$$

(3) Storage Deployment. The storage system adopts unified centralized storage deployment; that is, system data and user data are stored on the same storage. System data is accessed through the FC interface and stored in the form of FC-SAN. User data is accessed through the 10 Gigabit Ethernet interface and stored in the form of a file server. FC-SAN storage: it consists of Hongshan MS storage, dual-controller totaling 448 GB cache, 16 960GSSD hard drives, and 64 6 TB mechanical SAS disks; use FC to access the storage network to provide system operation and data storage services for infrastructure, virtual desktops, and virtual applications.

File storage: in order to enable users to retain personalized configuration and personal data in the cloud desktop mode, the configuration files, user personal data files, and operating system disks are separated. Use two file server virtual machines to form a file server cluster, provide file storage services for all users, configuration files and personal data files are centrally stored in the file server, and through CIFS (Common Internet File System) network share access [20].

(4) Component Deployment. Component installation consists of two parts: base platform components and virtual desktop components.

(1) Basic platform components: (a) Hyper-V server virtualization: using virtualization technology enables a physical server to run multiple virtual operating systems simultaneously. (b) Active directory: Microsoft's unified authentication management platform, used for centralized management of users and computers, unified identity authentication, etc. [18]. (c) DHCP server: dynamic IP address assignment protocol used to automatically assign IP addresses to all virtual machines. (d) CA server: certificate authority, used to issue certificates for the entire cloud desktop platform. (e) File

Table 2: Virtual server system deployment role.

Role	Virtual server	Function
Active directory	DC01, DC02	Active directory
DHCP	DHCP01, DHCP02	DHCP service
	SOFS01, SOFS02	User file storage
File server	SOFS-CLU	File server cluster IP
	Fileserver	File server access IP
Virtual desktop controller	RDBroker01, RDBroker02	Cloud desktop delivery controller
Desktop access server	RDWeb01, RDWeb02	User access
SCVMM	SCVMM01	Cloud desktop management
Virtual desktop database	RDSQL01, RDSQL02	SQL database
Access gateway	RDGW01, RDGW02	RD gateway

Table 3: System function test situation.

Serial number	Testing method	Expected outcome	Actual results
1	After normal input or abnormal input information, perform addition and modification operations	If no information is entered in the required fields, a warning box will pop up	As expected
2	Fuzzy and exact queries, see the results	The list will show the correct query results	As expected
3	Check whether the list information is updated correctly after adding, modifying, and deleting operations	The list is updated with new or modified information	As expected
4	Click on a control with an event listener	Response to events such as refresh	As expected
5	Book an experiment	The seat status changes to reserved and the name of the reserved person is displayed	As expected
6	Bind power supply devices corresponding to seats in batches	The sequence number of the seat corresponds to the serial number of the power supply, and the binding is successful	As expected
7	Check the code hint box information for errors	Accurate prompt information	As expected
8	Click on tree or parent class list	The subcategory list information will be refreshed accordingly	As expected
9	After making an appointment for the experiment, swipe the card at the specified time and other times to get on the machine	Open within the specified time, and other prompt boxes will pop up	As expected
10	Perform purchases, borrows, scraps, etc. to change inventory of equipment and low-value items	Inventory statistics are updated accurately	As expected
11	Loaned equipment is expected to be outstanding	The expiration prompt box will turn red	As expected

server: used to store user personal files, configuration files, SQL database daily backup files, etc.

(2) Virtual desktop components: (a) RD connection broker: used to provide deployment, delivery, management, and more of virtual desktops. (b) RD Web access: a Web service used to provide users logging in to cloud desktops. (c) RDVH virtualization host: used to host all virtual desktop virtual machines. (d) RD gateway: used to proxy cloud desktop client and backend virtual desktop traffic. (e) RD licensing: license issuance to provide the RDS virtual desktop platform. (f) RD session host: used to provide session-style shared virtual desktops

(5) System Deployment. The operating system of the infrastructure and virtualization host server is deployed as Windows Server 2016 Datacenter Edition, and the cloud desktop operating system is deployed as Windows 7 SP1 64-bit Enterprise Edition. The specific roles and functions of the virtual server are described in Table 2.

3.2.4. Cloud Desktop Operation and Monitoring. After the cloud desktop platform is deployed, resolve the custom domain name through the RD Web (desktop access server) IP address or DNS, open the cloud desktop homepage to log in, enter the user name and password in the active directory to display the laboratory cloud desktop collection, and click the collection icon to enter the cloud desktop. After the cloud desktop is successfully allocated, you can see the custom system desktop and preinstalled application software.

By logging into the cloud desktop platform on each terminal in the laboratory, you can obtain an operating system with preinstalled application software; all operations and data storage of students are performed in the cloud platform data center, without occupying local client resources. Through intensive and unified management, it can not only meet the needs of customized special operating systems and application software but also realize the purpose of resource sharing and data security. Through the third-party component NetScaler monitoring platform, it is more convenient to monitor the software and hardware usage of cloud desktop data center and cloud desktop connection [21]. From the traffic monitoring graph and gateway monitoring, it can be seen that when about 100 cloud desktops are in normal use online at the same time, the network bandwidth is about 300 M, and the utilization of CPU and memory also remains at a normal level.

4. Analysis of Results

4.1. System Function Test. System functional testing is to test all functional modules in the system, verifying that these modules work correctly and meet the user's needs. Before testing, based on previous project experience, we sorted out the test documents for the errors that are easy to make in the system development process and tested the functional items of the module according to the content of the documents. After discovering the problem, correct it immediately, improve the test document when new problem occurs, and repeat the test until no problem occurs; some contents of the test document are shown in Table 3.

4.2. Thin Client Performance Test. When testing the network bandwidth, use the thin client protocol machine to access the cloud platform, open the Thunder player to play the movie application, and then use the thin client machine to access the cloud platform using RDP; when RDP is playing a movie, the traffic is mainly in the range of 1.2~1.6 Mbps, and the network delay is less than 1.3 s. In the system management software, the Hyper-V+Deskpool mode is used to manage cloud desktops, and the client-side video broadcast is very good, which can well meet the needs of users.

5. Conclusion

From the actual application effect of cloud desktop, VDI cloud desktop realizes the effective unification of user experience, data management, and operation and maintenance management. The cloud desktop platform abandons the architectural differences of software and hardware resources and maximizes the utilization of software and hardware resources through virtualization technology, students in the absence of perceived system differences and resource shifts, uninterrupted and efficient use of laboratory resources. Through centralized software templates and storage, students do not need to install basic software and system configuration; they can send experiment and learning data to remote storage, for the needs of data mining on the cloud platform and students' experimental analysis in the later stage. Unified configuration and centralized management, effectively improve the efficiency of operation and maintenance management, reduce deployment and maintenance costs, more secure and flexible resource sharing and resource allocation for students.

Data Availability

The data used to support the findings of this study are available from the corresponding author upon request.

Conflicts of Interest

The authors declare that they have no conflicts of interest.

Acknowledgments

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Retraction

Retracted: Dynamic Synchronization Modeling and Simulation of Video Sensing Nodes Based on Internet of Things

Wireless Communications and Mobile Computing

Received 18 July 2023; Accepted 18 July 2023; Published 19 July 2023

This article has been retracted by Hindawi following an investigation undertaken by the publisher [1]. This investigation has uncovered evidence of one or more of the following indicators of systematic manipulation of the publication process:

(1) Discrepancies in scope
(2) Discrepancies in the description of the research reported
(3) Discrepancies between the availability of data and the research described
(4) Inappropriate citations
(5) Incoherent, meaningless and/or irrelevant content included in the article
(6) Peer-review manipulation

The presence of these indicators undermines our confidence in the integrity of the article's content and we cannot, therefore, vouch for its reliability. Please note that this notice is intended solely to alert readers that the content of this article is unreliable. We have not investigated whether authors were aware of or involved in the systematic manipulation of the publication process.

Wiley and Hindawi regrets that the usual quality checks did not identify these issues before publication and have since put additional measures in place to safeguard research integrity.

We wish to credit our own Research Integrity and Research Publishing teams and anonymous and named external researchers and research integrity experts for contributing to this investigation.

The corresponding author, as the representative of all authors, has been given the opportunity to register their agreement or disagreement to this retraction. We have kept a record of any response received.

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[1] Z. Wang and Y. Q. Wang, "Dynamic Synchronization Modeling and Simulation of Video Sensing Nodes Based on Internet of Things," *Wireless Communications and Mobile Computing*, vol. 2022, Article ID 2845786, 8 pages, 2022.

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Research Article

Dynamic Synchronization Modeling and Simulation of Video Sensing Nodes Based on Internet of Things

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In order to solve the dynamic synchronization problem of IoT video perception, the authors propose an abstract model DSAM based on IoT video perception. This method firstly establishes the abstract model DSAM of IoT video perception based on the π network and then analyzes the state evolution, model transition, and dynamic interaction of the model; finally, the model DSAM is used to analyze and simulate the example. The result shows that when the model DSAM is tested and verified and when the number of buffer media is 50, 100, and 200, the minimum number of underflows of the DSAM model is 2 and the minimum video data packet loss rate is 1.02; the results are better than those of the MTFSC and 3TFSC models; in addition, without synchronization control, the synchronization rate between video frames is lower than that with synchronization control. The test results show that the model proposed and established by the authors can correctly handle the dynamic synchronization of IoT video perception and has certain practical value.

1. Introduction

A video image perception system is mainly to detect and recognize moving objects or targets and can be widely used in various fields of security protection, such as campus, transportation, and family. At present, there are certain researches and applications on video image perception systems at home and abroad. However, the algorithm and hardware design are complex, the implementation cost is high, the communication protocol adopts a private protocol, and the versatility is poor [1].

As one of the industries in the national development strategy, the Internet of things industry in China has developed rapidly with the support of central and local policies, and its scale has increased year by year. The Internet of things technology has played an important role in the fields of intelligent transportation, intelligent logistics, intelligent building, intelligent security, and intelligent home [2]. For example, smart home products combine technologies such as computer networks and automated control systems and realize the perception and remote control of various household devices. The smart grid uses intelligent means to realize the efficient use of energy and the security of energy supply through the digital information network system. Smart buildings construct a safe, efficient, and convenient building environment through the comprehensive application of various types of intelligent information [3]. It can be seen that IoT devices have penetrated into all aspects of our lives, and the impact of IoT devices is also growing. Some IoT devices carry a large amount of private data of the majority of users, and whether some IoT devices work normally or not, it is related to the personal and property safety of users and the safety production of enterprises [4]. Some past cases always remind us that IoT devices are generally vulnerable.

As an important part of the new generation of information technology, the Internet of things is a combination of various information equipment (such as RFID radio frequency identification devices, various sensors, and GPS or Beidou positioning systems), wireless transmission technology, and Internet technology, according to the agreed agreement, a network technology that realizes information exchange and communication of related items to realize intelligent identification, positioning, tracking, monitoring, and management. As an application expansion of the Internet, the core of the development of the Internet of things is application innovation [5], as shown in Figure 1.

2. Literature Review

Although the Internet of things is still in the initial stage of development, most countries in the world have invested in a certain degree of technology, standards, application demonstrations, and business models and have achieved certain results [6]. As early as 2009, IBM launched the concept of "Smarter Planet"; the ideal effect of this solution is through the combination of a sensor network and Internet technology, changing the way of communication between people or between people and organizations to achieve thorough perception, extensive interconnection, and in-depth intelligence. Since then, top companies in various industries in the United States have also joined the IoT industry, aimed at improving the company's operational efficiency; many enterprise applications such as automatic remote meter reading systems, item tracking, and security systems for power companies have emerged. In Europe, the European Commission has formally formulated the Internet of things as a strategic development plan for European ICT. As a result of the EU's high emphasis on and strong support for the Internet of things, the application market of the Internet of things industry is relatively mature, especially in the Western European market; IoT applications have been realized in many fields such as safety monitoring, automotive information communication, public transportation, urban informatization, and industrial automation [7].

In the Internet of things, the most basic is the information and data perception of the underlying nodes; in the case of reliable hardware, there is still a failure of the intelligent sensing node. Among the reasons for the failure of the IntelliSense node, the most important issue is the software reliability of IntelliSense nodes. With the development of the times, the reliability growth model of software can be divided into classic type, imperfect debugging type (imperfect debugging), testing workload type (testing effort), change point type (change point), and other types of models. On the whole, research based on analytical methods accounts for a very large proportion [8]. Intelligent perception has been widely used and is an important infrastructure in the field of IoT perception. Intelligent sensing nodes integrate sensing information collection, real-time information processing, and real-time communication, such as the Internet of vehicles in the field of intelligent transportation; if a fault or accident occurs on the road, the intelligent perception system will perceive and process information such as location and environmental conditions in real time and transmit the processed information in real time for fast processing. Intelligent sensing nodes have high performance, such as brand-new, wide coverage and strong real-time characteristics, such as mutual communication and interoperability. Moreover, IntelliSense nodes have constraints in terms of power consumption, volume, and processor speed [9]. Qin et al. conducted an in-depth study on time-extended Petri nets and described reliability by using their good scalability. Finally, a relatively perfect time-expanded Petri net SRG model evaluation scheme was formed, and it was applied to the actual embedded modeling process with good results [10]. Pan et al. studied the partition of software and hardware with dual-objective multichoice and proposed a heuristic algorithm to generate approximate solutions quickly, using a custom tabu search algorithm, an improved approximate solution algorithm, and a dynamic programming algorithm that quickly computes an exact solution; the hardware and software partitioning is studied [11]. Sabol et al. studied the partitioning of software and hardware under variable demands of intelligent systems and proposed a set of partitioning algorithms for enhanced hardware/software resource sharing parameters. Sabol et al. studied the hardware and software partitioning of heterogeneous multiprocessor system-on-chip (MPSoC) and proposed an optimized integer linear programming algorithm to solve small input hardware and software A method for partitioning the problem [12].

The authors use the π network combined with the Petri net and the π calculus, establish the abstract model DSAM of the Internet of things video perception system, and realize the modeling of the dynamic synchronization of the IoT video perception system; being able to correctly handle the dynamic synchronization concurrency of IoT video perception has certain practical value [13].

3. Research Methods

3.1. Model Establishment. The IoT video perception system is a typical concurrent dynamic system. Using the π network, a dynamic synchronization abstract model DSAM (Dynamic Synchronization Abstract Model) for IoT video perception is established to describe its dynamic synchronization characteristics [14].

Definition 1. Define DSAM as a π network, that is,

$$\text{DSAM} = \left(C_p, X, T_t, C_f\right). \tag{1}$$

C_p represents a basic token Petri net system, which is a collection of video perception libraries for the Internet of things; $X = \{X_1, X_2, X_3, \cdots\}$ represents a collection of interactive buttons, which is a collection of changes in the video perception information of the Internet of things, and different buttons represent different changes; and $C_p \cap X = \phi$; T_t represents the time relationship set of the synchronous transition of IoT video perception, which is the arc set of the network DSAM, and $T_t \subseteq (C_p \times X)(X \times C_p)$; C_f is an attribute function defined above, which represents the set of mapping relationships of the location set.

C_p is a six-tuple; that is, $C_p = (P, T, B, F, I_D, M : M_0)$ is a basic Petri net, and there are only two types of positions in the net: "normal" and "master." Among them, P is a set of positions; T is a set of transitions; $B : P \times T \longrightarrow I, I = \{1, 2, 3, \cdots\}$ is a set of directed arcs from positions to transitions; $F : T \times P \longrightarrow I, I = \{1, 2, 3, \cdots\}$, representing the set of

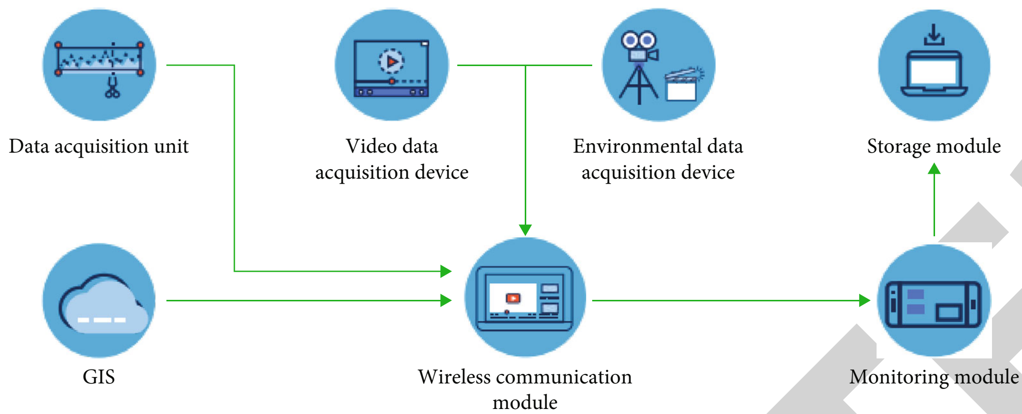


Figure 1: Video-aware node dynamics of the Internet of things.

directed arcs from transition to position; $M : P \longrightarrow I$ is the identification of the network system; $I = \{0, 1, 2, \cdots\}$; M_0 are the initial identification; I_D is the OPN (Object-oriented Petri Net) element, namely, $I_D = (C_{jp}, R_{\text{token}}, E_\pi)$, where C_{jp} is the element defined by the basic Petri net and R_{token} is the token of C_{jp}; E_π is the evolution factor of the DSAM model described by the calculus [15].

$X = \{X_1, X_2, X_3, \cdots\}$ is an interactive button set; there are six kinds of buttons: "Skip," "Pause," "Back," "Replay," "Restart," and "Modify Speed."

T_t mainly describes the set of time relations of the synchronous time transition of the IoT video perception system, and T_t can be formally defined by using TPN (Time Petri Net). DSAM conforms to the definition of the π network and is a π network. It needs to be defined here to better describe the DSAM model [16].

Definition 2. T_t is a time relationship set, which is an extension of a TPN network, that is,

$$T_t = \left(P_k, T_{dt}, Q_d, F_{kz}, F_{df}, S_{tbl}, W_{ma}, G_{bx}\right). \tag{2}$$

Among them, P_k is a collection of limited places of the Internet of things video perception system. $T_{dt} = \{t_{dt1}, t_{dt2}, \cdots, t_{dtn}\}$ is a limited set of temporal dynamic changes of the IoT video perception system and satisfies the condition $P_k \cup T_{dt} \neq \phi, P_k \cap T_{dt} \neq \phi$. $Q_d = \{q_{d1}, q_{d2}, \cdots, q_{dn}\}$ represents the limited transition set of various information data in the IoT video perception system and satisfies clause $P_k \cap Q_d \neq \phi, Q_d \cap T_{dt} \neq \phi$. $F_{kz} \subseteq (P_k \times T_{dt}) \cup (T_{dt} \times P_k) \cup (P_k \times Q_d)$ is the set of arcs that control flow, and $F_{df} \subseteq (P_k \times Q_d) \cup (Q_d \times P_k) \cup (P_k \times T_{dt})$ is a collection of arcs of the data flow, representing the dynamic relationship of the system. S_{tbl} is the mapping from T_{dt} to synchronization transition rules. $W_{ma} : T_{dt} \longrightarrow P_k$, that is, the mapping relationship between the dynamic time transition set and the finite place, and it satisfies $\forall p_k \in \{\text{master}\}, \exists t_{dti} \in T_{dt} | W_{MA}(t_{dti}) = p_k$. $F_{tf} : T_{dt} \longrightarrow (R{+}\cup\infty)$ which is the time mapping function, and $R+$ is the set of positive real numbers. G_{bx} is the mapping function relationship between the transition and its associated interactive button set X, namely, $T_{dt} \longrightarrow X$, which can be defined as $\forall x \in X, \exists t_{dti} \in T_{dt} | Gbx(t_{dti}) = x$.

According to the model established above, the graphical description diagram of the model DSAM can be obtained by using the graphical description method. Under the synchronization time constraint of T_{t0}, the P_0 and P_2 tokens are changed. Under the interactive operation of the Internet of things video data frame X_i, the changes are further transferred, and the graphical description of the model DSAM shown in Figure 2 is obtained.

3.2. Model Analysis. Using π-net theory, the state evolution, transition, and dynamic interaction of the DSAM model are analyzed.

3.2.1. State Evolution. When studying the DSAM model, the state of the model should be analyzed first, and the state set of the model should be given; then, the state evolution of the model should be studied on the basis of the state, and the state evolution rules should be given.

Definition 3. Model state set definition: the state set of DSAM is represented by Ss; then, Ss is a triple, that is,

$$Ss = (c, T_{\text{det}}, K_{ebt}). \tag{3}$$

Among them, P_t is the location set containing tokens in the model and T_{det} is the dynamic valid time period table of various information in the model; the number in the table is the same as the number of marked locations; if the user performs a pause operation at a certain moment, the value in T_{det} is the time remaining at the position; K_{ebt} is the button list that the user will operate; that is, record the user's optional operations from the present moment to the end.

Rule 1. State evolution rule: suppose $t_{\text{det}} \epsilon T_{\text{det}}$ is the transition of state Ss enabled by relative time R_t; then, the model can change at the dynamic effective time t_{det} and evolve into a new state Ss', namely, $Ss' = (P_t{}', T_{\text{det}}{}', K_{ebt}{}')$, as shown in

$$P_t' : (\forall p_k \in P_k) P_t'(p_k) = P_t(p_k) - R_t(t_{\text{det}}, p_k) + F_{kz}(t_{\text{det}}, p_k). \tag{4}$$

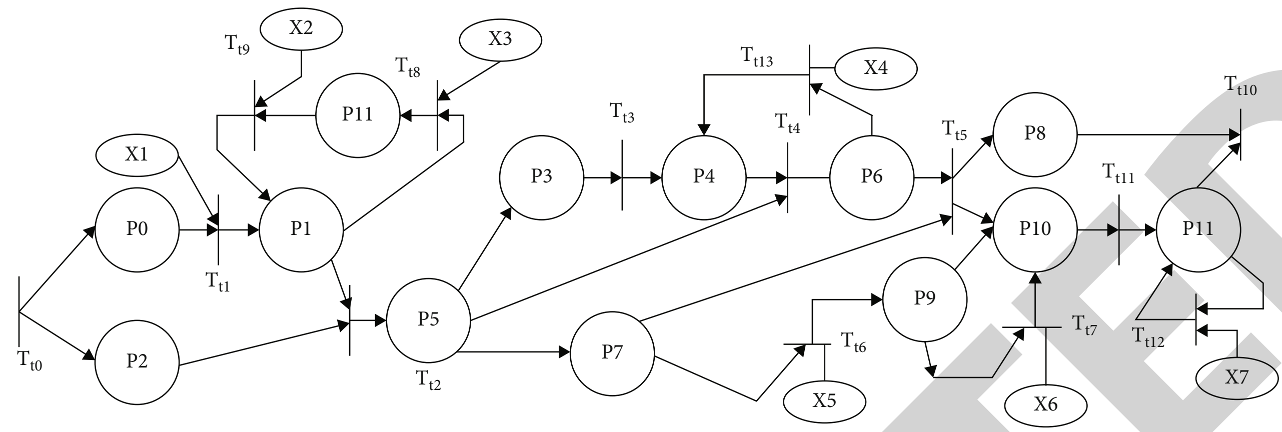


FIGURE 2: Graphical representation of the model DSAM.

$T'_{\det}$: ${T_{\det}}'$ is the dynamic relative effective time period table of the position marked by ${P_t}'$, and if $[a_i, n_i, b_i]$ is the time interval of the place P_{ki} in the state of Ss, it satisfies the following:

$$\forall p_k \in P_k \wedge P'_t(p_{ki}) > 0, \tag{5}$$

$$T'_{\det}(p_{ki}) = \begin{cases} [L_{\max}(0, a_i - \theta), n_i - \theta, L_{\max}(0, b_i - \theta] P_t(p_{ki}) > 0, \\ [a_i, n_i, b_i] P_t(p_{ki}) = 0, \end{cases} \tag{6}$$

$$K'_{ebt} : \forall t_t \in T_t, \tag{7}$$

$$K'_{ebt}(t_t) = \begin{cases} x, \exists x \in X \wedge P'_t(p_{kit}) > 0 \wedge X P_t(t_t) = x, \\ \phi. \end{cases} \tag{8}$$

Among them, p_{kit} is the input position of transition T_{dt}.

3.2.2. Model Change. The transitions of the model DSAM mainly include "Key"-type transitions and non-"Key"-type transitions.

Definition 4. Transition occurrence condition: set in time $\triangle t_t$, the triggering of transition $t_{\det}$ in t_t is determined by the state; it must satisfy the following:

(i) $t_{\det}$ is enabled by P_t at time point θ_t: $(\forall p_{ki} \in P_k)(P_k(p_{ki}) \geq F_{kz}(p_{ki}, t_{\det})$

(ii) θ_t meets: $\min(i) \leq \theta_t \leq \min_i(\max(i))$

When the transition conditions given in Definition 4 are met, the transition cannot occur because the time factor is also required. Definition 2 shows that if the time T_t meets the requirements of the TPN network, the transition $t_{\det}$ can occur.

Rule 2. Model communication transition rule: assuming that p_{pi} and p_{pj} are a pair of conjugate transitions of the model DSAM, if there are two subnetworks $\mathrm{Net}_1 t$ and Net_2 of the network DSAM that are complementary to each other and the functions that identify all the place state items of the network DSAM, for any two states belonging to Ss, there are $\forall t_1 \in \mathrm{Net}_1, t_2 \in \mathrm{Net}_2, \exists \mathrm{BS} * (t_1) = \alpha_{t_1}, \mathrm{BS} * (t_1) = \alpha_{t_2}$; then, t_1 and t_2 can generate communication transition t_{tb} in the network DSAM, namely, $t_{tb} = <t_1, t_2>$, $\omega_t = \xi$ (representing the transition type between various information such as input transition, free output transition, restricted output transition, communication transition, and matching transition), such that $^*t_{tb} = {}^*t_1 \cup {}^*t_2$, $t^*_{tb} = t_1{}^* \cup t^*_2$, $\forall s \in {}^* t_1$, $C_f(s, t) = C_f(s, t_1)$, with the rule: let $\lambda_{t1} = ay\{y/x\}$, where λ_{t1} is the number of various information of IoT video perception, x is the label of the output library, y is the free channel name on the output, and a is the replacement of the channel name. There are the following:

(i) When $\omega_{t2} = ay$, then $\omega_t = \xi\{y/x\}$, and $\forall s \in t^*_1$, $C_f(t, s) = C_f(t_1, s)$

(ii) When $\omega_{t2} = a(y)$, then $\lambda_t = \xi\{y/x\}$, and $\forall s \in t^*_1$, $C_f(t, s) = C_f(t_1, s) + (\varphi, \varphi, \varphi, \{y\})$

3.2.3. Model Dynamic Interaction. For the IoT video perception system, the dynamic interaction with users is to realize the synchronization problem of IoT video perception. If the transition accepts the user input button, there is a schematic diagram of the interactive operation as shown in Figure 3 (where $\{X_1, X_2, X_3, \cdots\}$ is the interactive button set X).

(i) "Skip": if the user input button is "Skip," the model DSAM transition will be activated immediately, and the library place that is not executing completes the semantics

(ii) "Pause" and "Restart": if the user submits a "Pause," the place C_p accepts a token and performs a Nop operation at the same time until the next input interaction is "Restart"

(iii) "Modify Speed": if the user inputs the "Modify Speed" operation of the library place θ_t at time C_p, the result is to change the execution speed of various information of IoT video perception

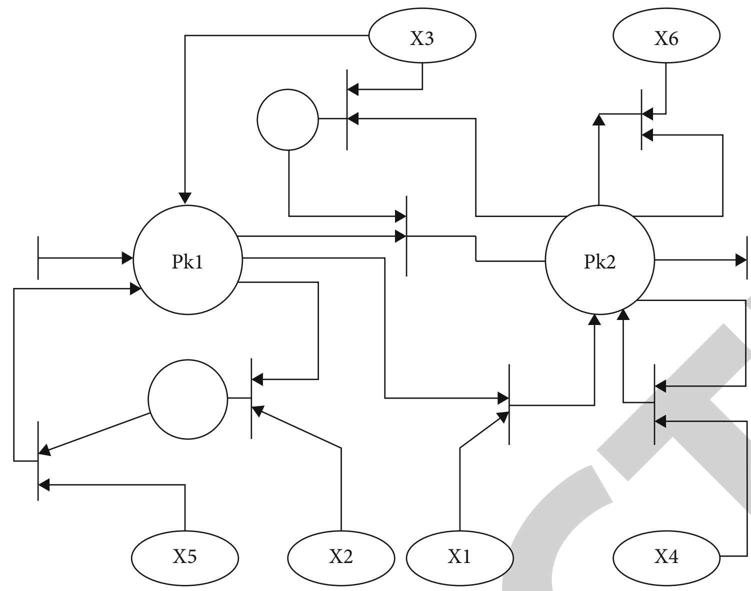


Figure 3: Graphical description of the π network for model interaction.

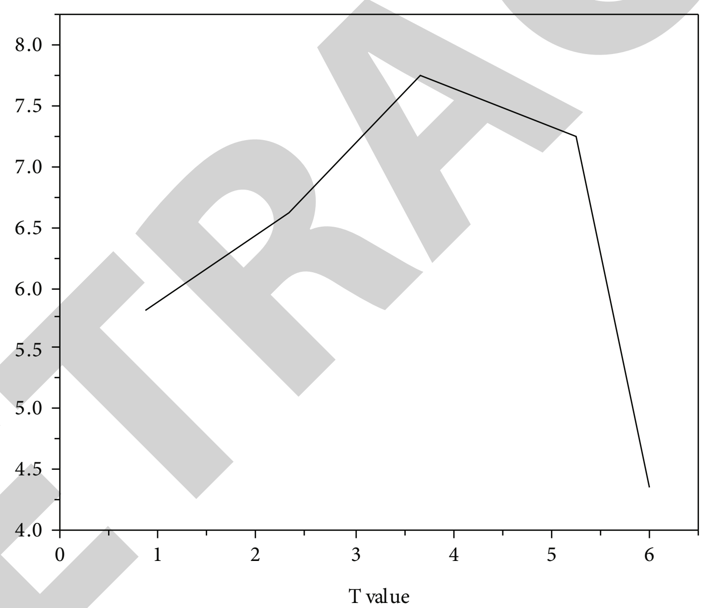
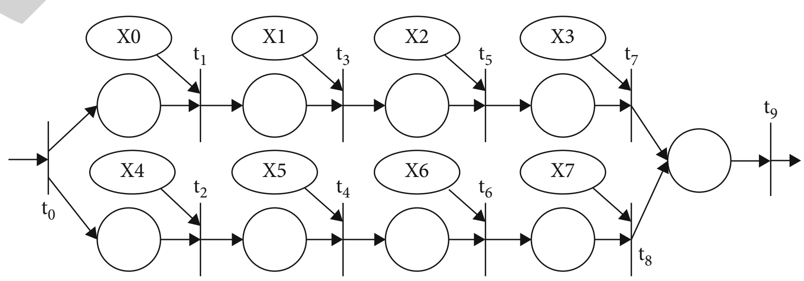
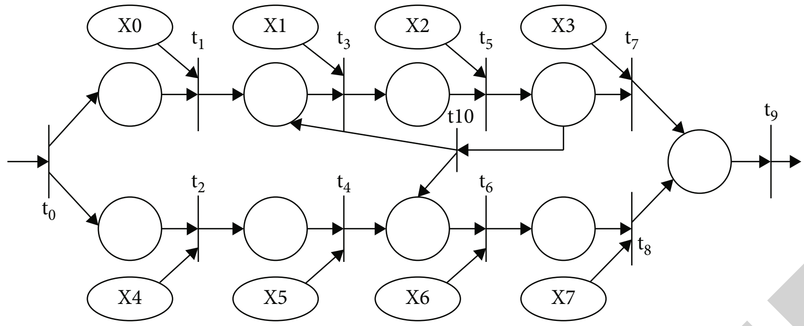


Figure 4: Sequence diagram of IoT video perception data flow.



Among them: Pi represents the Cpi in the model DSAM; Xi represents the interactive operation; ti represents the synchronization time; the arrow represents the transition.

Figure 5: DSAM diagram of the audio and video synchronization model.



Among them: Pi represents the Cpi in the model DSAM; Xi represents the interactive operation; ti represents the synchronization time; the arrow represents the transition.

Figure 6: Exception handling of the audio and video synchronization model DSAM.

Table 1: Comparison of model DSAM with MTFSC and 3TFSC video intraframe synchronization quantization.

Project	Comparing results								
Number of buffer media		50			100			200	
Model	DSAM	MTFSC	3TFSC	DSAM	MTFSC	3TFSC	DSAM	MTFSC	3TFSC
N_{DownFlow}	15	20	25	8	10	12	2	4	9
X_{DataLost} (%)	1.02	1.50	2.15	1.07	1.98	2.18	1 .09	1.99	2.28

Table 2: Synchronization comparison between video frames (%).

Project		Comparing results		
	Test time	9:15	9:25	9:35
No synchronization control	Teacher audio and video synchronization	77.23	70.12	71 .02
	Teacher audio and screen sync	77.14	75.29	73.25
	On-screen text and teacher audio sync	75.48	69.58	70.46
With synchronous control	Teacher audio and video synchronization	99.12	99.75	99.14
	Teacher audio and screen sync	99.45	99.76	99.46
	On-screen text and teacher audio sync	98.17	99.25	99.74

(iv) "Back": the user has entered a back operation, and the result is the IoT video perception information directly back to the previous moment or time period

(v) "Replay": if the user input is the "Replay" button, the model DSAM will reexecute various information of the operated IoT video perception

From the above analysis, it can be seen that the DSAM model can well realize and complete the dynamic interaction between media and users [17].

4. Analysis of Results

4.1. Example Simulation. In order to use the DSAM model to describe the dynamic synchronization problem of IoT video perception, it is assumed that the IoT video perception system is a composite data stream of video, sound, text, and animation; the time series relationship between media objects and subobjects is shown in Figure 4. The user interacts with various information of IoT video perception through the interaction button set X [18]. When starting to run, you can directly jump to C_{f1} for performance, "Pause" and "Restart" Vdo1 performance, return from Vdo3 to Vdo2 for performance, and also make am1 perform again.

The synchronization of audio and video is shown in Figure 5. The audio and video data stream speed is 10 frames per second. The maximum distortion in QoS is 80 ms, and the maximum jitter is 10 ms.

4.2. Exception Handling. It can be seen from the example simulation that the maximum distortion and maximum jitter in QoS are caused by the difficulty of fully synchronizing various information of IoT video perception, so it is necessary to use certain methods to process media data streams. The processed sound and video are shown in Figure 6.

In IoT video-aware synchronous communication, data loss due to signal attenuation, interference, and delay is inevitable. In the simulation example, the LDU of the audio stream cannot be discarded arbitrarily for the sound data, and a suppression arc is introduced for abnormal processing. For video media streams, losing a small amount of data has little effect on video QoS. Therefore, the model is able to implement exception handling and is robust to a certain degree of object loss [19–21].

4.3. Model Performance Analysis. To analyze the performance of the model, first analyze the synchronization quantification within the media, and then, analyze the synchronization quantification between the video information. The internal synchronization quantization of the video is analyzed, and its indicators are mainly the buffer underflow times N_{DownFlow} and the data information packet loss rate X_{DataLost}; the data shown in Table 1 are obtained through experiments. From the data in Table 1, it can be seen that when the model DSAM is tested and verified, the obtained data buffer underflow times are less than those of the other two models. The packet loss rate of video information data is also lower than that of the other two models. Therefore, the model DSAM has certain advantages in the control of intravideo synchronization.

A quantitative test is carried out on the synchronization between video frames, the test environment uses video images, voice, text, etc., under experimental conditions, and the teacher lectures in the Internet of things video perception classroom are tested, in order to verify video frame synchronization. After experiments, the data shown in Table 2 were obtained. From the data in Table 2, it can be seen that without synchronization control, the synchronization rate between video frames is lower than that with synchronization control [22].

From the above analysis, it can be seen that the model DSAM has excellent performance in both intravideo synchronization control and video interframe synchronization control [23–25].

5. Conclusion

Aiming at the dynamic synchronization problem of Internet of things video perception, the authors use the π network combined with the Petri net and π calculus to establish the abstract model DSAM of the Internet of things video perception system and realize the modeling of the dynamic synchronization of the Internet of things video perception system. Through the simulation and analysis of the model DSAM, it can be seen that the model proposed and established by the authors is able to correctly handle the dynamic synchronization of IoT video perception which has certain practical value.

Data Availability

The data used to support the findings of this study are available from the corresponding author upon request.

Conflicts of Interest

The authors declare that they have no conflicts of interest.

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Hindawi
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https://doi.org/10.1155/2023/9796378

Retraction

Retracted: Integrated Wiring System of Intelligent Building Based on Internet of Things

Wireless Communications and Mobile Computing

Received 18 July 2023; Accepted 18 July 2023; Published 19 July 2023

This article has been retracted by Hindawi following an investigation undertaken by the publisher [1]. This investigation has uncovered evidence of one or more of the following indicators of systematic manipulation of the publication process:

(1) Discrepancies in scope
(2) Discrepancies in the description of the research reported
(3) Discrepancies between the availability of data and the research described
(4) Inappropriate citations
(5) Incoherent, meaningless and/or irrelevant content included in the article
(6) Peer-review manipulation

The presence of these indicators undermines our confidence in the integrity of the article's content and we cannot, therefore, vouch for its reliability. Please note that this notice is intended solely to alert readers that the content of this article is unreliable. We have not investigated whether authors were aware of or involved in the systematic manipulation of the publication process.

Wiley and Hindawi regrets that the usual quality checks did not identify these issues before publication and have since put additional measures in place to safeguard research integrity.

We wish to credit our own Research Integrity and Research Publishing teams and anonymous and named external researchers and research integrity experts for contributing to this investigation.

The corresponding author, as the representative of all authors, has been given the opportunity to register their agreement or disagreement to this retraction. We have kept a record of any response received.

References

[1] L. Du, "Integrated Wiring System of Intelligent Building Based on Internet of Things," *Wireless Communications and Mobile Computing*, vol. 2022, Article ID 1086210, 8 pages, 2022.

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Volume 2022, Article ID 1086210, 8 pages
https://doi.org/10.1155/2022/1086210

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Research Article

Integrated Wiring System of Intelligent Building Based on Internet of Things

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In order to explore how the intelligent building can realize the integrated wiring system, the author proposes an integrated wiring system for the intelligent building based on the Internet of Things. This method recommends key technical problems and solutions based on the information represented by the Internet of Things and explores the research on the realization of integrated wiring systems in intelligent buildings. Research has shown that the integrated wiring system of intelligent buildings based on the Internet of Things can solve the shortcomings of traditional buildings, and the happiness index of occupants has increased by about 15%. In the future, a building will be a platform, and each building will be an IoT unit and a cell body, making the Internet of Buildings possible and building a big data platform for the Internet of Buildings.

1. Introduction

China in the 21st century is a rapidly developing China, an era when hundreds of millions of Chinese people realize the Chinese dream [1]. Architecture is a symbol of the development of the times; today, various high-rise buildings in China are springing up like bamboo shoots after a rain. With the development of the times and the advancement of science and technology, architecture has also entered the era of intelligent buildings, and buildings are no longer traditional rigid buildings; it has a certain intelligence, can listen, can see, can perceive, can think, can judge, and has the ability to "think and make decisions"; it represents the latest trend in the development of intelligent buildings. What makes a smart building smart depends on its design. It takes many designers to use their ingenuity to implant a "nervous system" into the building.

With the rapid growth of the number of intelligent buildings, more and more design institutes have set up intelligent majors, or weak current majors [2]. Engineering integrators are also equipped with corresponding intelligent building designers. However, since the starting point of intelligent buildings in China is still relatively late, despite the development of nearly two decades, the development of intelligent buildings is still limited, and most people are still unfamiliar with the concept of intelligent buildings, unlike water supply and drainage, strong electricity, and decoration; even people in the industry may not fully understand the meaning [3].

Building intelligent weak current system has high technical content, long construction period, and complex process. There are many problems in the design of intelligent weak current; for example, the current technical specifications and standards related to the weak current industry are not unified, and with the rapid development of technology and the rapid upgrading of products, some current specifications cannot meet the technical requirements; moreover, in the process of intelligent design, some personnel from other majors and units also interfered with the design, making the design works unreasonable and the construction quality unqualified, and the degree of functional realization of the design is low. Intelligent building designers need to have strong comprehensive strength and practical experience, not only to master various professional knowledge but also to have rich design experience; it is necessary to master not only professional knowledge in many aspects but also rich design experience and mastery of cutting-edge technology and latest products; unfortunately, such designers are currently in short supply, resulting in unreasonable design of intelligent systems, low design quality, and low recognition from owners [4].

The "smart building" in the 21st century will be an upgraded version of the "smart building," by making full use of communication technology, artificial intelligence technology, Internet of Things technology, and BIM technology to sense and analyze the key information of the core system of the entire building operation, in order to achieve the goal of "efficiency, comfort, safety, and energy saving"; it can respond intelligently to various needs including people's livelihood, environmental protection, and public safety and create a better life for people [5].

A smart building is generally composed of four systems: building system, communication automation system (CAS), building equipment automation system (BAS), and office automation system (OAS). The BAS, CAS, and OAS systems together constitute the brain and nervous system of the building. Its key technologies are Internet of Things technology, BIM technology, artificial intelligence technology, and cloud computing technology.

As a smart building industry closely linked to the Internet of Things, the Internet of Things has a ubiquitous impact on smart building technology, and devices are spread across most subsystems through sensor networking technology [6]. It can be said that many subsystems are already close to the form of the Internet of Things or are already in the form of the Internet of Things, such as monitoring, security, one-card, professional applications, and other systems in building equipment. The interaction between the Internet of Things and smart buildings is realized; especially RFID technology is widely used for personnel management, equipment management, and material management in buildings. However, the applications that are designed today can only be used in the field of architecture, they all define and use the surrounding contacts in a granular manner according to the characteristics of the system; in this way, granular objects of different granularity levels will inevitably form the source of massive data, which requires that we must rely on massive data processing platform to carry out. The Internet of Things has seven key technologies, including hardware and software technology, identification technology, network architecture, network and communication, data representation and processing, energy technology, and security and privacy technology [7], as shown in Figure 1.

2. Literature Review

Ishmael et al. said that intelligent buildings developed earlier in the United States and the research on it was earlier [8]. Murugesan began research to develop a design standard for home electronics, and the following year, the American Smart Building Association was established, conducting basic research work related to intelligent buildings [9]. In 1989, Li et al. introduced the integrated modernization model of air conditioning control, electrical control, and data communication integrated wiring system for the whole unit [10].

Qin and Xie said that as early as 1986 in Europe, the Eureka project integrated home system development research as the focus of research and development [11]. Since the 1980s, the European Committee for Standardization has developed a digital bus standard for household appliances and for the further standardization of smart housing technical standards. Smart buildings in Europe are mainly concentrated in some modern cities, such as Madrid, Frankfurt, London, Paris, and other well-known cities.

In the early 1980s, Japan vigorously promoted household electronic products; in the mid-1980s, Japan proposed a new concept of home automation. In recent years, Wang et al. proposed the concept of a superintelligent building home integration system [12]. In 1996, Japan launched the smart home multimedia technology and obtained important international research results. Japan is one of the representative countries that combine the theory and practice of intelligent buildings, and it is also one of the major intelligent building markets in the world.

Kim et al. believe that in Southeast Asia, Singapore has the leading research level of intelligent building technology. Singapore's Ruby family intelligent management system has been used in hundreds of residential communities [13]. With the rapid rise of intelligent buildings, the Ministry of Construction of China has issued relevant intelligent building standards, in order to standardize the intelligent design and construction of Chinese buildings. In the early 1990s, Mihoubi et al. carried out research on the quality of intelligent building intelligence [14]. The characteristics of intelligent buildings in various countries in the world are investigated, analyzed, and summarized, and the quality evaluation factors of intelligent buildings are obtained from the aspects of function, economy, and automation. After that, many Chinese experts and technicians in the industry have written a lot of books about intelligent buildings, in order to help more people understand intelligent buildings and raise people's awareness of the importance of intelligent buildings. At the same time, a large number of intelligent building design institutes, intelligent building consulting agencies, intelligent building system integrators, and intelligent building product suppliers have sprung up in China one after another.

Kouki et al. said that at present, China's construction industry is developing rapidly. With the continuous progress of science and technology, intelligent buildings have been widely used and promoted, and there are more and more supporting weak current projects, and intelligent weak current design has also improved significantly [15]. Because of the importance of intelligent buildings, intelligent buildings in China have also flourished, especially represented by more developed cities such as China's coastal areas; after that, cities in other regions are not far behind, and smart buildings have also developed rapidly.

3. Methods

3.1. Structure of BP Neural Network. Calculate the corrected connection weights. If the error function is e and the iterative partial derivative of each neuron, $\Delta w_m(k)$, is the

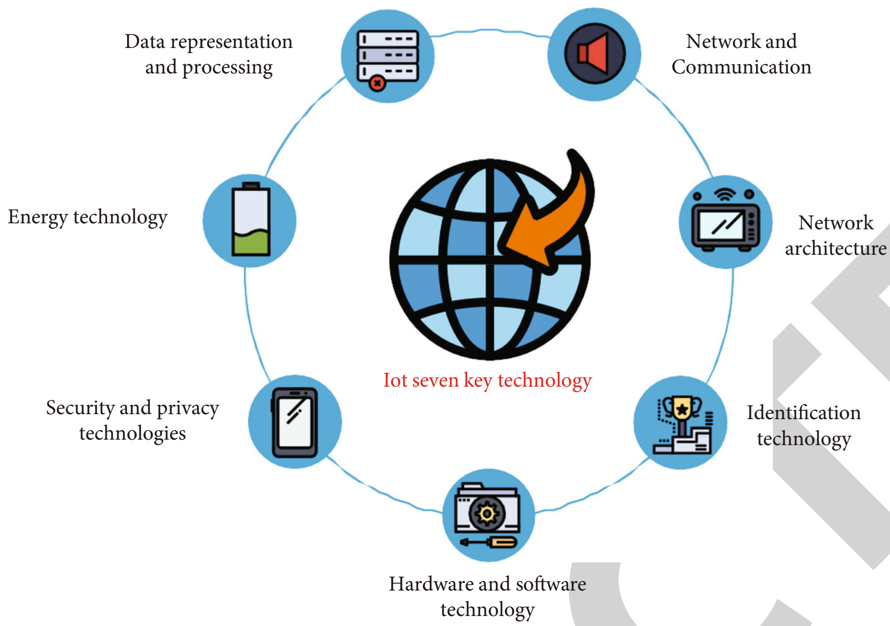

Figure 1: Key technologies of the Internet of Things.

corrected connection weight, the formula for calculating the variable value $\Delta w(k)$ is shown in

$$\Delta w(k) = \delta(k) x(k). \tag{1}$$

If the global error is defined as E, the method for calculating E is as shown in

$$E = \frac{1}{2m} \sum_{k=1}^{m} \sum_{a=1}^{q} \left(d_a(k) - y_a(k)\right)^2. \tag{2}$$

For example, in the case where the input layer is 8, the relationship between a certain neuron n in the hidden layer and the input layer data can be as shown in

$$f_n = \sum_{i=1}^{8} w_{ni} X_i. \tag{3}$$

Calculate the fitness value of the population, and find the optimal individual from it, as shown in

$$\mathrm{FitnV} = \mathrm{ranking}(\mathrm{Obj}). \tag{4}$$

The selection operation is shown in

$$P_i = \frac{F_i}{\sum_{j=1}^{N} F_j}. \tag{5}$$

The crossover operation is shown in

$$a_{kj} = a_{ij}(1 - b) + a_{ij} b, \tag{6}$$

$$a_{ij} = a_{ij}(1 - b) + a_{kj} b. \tag{7}$$

The mutation operation is shown in

$$ai_j + \left(ai_j - a_{\max}\right) * f(g), \tag{8}$$

$$ai_j + \left(a_{ij} - a_{\min}\right) * f(g), \tag{9}$$

$$f(g) = r_2 \left(\frac{1 - g}{G_{\max}}\right)^2. \tag{10}$$

3.2. Analysis of Correlation Degree of Smart Building Industry. Industrial relevance refers to the supply and demand of products, and the formation of industry and industry is interrelated, and they are the internal connection of preconditions for each other [16]. The analysis of the correlation degree of the smart building industry is mainly carried out from two aspects: research analysis and consultation of relevant experts. According to the analysis results of these two aspects, a summary table of the correlation degree of the smart building industry is summarized and analyzed. From this chart, it can be seen that the related industries that are mainly related to smart buildings include the Internet of Things industry, construction industry, residential industry, energy conservation and environmental protection, smart home industry, information service industry, smart city, cloud community, communication industry, and electrical industry. A summary table of the correlation degree of the smart building industry is shown in Table 1.

In view of the demand analysis of the smart building market, a survey and questionnaire survey were conducted on an intelligent building system engineering company in the early stage. After consulting relevant experts, a few enterprises, and some relevant technical personnel were interviewed [17]. After this series of investigations, the materials of this period were integrated, and the important value

Table 1: Summary of the relevance of the smart building industry.

Numbering	Related industries	Average survey score	Processing points
1	IoT industry	8.62	0.657
2	Construction industry	11.13	0.489
3	Residential industry	6.28	0.291
4	Energy saving and environmental protection	7.88	0.175
5	Smart home industry	12.66	0.366
6	Information service industry	5.20	0.077
7	Smart city	3.14	0.341
8	Cloud community	1.31	0.187
9	Communications industry	4.91	0.080
10	Electrical industry	2.57	0.054

analysis of the market demand for smart buildings was finally obtained, as shown in Table 2.

From this analysis table, it is not difficult to see that the current market demand for smart buildings requires a good development environment and perfect laws and regulations as support to strengthen publicity efforts and launch model projects to increase the prevalence of smart buildings, thereby expanding the applicable population. In the medium and long term, it is necessary to strengthen the research and development of new intelligent functions and launch new intelligent functions in a timely manner to attract more consumers. It is also necessary to appropriately reduce industrial costs [18], thereby improving the competitiveness of smart buildings in the market.

The application of advanced technologies such as the Internet of Things, cloud computing, and wireless communication to building intelligence will inject wisdom into the building, making various facilities in the building more widely interconnected, information transmission is more efficient and rapid, and decision-making is more efficient. With the gradual deepening of people's understanding and understanding of building intelligence, building intelligence will not only be the design and construction of complex systems but also the mechanical automation of auxiliary functions and auxiliary equipment such as management systems and control systems; it will also be integrated with other architectural concepts to bring about larger, more comprehensive changes, and in order to achieve the coordination and optimization of various functions of the building [19]. Smart buildings will develop in the direction of green, ecological, artificial and natural intelligence, traditional and modern penetration, and architectural.

3.3. Greening of Smart Buildings. When people design buildings, they are different from the past, only for spaciousness and comfort; modern people are now also considering the impact of buildings on their own behavior and whether they consume too much energy and have realized some ideas in reality, with some typical success case. We list a few here well-known devices that can actively and passively manufacture and develop sunlight: the Future House at the Museum of Welsh Living, designed by Jesticot and Whiles, and the London Zero Carbon Pavilion at the World Expo, which can achieve zero-energy operation [20]. Energy-saving smart buildings can be used to develop many things that are beneficial to people's lives; for example, in terms of enhancing sunlight, there are daylight frames and heliostats, automatic windshields are used to control ventilation, sound-absorbing baffles are used to mute noise, photoelectric effects are used to generate electricity, and shutters are used for heat insulation; in addition, it also includes its own use of technology to test the life cycle and fully autonomous management of the power system.

Economic development requires huge energy consumption, and the world is facing a severe energy crisis. To this end, the world has put forward the concept of energy saving and advocated energy-saving behavior. Building energy efficiency is an important measure. Green buildings are bound to be one of the trends in the development of smart buildings.

As we all know, the functions of modern green buildings are no longer limited to shelter from wind and rain, ventilation, and lighting like traditional buildings in the past; buildings in the new era must be able to adapt to the environment and achieve the function of protecting the ecology. First of all, it is based on the principles of sustainable development and ecology, which is different from traditional aspects in many aspects, such as what materials to choose, what kind of structure to build, and how to plan and design; at present, the Ministry of Housing and Urban-Rural Development of China has issued corresponding policies in this regard; whether a building is a green building depends on whether it meets the following standards:

(1) Is it spacious enough from an ecological point of view [21]

(2) The materials used are environmentally friendly materials, which should be absolutely harmless to people and the environment

(3) From the ecological principle, the whole house is completely pollution-free when it is designed and constructed

(4) Can it be integrated with the surrounding ecological environment

Table 2: Analysis table of important value of smart building market demand.

Order	Market demand factors	Important value
1	Policies and regulations, development environment	0.83
2	Strengthen publicity	0.71
3	Strengthen the prevalence and applicability of smart buildings	0.58
4	Introducing new smart features	0.27
5	The postwork of smart buildings	0.35
6	Reduce industrial costs	0.17

(5) The residence should also be environmentally friendly enough during operation, and the energy consumption should be as low as possible

3.4. Realization of Ecology. What is the impact of intelligent buildings on the realization of ecologicalization? Generally speaking, the architectural forms of intelligent buildings are in line with ecological standards, whether it is the shape of the building or the structure of the building; there are very practical considerations in saving energy, reduced energy consumption for ventilation, heating and cooling, lighting, etc.; as Kalter Kronter said, the so-called intelligent design is the embodiment of beauty, and this kind of beauty is on the surface to make the building integrate with nature and become natural, to keep our buildings high quality, whether conditions are favorable or unfavorable, and in order to keep track of some of its changes; of course, in order to achieve the above, it must be the result of the joint action of various disciplines, including bioengineering, earth science, and bionic science; only by integrating them can we build the green ecological building we want; at present, there are many examples that can embody this concept; here, we list a few: such as the Heliotrope commercial and residential building, which can shine like a sunflower, and the fantasy house in Denmark, which can imitate the closure of petals [22].

At present, many scholars in China are also advocating this concept, incorporating people into the cycle system of nature; this requires the builders of the house not only to care about the construction process of the building but also to pay attention to its life cycle; ecological buildings should generally have the following characteristics:

(1) Humans can feel comfortable and healthy living in it, which requires that the temperature should be suitable, the humidity must be suitable, the air should be clean enough, the lighting effect should be good enough, no noise, and the space should be flexible and spacious

(2) Sufficient consideration should be given to the use of the natural environment, and resources should not be wasted, and absolute land savings should be achieved; in material selection, materials that can be reused or recycled should be used as much as possible; to achieve a sustainable development effect, we should save as much energy as possible

(3) The pollution or damage to the environment should be small enough, which mainly includes proper disposal of garbage and noise reduction

From a technical point of view, ecologicalization can be divided into three technical levels, including low-tech, light-tech, and high-tech. Relatively speaking, low-tech uses less or no high-tech means; it generally uses accurate technical analysis to achieve ecologicalization of buildings. Light technology uses many high-tech components; it aims to make the performance of buildings more excellent, and it is mainly realized in construction technology; generally speaking, saving materials and reducing costs must rely on this level of technology. High-tech uses more high-tech components; it aims to maximize the energy use efficiency of buildings, create a comfortable environment for people, and protect the ecological environment, mainly relying on this level of technology [23]. Of course, high technology is also based on traditional technology; the special thing is that it uses more advanced means. The famous RoofRoof is a good example; its original design concept came from traditional temples in Malaysia and louvers to block intruders, so it was designed as an "environmental filter." It is of great theoretical help for the realization of the ecologicalization of intelligent buildings.

When we stand in front of a building, the first thing we see is the outer wall, which is the first protective layer of the building. Regardless of wind, frost, rain, snow, or fog on a sunny day, the outer wall is always free from the influence of the atmosphere, while adjusting the flow of energy in various forms such as light, heat, and sound, it provides people living indoors with a safe, secret, easy-to-access, wide field of vision. The full name of the outer wall is the intelligent outer protective structure, it is like human skin and is controlled by the "hypothalamus" of the human body, and it can automatically simulate the response of the outer wall to changes in the outside world and can change the shape and material accordingly. The body can also develop routine patterns that best respond to particular conditions. The outer wall can not only control itself but also help or guide the user to control [24].

When developing the potential of intelligent "skin," intelligent technology introduced a large number of plants, which greatly increased the use of space, rather than just staying in the variability of space and cutting aspects that conform to structural and ecological functions in appearance. These have changed the traditional space form while saving building energy consumption and improving the indoor environment. Contemporary society has higher requirements for smart buildings, and it is necessary to provide more possibilities for space and functions. The specific manifestations are enhancing the interweaving penetration of greening and buildings and performing functional replacements that replace the existing functions of buildings with other functions [25].

With the development of science and technology and the drive of people's innovative spirit, the future development of smart buildings will be from the intelligence of the internal functions of the building to the intelligence of the entire building including the outer wall, and the building will be endowed with "life."

4. Results and Analysis

According to the analysis results of the important value of the market demand of smart buildings, the industrial goals of smart buildings are obtained through seminars, and finally, the development goals of smart buildings are analyzed by SPSS software, as shown in Table 3.

According to the ranking of the smart building industry goals reflected in the above table, the time and technical indicators for realizing the industry goals are put forward through analysis, as shown in Table 4.

Although the concept of architecture has transitioned from "intelligent building" to "smart building," in practice, the construction situation has not reached the expected good. The continuous emergence of new technologies will gradually promote the development process of "smart buildings" [26]. The talent training model is not perfect. Although most architectural design institutes currently have professional facilities, they mainly focus on five majors: architecture, structure, water, electricity, and heating, and there is a lack of personnel who can engage in intelligent building system engineering design. Moreover, system integrators have more intelligent system design personnel than architectural design institutes, and most of them are familiar with the technologies of various subsystems of the intelligent system and are also familiar with equipment products. The problem is that these people start to design construction drawings without design training after they leave the school. These people do not know enough about architectural design, and the quality of construction drawings is of course poor. First, in architectural design, all majors such as architecture, structure, water, electricity, and heating are designed by design institutes, and system integrators specialize in intelligent design. It can be seen that it is difficult to cooperate with various majors [27].

Second, the smart building market lacks the unified management of all government departments, and the smart building design does not have perfect design specifications and standards. At present, the development of smart buildings in China is in a state of disordered management, which restricts the development of smart technology in China. For example, the fire department manages firefighting equipment, the power supply department manages power supply and distribution, the security department manages the security department, the construction department manages buildings, and the post and telecommunications, information, and other departments also want to incorporate "smart buildings" into their own industry management. Each department is in charge of its own piece, and there is no unified department to coordinate and manage it. When the various systems of smart buildings are integrated, it is difficult to meet the requirements of smart buildings [28]. In addition, there is also a lack of design specifications and grade evaluation standards for smart buildings, which is also an important reason for the relative confusion in the smart building market, which makes some buildings with only some smart functions also call themselves "smart buildings."

There is also the intelligent building industry, which is mainly engaged in the integrated wiring of various buildings, as well as the construction of fire protection, communication, security, equipment management automation, and business support systems. In essence, the intelligent building industry is a system integration business. The market is extremely fragmented due to low technical barriers in the smart building industry in China. According to Handing Consulting, the top ten smart building manufacturers in China only account for about 15% of the market.

As we all know, China's GDP currently ranks second in the world, and it still maintains a rapid growth momentum. China's investment in the construction industry is also increasing year by year. In the past seven years, the average annual growth rate of my country's GDP was 11.07%; during this period, China's fixed asset investment was also normal; in 2005, it was 8.88 trillion yuan; in 10 years, it has grown to 27.81 trillion yuan, which has nearly doubled in just five years, with an average annual growth rate of 25.73%, in terms of real estate investment; in 2005, it was only 1.59 trillion yuan; in 10 years, it has grown to 4.83 trillion yuan, and this growth momentum is the same as the growth level of social fixed asset investment; it can be seen from this that the development speed of the construction industry is absolutely beyond imagination. Specifically, in 2005, it was only 3.46 trillion, and in 2010, it increased to 9.52 trillion, as shown in Figure 2.

Although China's smart home market is developing rapidly, there is still a long way to go before it can truly bring people a "smart" feeling. In the future, various types of characteristic TVs will appear, such as TVs that can change the screen size arbitrarily and TVs with movable screens.

TVs can also integrate personal technology, home security systems, and home entertainment centers, realize more powerful functions, and bring convenience and fun to the family.

The next-generation network system is a converged network, which usually refers to a converged network of the Internet, mobile communication network, and fixed telephone communication network that can support voice, data, and multimedia services at the same time with IP as the core. China has made great progress in the research of this fusion network. At present, the application research of the softswitch technology given to NGN in mobile and multimedia communication has been started.

Table 3: Target evaluation value of smart building industry.

Order	Industrial target elements	Evaluation value
1	Standardization of technologies to reduce energy consumption in smart buildings	0.392587
2	Industrial target elements	0.312544
3	Develop the diversity and ecology of smart buildings	0.286171
4	Improve industrial technology	0.234184

Table 4: Analysis of target elements of smart building industry.

Serial number	Industrial target elements	Specific direction	Goals		
			0–3 years	3–5 years	5–10 years
1	Reducing energy consumption in smart buildings	Green	20%	30%	40%
2	Technical standardization	Smart building industry standard	/	/	/
3	Develop the diversity and ecology of smart buildings	Ecological	15%	25%	40%
4	Improve industrial technology	RFID sensor BIM	20%	50%	80%

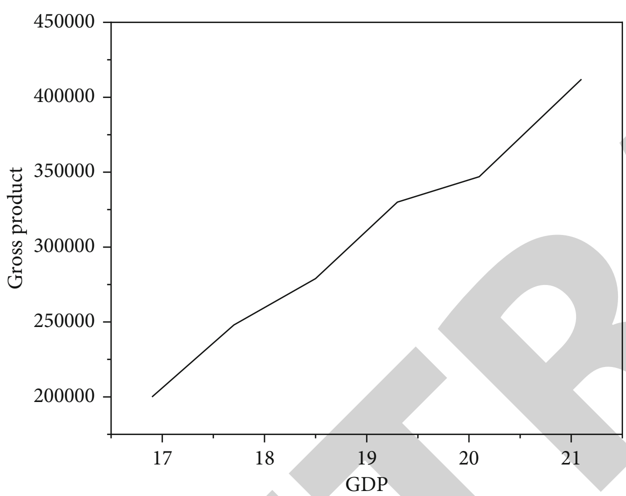

Figure 2: China's GDP and growth rate.

The next-generation mobile communication technology, the so-called 4G network, has higher speed and better spectrum utilization. The technology has gradually entered the commercial field.

The wireless network system between cities and intercity will carry most of the tasks of information transmission. Urban networks will invade all application fields of human society, and most devices will have wireless network interfaces, enabling access to information and control anytime, anywhere.

In the more distant future, with the advancement of technology and the deep development of the human brain, the development of control and information transmission may completely exceed the current camera. Neurons and field transmission can transfer information between different spatial dimensions.

5. Conclusion

In the 21st century, with the continuous development of Chinese society, more and more people have gathered in cities. The Nobel Prize winner American economist Stiglitz predicted: There are two major events affecting the progress of human civilization in the 21st century, one is the technological revolution led by the United States, and the other is the urbanization of China. At present, China is in a period of vigorous development of urbanization, but the process of urbanization is not smooth, resulting in many serious problems. In order to solve these problems, the construction of smart cities has become an inevitable trend of urban development in the world today. Smart cities use new-generation information technologies such as spatial geographic information, big data, the Internet of Things, and integration to create new concepts and models in the process of urban planning and construction, management, and service intelligence. As a part of smart city construction, smart buildings will also play a pivotal role in smart cities. For intelligent building design method based on the idea of Internet of Things, it was aimed at providing a new concept for China's current intelligent building design industry.

Aiming at the main problems existing in the current intelligent building design, a solution based on the idea of Internet of Things is proposed. The intelligent building design method based on the Internet of Things is emphatically expounded, and the Internet of Things topology diagram of common intelligent subsystems is extracted. The front-end access, data transmission, and back-end devices in the figure correspond to the three-layer architecture of the sensing layer, the transmission layer, and the application layer of the Internet of Things, and the Ethernet is used as the link between the various subsystems. For a single building, the front-end equipment of each system is the sensing layer equipment, which is responsible for the collection of data such as video images, audio, temperature, humidity, and operating status of electromechanical equipment; the building, in turn, will be the sensing layer of the Internet of Buildings, responsible for data collection for each building.

Data Availability

The data used to support the findings of this study are available from the corresponding author upon request.

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Retraction

Retracted: Research on Information Retrieval Effectiveness of University Scientific Researchers Based on Mental Model

Wireless Communications and Mobile Computing

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This article has been retracted by Hindawi following an investigation undertaken by the publisher [1]. This investigation has uncovered evidence of one or more of the following indicators of systematic manipulation of the publication process:

(1) Discrepancies in scope
(2) Discrepancies in the description of the research reported
(3) Discrepancies between the availability of data and the research described
(4) Inappropriate citations
(5) Incoherent, meaningless and/or irrelevant content included in the article
(6) Peer-review manipulation

The presence of these indicators undermines our confidence in the integrity of the article's content and we cannot, therefore, vouch for its reliability. Please note that this notice is intended solely to alert readers that the content of this article is unreliable. We have not investigated whether authors were aware of or involved in the systematic manipulation of the publication process.

Wiley and Hindawi regrets that the usual quality checks did not identify these issues before publication and have since put additional measures in place to safeguard research integrity.

We wish to credit our own Research Integrity and Research Publishing teams and anonymous and named external researchers and research integrity experts for contributing to this investigation.

The corresponding author, as the representative of all authors, has been given the opportunity to register their agreement or disagreement to this retraction. We have kept a record of any response received.

References

[1] Y. Zhang, Yiyang, and J. Yang, "Research on Information Retrieval Effectiveness of University Scientific Researchers Based on Mental Model," *Wireless Communications and Mobile Computing*, vol. 2022, Article ID 5852946, 7 pages, 2022.

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Research Article

Research on Information Retrieval Effectiveness of University Scientific Researchers Based on Mental Model

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The information retrieval behavior of scientific researchers is a behavior that is affected by multiple factors such as cognition, emotion, task, and user type and has its unique cognitive characteristics. In the context of scientific research, this paper conducts research on the information retrieval behavior of scientific researchers and analyzes the three levels of user mental model "user cognition, user behavior, and user emotion." According to the mental model construction process, define the user segmentation of basic tasks, formulate recruitment plan, set interview scope, analyze data, construct mental model, product adjustment and gap analysis, export structure seven steps, construct the mental model of scientific research workers' information retrieval, carry out research on the information retrieval efficiency of scientific researchers, describe the user portrait based on the mental model, and put forward strategies to improve the efficiency of user information retrieval.

1. Introduction

Information retrieval is an indispensable link for scientific research workers. The information retrieval behavior of scientific research workers is a kind of behavior under the joint influence of many factors such as cognition, emotion, task, and user type, which has its unique cognitive characteristics. The efficiency of information retrieval also directly affects the scientific research efficiency of researchers. Mental model is a research method of psychology and has made many achievements in many application fields. The concept of mental model was first put forward by psychologist Kenneth Craik in 1943. He believed that mental model can predict the danger in unfamiliar environment and help human beings reduce their potential harm [1]. Professor Johnson Laird further developed the mental model, which made the concept of mental model really come into being. He proposed to use the mental model to understand people's cognition, experience, and knowledge structure of the real world. Because of the differences in individual cognition, the mental model is iterative and corrective [2]. The most frequently cited definition of mental model in recent years was proposed by Rouse and Morris in 1986. Rouse and Morris think that mental model is a psychological mechanism or established cognitive framework by which people describe the goals and forms of the system, explain the functions of the system, observe the state of the system, and predict the future state of the system. People use mental model to improve the efficiency of cognitive activities [3]. In the field of management, the theory of mental model has been further extended, Johnson-Laird's definition of mental model is that for a single individual's understanding of the relationship among himself, other individuals, and groups, it assumes the way of social operation, and it is its main function for people to explain and describe the causes of phenomena and predict possible follow-up events in order to avoid or control them in time [4]. After the publication of the Fifth Discipline, the theory of mental model is well known in the field of management, and mental model plays an important role in the process of human cognition of the world. It is mentioned in the book that the mental model is deeply rooted in people's hearts, and it is about the cognition of individuals, others, society, and the world [5].

Applying mental model theory to the research of users' scientific research behavior, it is a further exploration of the application of mental model theory, by analyzing the information retrieval behavior of scientific research users [6]. This paper constructs a mental model of information retrieval behavior of scientific research users from three levels, user cognition, user behavior, and user emotion, and applies it to the evaluation of user information retrieval efficiency and scientific research efficiency, in order to further improve the scientific research efficiency of scientific research users.

2. Construction of Mental Model of Information Retrieval Efficiency for Scientific Research Workers in Colleges and Universities

2.1. Basic Experiment of Mental Model

2.1.1. Preparation for the Experiment. Mental model is the basis for individuals to recognize, think, and act internally and externally. Everyone has mental model, which determines our perspective of observing things and relevant conclusions. Mental model is a relatively abstract concept, so it is necessary to explore users' mental information by establishing experiments, extract abstract information, transform it into concrete information, and analyze and evaluate it.

The purpose of this experiment is to preliminarily construct the mental model of the target users, through interviews with scientific research workers, users can reproduce information retrieval scenes and answer corresponding questions, so as to discuss users' scientific research behavior and information retrieval behavior mode, and obtain information such as cognition, retrieval demand, motivation, preference, habit, and evaluation of scientific research workers in the process of information retrieval [7, 8].

2.1.2. Experimental Research Methods. This experiment constructs the mental model through two stages. The first is the representation and extraction of mental information, using certain methods to express the thinking activities and behaviors of the target users and extract the mental information of the target users. At this stage, focus groups and interviews, questionnaires, card classification, and other three research methods. The second is to analyze the data of the mental model and evaluate and analyze the mental information extracted from the previous stage. Commonly used methods of mental model data analysis include affinity graph method, concept map calculation, path search method, multidimensional scale method, and cluster analysis [9]. In the real process of building a user's mental model, it is difficult to obtain a complete mental model by a single measurement method. To obtain different mental models, various methods are usually used to obtain them in combination with the research objects.

2.1.3. Selection of Subjects. In order to obtain the mental model of scientific research workers' information retrieval more effectively, the users selected in the early research should be more targeted and meet the target user groups of products. This research mainly focuses on the information retrieval behavior of scientific research workers, so we choose university teachers and students as the research objects. This group has a certain scientific research foundation, continues to carry out scientific research work, and has rich experience in information retrieval, so it meets the needs of this experiment. In the interview work, it is planned to establish classified user groups, including three groups: university teachers, university graduate students, and university undergraduates, with 5 interviews in each group, totaling 15 people. Questionnaires are distributed to college teachers and students, and 200 questionnaires are planned to be distributed.

2.1.4. Experimental Flow Design. In order to get the mental model experiment to be carried out smoothly, it is necessary to make a detailed plan for the specific experimental steps, time, and place in advance, mainly writing the interview outline needed when communicating with interviewers. The interview outline is semistructured, mainly through the problem from shallow to deep, first, guide the interviewee into the state through simple questions, after understanding the retrieval habits of users, then encourage the respondents to review the latest information retrieval experience, let the user tell the whole retrieval process completely, and then interview the main line of information retrieval preparation, retrieval process, and retrieval effect evaluation according to the user's statement, so as to gradually dig out the user's cognition, retrieval demand, retrieval preference, retrieval habit, some interactive operations, and emotional changes of retrieval evaluation [10, 11]. The whole process of the interview is divided into five parts: the first part is warm-up, that is to introduce the subject, form, purpose, and data protection instructions of the interview to the interviewee first, it is mainly to let users enter the interview preparation state and understand what needs to be done next; then ask the interviewee basic information and other basic questions; the third part is to interview users with some related problems before retrieval, including retrieval needs, motivation, frequency, and software used, and then encourage users to recall the latest retrieval behavior and tell it out; the fourth part is according to the user's statement, continue to discuss the interactive operation and feelings that users will have in the retrieval process, and ask the pain points and cool points in the whole retrieval process; the fifth part is a summary of the whole interview content. The following is an outline of the whole interview.

(1) Basic information

Gender, age, educational background, and occupation.

(2) Basic ability of information retrieval

Do you often search for information? What is the frequency of information retrieval?

As a researcher, do you know the commonly used databases for academic information retrieval?

Which database is often used for information retrieval?

(3) Preparation before information retrieval

Under what circumstances will information retrieval be carried out?

What is the purpose of information retrieval?

Do you have basic information retrieval skills?

Before carrying out information retrieval, can you clearly realize your retrieval needs?

Before information retrieval, can the retrieval requirements be accurately described as search terms?

(4) Information retrieval process

When was the last information search?

Please describe the process of the latest information retrieval, including motivation, time, retrieval scene, equipment, database used, retrieval behavior, retrieval effect, and retrieval evaluation.

(5) Evaluation of information retrieval

Why do you choose one or several databases for information retrieval?

Information retrieval results meet the needs.

Score the satisfaction of information retrieval experience, with a full score of 10 points.

The effect of information retrieval results on scientific research.

Will there be any problems in the process of retrieval?

After encountering problems, how will they be solved? Such as asking others for help and looking for answers in the network.

Will the retrieval function be expanded for the database used? Such as using advanced retrieval and professional retrieval.

Is there any function that needs to be improved in the database that is used at present?

Will you explore other unfamiliar databases for retrieval?

When there is no clear scientific research demand, will you use the database to browse professional information?

2.1.5. Experimental Implementation. Before the experiment, we should make corresponding preparations, including preparing the outline of the interview, recording equipment (convenient for playback in later analysis), selecting the appropriate experimental place, in order to make the interviewees stay in a relaxed and quiet scene as much as possible, due to the epidemic situation, 6 of the 15 subjects in this experiment completed the interview in the laboratory or library, and 9 people conducted video interviews, each experiment took about 40 minutes [12, 13].

2.1.6. Experimental Conclusions. According to the interview outline, 15 users were interviewed in depth, the interview information was combed and descriptive statistics, and the representative conclusions were sorted out.

In the basic ability of information retrieval, most users think that they often carry out information retrieval. The frequency of information retrieval varies, and some users indicate that it will be carried out at any time according to the scientific research plan, more than 10 times a week. The information retrieval frequency of most users exceeds 5 times a week. Respondents said that as researchers, they know more about the commonly used databases of information retrieval and have their own databases. The Chinese databases are CNKI and Wanfang databases, while the foreign databases are Web of Science and Elsevier. In the preparation before information retrieval, most users indicated that they would carry out information retrieval in the scenarios of project declaration, writing papers, project research, and completing course assignments. The main purpose of information retrieval is to find relevant research documents and provide research basis for their own research. About half of the users think that they have mastered the basic information retrieval skills and implemented them in the retrieval process. Before information retrieval, most users think that they can clearly realize their retrieval needs. But in the transformation of retrieval requirements, about half of users said that they can describe the retrieval requirements as appropriate search terms and get the required retrieval results, while some users think that they have not clearly expressed them as appropriate search terms, so they need to search for many times. In the description of information retrieval process, most users reviewed the latest information retrieval scene; clearly expounded the retrieval motivation, time, retrieval scene, equipment, and database used; described the retrieval process; and evaluated the retrieval effect. In the aspect of information retrieval evaluation, more than half of users said that the retrieval results can meet their own retrieval needs and scored the satisfaction of retrieval experience above 8 points. Most users think that information retrieval results can play a positive role in scientific research [14]. In the process of retrieval, more than half of users have encountered corresponding problems. Some of these problems have been solved by turning to librarians, contacting database customer service or looking for answers in the network, and some users' problems have not been solved, so they are shelved. One-third of users indicated that they would take advantage of the expansion functions of the database, such as advanced retrieval, reference export, and sorting. For the database currently used, some users have proposed to improve the corresponding functions, such as batch download and synchronization between mobile phone and computer. In the absence of clear scientific research needs, only a few users will use the database to browse professional information [15, 16].

2.2. Quantitative Collection of Mental Information

2.2.1. Purpose of Research. In the first stage, the author conducted in-depth interviews with learners and collected a large number of mental information of users during information retrieval. In the second stage, on the one hand, in order to make the results more accurate and effective, the author compiles the information obtained from the interview into a questionnaire and uses the quantitative characteristics of the questionnaire to carry out a large-scale

Table 1: Mental model of information retrieval for scientific researchers.

Information retrieval motivation and preparation	Retrieval habits	Common databases Retrieval frequency Retrieve preferences
	Retrieval motivation	Retrieval scene Retrieval purpose Attitude towards information retrieval
	Retrieval preparation	Selection and understanding of database Retrieve requirement description Retrieval requirement transformation Selection of search words Selection of retrieval mode Retrieval result preset
Information retrieval ability and implementation	Competence	Proficiency in database Able to complete the retrieval process skillfully Applying certain information retrieval technology
	Retrieval implementation	Single retrieval time Retrieve policy changes View rate of retrieval results Retrieval result acquisition rate Screening of retrieval results Sorting of retrieval results
Information retrieval effect and evaluation	Retrieval effect	Expectation degree of retrieval Recall and precision Satisfaction degree of retrieval requirements Encounter result Willingness to continue information retrieval Differences between information retrieval and other users
	Satisfaction	Satisfaction of retrieval system Satisfaction of retrieval experience
	Extensive demand	Expanding requirements for retrieval results Expanding requirements for retrieval system Suggestions on retrieval system

delivery, thus verifying the effectiveness of the previous interview results. On the other hand, using the large-scale questionnaire, as well as easy to quantify the characteristics of the user's mental model information to collect again, so that the mental model is more complete [17].

2.2.2. Design of Questionnaire. The questionnaire design is based on the results of the first stage of user interviews. The content of the questionnaire is designed from five aspects: basic information, information behavior habits, basic ability of information retrieval, and current situation of information retrieval, expectation, and evaluation of information retrieval.

(1) Basic information

Including gender, age, educational background, and occupation.

(2) Behavior habit of information retrieval

Including information retrieval scene, retrieval frequency, single retrieval time, retrieval result viewing rate, and retrieval result acquisition rate.

(3) Information retrieval ability

Including the selection of information retrieval sources, the understanding of information retrieval database, the degree of information demand transformation, and the use of information retrieval technology.

(4) Present situation of information retrieval

Including the motivation of information retrieval, the attitude towards information retrieval, the advantages and disadvantages of information retrieval database, the willingness of information retrieval to continue, and the differences between information retrieval and other users.

(5) Expectation and evaluation of information retrieval

Including users' expectation of information retrieval, satisfaction of information retrieval experience, satisfaction rate of information retrieval to scientific research needs, and expansion needs of information retrieval.

2.2.3. Distribution of Questionnaires. The teachers and students of some universities in Jilin Province, Liaoning Province and Beijing City were selected as samples, and 200

Table 2: Typical user portraits.

	1	2	3
Gender equality	Women	Women and men	Men
Age	18-22	22-30	30-40
Retrieval motivation	Learning needs	Learning needs and scientific research needs	Scientific research needs
Frequency	Low frequency	Very high frequency	High frequency
Search database	Chinese	Chinese, foreign language	Chinese, foreign language
The single retrieval time	20 min	30-60 min	30-40 min
Retrieval methods	Basic retrieval	Basic retrieval, advanced retrieval	Basic retrieval, advanced retrieval
Expected results		Less than 1000 articles	Less than 500 articles
Adjust the retrieval strategy	Occasionally	Often	Often
Demand satisfaction	Basically satisfied	High satisfied	Basically satisfied
Persistent willingness	Low	High	High
Extended functions		Frequently screening, sorting, deriving references, document management	Frequently screening, index
The satisfaction of system	Generally satisfactory	Very satisfactory	Relatively satisfactory
User experience	Generally	Better	Better
Expectations	Easily accessible, sense of purpose	Easy retrieval, easy access, diversity, timeliness	Easy retrieval, easy access and conciseness
Meaning	Meaning	Very meaning	Meaning

questionnaires were distributed and 186 questionnaires were recovered [18, 19].

2.3. Construction of Mental Model of User Information Retrieval

2.3.1. Construction of Mental Model. Combining the basic experimental results of mental model and the quantitative collection of mental information, the mental data are analyzed to form clustering tasks, and the extracted tasks are classified into one class according to similarity and then aggregated into task towers, which are named, Similar "mission towers" are grouped into "mental spaces" and named separately. Finally, three mental spaces are formed, and the mental model of scientific research workers' information retrieval is constructed with the three-layer structure of task-task tower-mental space, as shown in Table 1.

2.3.2. User Portrait. By constructing the mental model of users, the author has a deeper understanding of the whole process of information retrieval for scientific research workers in colleges and universities. In order to have a clearer and macroscopic grasp of the target user groups and deeply understand their needs, the author constructs a typical user role model through cluster analysis according to the previous survey data (as shown in Table 2). User role does not refer to a specific person, but a collection of user behavior characteristics with the same attributes. Through abstract processing of a large amount of data, typical users of products are constructed, mainly including basic information, information retrieval habits, demand intensity, and pain points. Create fictional characters to help researchers understand more clearly the current cognitive status and core needs of users involved and provide better promotion strategies.

3. Strategies for Improving the Efficiency of User Information Retrieval

3.1. Understand the Retrieval System and Subdivide the Retrieval Purpose. Scientific research workers first need to information retrieval system, that is, we often say that the database has enough understanding, understand the basic information of the database, such as literature composition, basic retrieval function, expansion function, advantages and disadvantages of the database, requirements for retrieval and downloading of database resources, and define your commonly used Chinese and foreign databases as the main source of retrieval, and at the same time, understand some basic knowledge of standby databases as supplementary databases for retrieval. Before carrying out information retrieval, researchers should subdivide their retrieval purposes, including course study, thesis writing, project demonstration, patent application, and search criteria and formulate corresponding retrieval strategies according to the retrieval purposes [20].

3.2. Clarify Retrieval Needs and Improve Retrieval Skills. Researchers should clarify their own retrieval needs, and retrieval requirement is a kind of tacit knowledge and is in the brain of the searcher. This retrieval requirement may be clear or vague, but no matter what, it is necessary to transform the retrieval requirement into search words that can be read by the system. In the retrieval system, the selection of search words is very important, which is related to the comprehensiveness and accuracy of the retrieval results, that is, the recall and precision that we are familiar with. In order to transform the retrieval demand into search terms, researchers need to master the necessary retrieval skills, including the selection of retrieval ways, retrieval methods, the use of Boolean logic retrieval, and the use of retrieval operators. The improvement of retrieval skills will help researchers complete the information retrieval work more smoothly.

3.3. Adjust the Retrieval Strategy to Accurately Hit the Results. In the process of information retrieval, one search may not complete the search task successfully. It is necessary for researchers to constantly adjust the retrieval strategy to ensure the smooth development of retrieval. In the process of adjusting the retrieval strategy, we can make full use of the expansive functions in the information retrieval system, such as screening, sorting, Boolean logic assembly, superposition of retrieval approaches, and export of retrieval results, so as to accurately hit the results and improve the retrieval efficiency.

3.4. Carry Out Retrieval Education to Improve Information Literacy. For most researchers, receive certain information retrieval training, is the necessary way to improve the efficiency of information retrieval, through the education of information retrieval courses, it can make searchers better master the basic knowledge of information retrieval system, basic skills of information retrieval, skills of improving information retrieval efficiency and related knowledge of information ethics, and improve information literacy and "search for business" from four aspects of information awareness, information thinking, information skills, and information ethics, thus improving scientific research efficiency.

4. Conclusion

Information retrieval is one of the essential work contents for scientific research workers to carry out scientific research work. How to improve the efficiency of information retrieval is a concern of many scientific research work. In this paper, mental model is applied to the study of information retrieval efficiency, through the basic experimental results of mental model and the quantitative collection of mental information, construct the mental model of information retrieval for scientific research workers, it also depicts the user portrait, which has certain reference value for understanding and improving the information retrieval efficiency of scientific research workers. However, this paper does not further explore the mental model system and does not apply necessary evaluation methods to calculate its weight and conduct empirical research, which needs further exploration in future research.

Data Availability

The data used to support the findings of this study are available from the corresponding author upon request.

Conflicts of Interest

The authors declare that they have no conflicts of interest.

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Retraction

Retracted: Research on Online Virtual Energy-Saving and Environment-Friendly Building Design and Implementation Based on VRML

Wireless Communications and Mobile Computing

Received 18 July 2023; Accepted 18 July 2023; Published 19 July 2023

This article has been retracted by Hindawi following an investigation undertaken by the publisher [1]. This investigation has uncovered evidence of one or more of the following indicators of systematic manipulation of the publication process:

(1) Discrepancies in scope
(2) Discrepancies in the description of the research reported
(3) Discrepancies between the availability of data and the research described
(4) Inappropriate citations
(5) Incoherent, meaningless and/or irrelevant content included in the article
(6) Peer-review manipulation

The presence of these indicators undermines our confidence in the integrity of the article's content and we cannot, therefore, vouch for its reliability. Please note that this notice is intended solely to alert readers that the content of this article is unreliable. We have not investigated whether authors were aware of or involved in the systematic manipulation of the publication process.

Wiley and Hindawi regrets that the usual quality checks did not identify these issues before publication and have since put additional measures in place to safeguard research integrity.

We wish to credit our own Research Integrity and Research Publishing teams and anonymous and named external researchers and research integrity experts for contributing to this investigation.

The corresponding author, as the representative of all authors, has been given the opportunity to register their agreement or disagreement to this retraction. We have kept a record of any response received.

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[1] Z. Lai, Q. Zeng, and S. Zhou, "Research on Online Virtual Energy-Saving and Environment-Friendly Building Design and Implementation Based on VRML," *Wireless Communications and Mobile Computing*, vol. 2022, Article ID 5869037, 7 pages, 2022.

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Research Article

Research on Online Virtual Energy-Saving and Environment-Friendly Building Design and Implementation Based on VRML

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In order to change the status quo of lacking holistic and intuitive research on building energy efficiency in China, an online virtual energy-saving and environment-friendly building system based on VRML was proposed. The two subsystems of virtual simulation technology, "virtual reality" and "energy consumption simulation," were integrated and applied to the design research of building energy efficiency. On the basis of inheriting the advantages of the traditional way, the independent application mode of the two was changed. The application analysis was carried out using a real energy-saving demonstration project as the research object. The experimental results showed that the energy-saving rate of the enclosure structure of the three buildings was 35.742%, 30.408%, and 35.696%, respectively. It was concluded that the system provided a more systematic and intuitive method to the design and research of building energy efficiency.

1. Introduction

With the rapid development of China's economy, many high-tech technologies and products have been widely used in people's daily life and work, bringing great convenience to people. Virtual reality technology is a high-tech technology that has been developing very fast in recent years. It establishes a three-dimensional space through panoramic roaming, so that people can interact with the three-dimensional virtual space as if they were there and can experience various sensory sensations in real life. It is a digital human-machine interface technology that uses various virtual reality devices and virtual environments to bring realistic and intense sensory impact to users and facilitate the planning and design of complex large-scale engineering projects [1]. Virtual reality technology has been widely used in many fields such as architecture, military, medicine, and aviation, which has been favored by many researchers and scholars with the advantage of enhancing human subjective feelings.

Architectural space virtualization refers to the establishment of virtual architectural space through high-tech technology (Figure 1). Architectural space has been continuously developed from the traditional two-dimensional and three-dimensional picture display to virtual reality scenes, with strong realism as well as vividness, which is currently extremely valuable technology applications [2]. Users can use the keyboard and mouse to observe the virtual building space in an all-round way, with many observation perspectives such as overlooking, looking up, distant, and close. The virtual building space established by 3D modeling method has precise dimensions, strong sense of experience, and applicability. VRML is a virtual reality modeling language for establishing 3D interactive scenes, which can be combined with Internet technology and applied to 3D scene models established by virtual reality technology. Internet users can browse 3D virtual reality scenes established by VRML technology by browser, and it is an important tool for establishing virtual architectural space [3]. B/S structure is browser or server structure, through the installation of the server to enable users to use the browser to run all functions of the server. With the development of Internet technology, B/S structure has gradually replaced the traditional

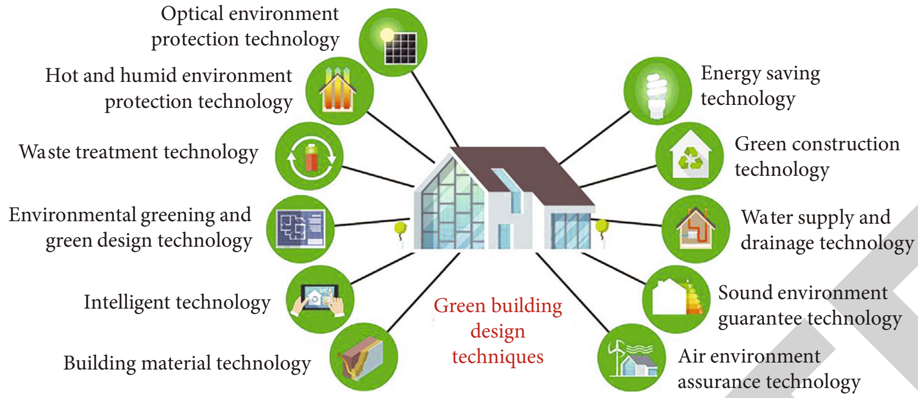

Figure 1: Energy-saving and environmental protection building design.

C/S structure, which is widely used in many fields and the main structure of software system construction.

2. Literature Review

Through the successful application of BIM-based visualization technology in Hangzhou East Station project, Li et al. utilized technologies such as PKPM 3D modeling and construction simulation to solve the complex spatial relationships of the hub project structure and the development of construction plans well [4]. Kong et al. investigated the specific application of BIM technology in the construction process of a large stadium, reflecting the ability of BIM to control the construction of complex-type buildings [5]. Nageib et al. proposed a new visualization and collaborative design method, which was the joint use of the Revit, Fuzor, Civil 3D, and InfraWorks software. Fuzor was used for virtual roaming inside the project to complete the component information viewing and collision detection. And the model information was imported into InfraWorks without loss to complete the visual collaborative design outside the project [6].

Finally, it was concluded that this method could help to proceed more quickly and accurately in the design stage in order to shorten the design cycle, reduce rework, and save costs for the visualized codesign of the subway station. Bai et al. created a virtual architectural teaching environment with the help of VR software Skyline, where the interior and exterior structures of the building were presented in a visualized manner so that students could interact with learning content in a natural way in a virtual environment in real time. It not only greatly increased students' interest in independent learning and facilitated the construction of knowledge but also facilitated the updating and sharing of teaching resources [7]. Dan et al. analyzed a new concept from VR to BIM + VR, proposed to build "BIM+VR teaching application platform," and discussed the implementation and application of the Fuzor software in design teaching and experience summary. The research concluded that BIM + VR jointly assisted planning and design became a direction and the promotion and optimization of VR to BIM would certainly promote its application and development in the field of design teaching and research [8]. Soyaslan et al. reflected on the limitations of VR technology in architectural design teaching by analyzing the current situation in the domestic architectural design field [9]. There are many limitations in today's VR technology, such as high hardware cost and inability to be well compatible with architectural design software platforms. And virtual reality technology is more applied to design expression rather than design process. Its exploration of a teaching practice of BIM-based virtual reality technology-assisted architectural design process provides convenient interoperability between virtual reality and design for many students at the same time in a low-cost way, so that students can master the application of BIM-based virtual reality-assisted design.

With energy and environment issues becoming a global concern, building energy efficiency has become one of the basic strategic plans for sustainable development in China. It has developed rapidly in terms of policy and standard development, product development and promotion, and engineering implementation, with remarkable results. Despite this, there are still many problems with building energy efficiency in China, mainly in (1) insufficient public awareness of energy efficiency, (2) lack of overall consideration in building program design, and (3) insufficient energy efficiency research and implementation. If a more systematic and intuitive design, research, communication, and management platform can be created, it will not only promote the promotion of building energy efficiency concepts, technologies, and products but also provide effective help for the overall design of building programs. Based on this, two subsystems of virtual simulation technology, virtual reality and energy consumption simulation, are proposed to be fully used in building energy efficiency and analyzed in conjunction with actual engineering applications to seek a new approach for the design and research of building energy efficiency [10].

3. Research Methods

3.1. Current Application of Virtual Simulation Technology in the Field of Building Energy Efficiency. Virtual simulation technology is a new technology that uses computers and a variety of specialized physical effect equipment as tools to perform dynamic experimental research of hypothetical or actual systems with the help of system models [11]. It is economical, isolated, safe and controllable, fast, and predictable, which can effectively solve the problem of the connection between abstract thinking and the entities it generates. And its application in the field of building energy efficiency is mainly reflected in the following two aspects.

3.1.1. Aiding Building Scheme Design. Energy-saving, as a performance requirement of modern buildings, has been gradually integrated into the building scheme design. Through software such as 3DMax, virtual simulation technology can create a three-dimensional virtual environment, giving the user a first-person feeling. It also can realize the simulation of building indoor and outdoor temperature and humidity, sunlight, wind environment, thermal environment, etc., and integrates the building energy-saving design into the overall building design. The architect wanders away from the real virtual building scene during building scheme design, making the sense of space in the building design more interactive and flexible, enhancing the authenticity greatly, and providing an active, real-time, interactive design approach for the architect to evaluate and verify the design intent. In the process of energy-saving building scheme design, virtual simulation software such as 3DMax realizes the physical environment simulation of buildings, building simulation and interior design simulation, etc., which assists in energy-efficient building scheme design well [12].

3.1.2. Building Energy Consumption Simulation. Another important application of virtual simulation technology in building energy efficiency is energy consumption simulation. Since a building is a complex system, there are many factors affecting its energy consumption, such as the thermal performance and structural design of the building itself, outdoor climatic conditions, the performance of air conditioning equipment, the distribution of internal personnel, work, and rest patterns, etc. And there are extremely complex interconnections among the factors. This requires a holistic, systematic, and changeable principle to calculate and analyze the energy consumption of the building. It is difficult to obtain accurate and objective conclusions from simple calculations alone, but through dynamic computer simulation calculations, the building energy consumption can be simulated more quickly. And the simulation results can be transformed into energy consumption and thermal comfort indexes that are easily understood by the public with certain standards, which can provide a more comprehensive, realistic, and convenient analysis and evaluation of energy-saving designs. It greatly shortens the design cycle and improves the design quality [13]. Commonly used energy consumption simulation software at home and abroad includes EnergyPlus, DOE-2, TRNSYS, ESP-r, DeST, etc. [14].

3.2. The Integrated Application Concept of Virtual Simulation Technology in Building Energy-Saving with 3DMax. The virtual simulation technology has two subsystems, namely, virtual reality and energy consumption simulation. 3Dmax can realize 3D virtual simulation of buildings, creating an intuitive and interactive platform for building scheme design. Energy consumption simulation software can calculate and analyze building energy consumption, providing effective reference and verification for designers to analyze and evaluate and modify energy-saving schemes. However, these two subsystems are independent of each other. If they are further combined, they will create a more systematic, intuitive, and realistic platform for the design and research of energy-efficient buildings.

The 3D simulation of energy-efficient buildings is realized through 3DMax, so that the proposed buildings, especially the components that have an important impact on energy-saving, are visually and graphically displayed in front of designers and researchers. The computer simulation of building energy consumption is carried out with the help of energy consumption simulation software to study and analyze the energy-saving effect of buildings. Then, the results of building energy consumption calculation and analysis are used as basic attribute information, and the human-computer interaction platform through the virtual reality technology gives the energy efficiency attribute to the 3D building. It can be edited and analyzed and managed in real time, making the research and analysis of building energy efficiency intuitive and visual [15]. All the above ideas can be realized by existing technologies, software, etc. With the integrated application of virtual simulation technology, people will be able to immerse themselves in the building and realize the following functions with just a click of the mouse: (1) a comprehensive and clear understanding of the appearance and structure of building components, material properties, and their impact on energy efficiency; (2) a quick and convenient way to call up the indicators of the overall energy efficiency of the building; and (3) a systematic and intuitive way to grasp the overall effect of the energy-saving scheme. It is an important guide for the design, research, and management of building energy efficiency.

3.3. The Establishment of Building Space Virtual Scene. Using VRML language as the building space virtual scene model building tool, the establishment of building space virtual scene mainly includes the following steps.

(1) Spatial coordinate system and scale are constructed. The required exterior wall of the building space is paved with bricks of the same specification, and the length and width of independent bricks are used as the basic unit of the building space. The bricks of the building space are rendered at the same time, and the scale of the building space is determined by using bricks

(2) The components represent the specific coordinates of the building components in the right-angle coordinate system of the building space, that is, the location of the building components. The minimum coordinate points of building components, namely, the positions built in the building space, can be obtained according to the priority order of x, y,

Table 1: Three schemes of enclosure structure.

Types of enclosure structure	Building I	Building II	Building III
External wall	Polyurethane rigid foam is sprayed on exterior walls	Molded polystyrene panel insulated exterior wall surface	Polyurethane rigid foam is sprayed on exterior walls
Roofing	Polyurethane rigid foam-polyurea elastic	Synthetic polymer membrane	Polyurethane rigid foam-polyurea elastic
	Insulation and waterproof roofing (I)	Coated membrane waterproof roofing	Insulation and waterproof roofing (II)
External window	Tempered hollow louvered glass plastic steel windows	Ordinary hollow plastic steel windows	Tempered hollow louvered glass plastic steel windows

and z axes. After all the components in the building space are established, the physical model of all the components in the building space is summed up to obtain the building space data model, as follows:

$$\text{Building} = \sum \text{Structural}\,(x, y, z). \tag{1}$$

In the equation, Structural (x, y, z) represents the information of the components in the created building space

(3) Building space construction

The steps in the building space are used as an example to analyze the building space entity modeling process, and the steps in the building space are modeled with the following:

$$\text{Steps}\,(a, b, c, d, h). \tag{2}$$

In Equation (2), a and b denote the coordinates of the step position and the length of the steps, respectively. c and d denote the width of the steps and the height of the steps, respectively. h denotes the total number of steps in the building space.

The preliminary architectural space model with contour characteristics is realized through the above process. Based on this, through texture mapping and other steps, the architectural space virtual scene texture, color, environment, and other visual effects of the reality are achieved [6].

3.4. Project Example Design

3.4.1. Project Overview. The three energy-saving demonstration R&D buildings (No. I, No. II, and No. III R&D buildings, respectively) are used as the research objects. The single building design scheme of the three buildings is the same, all of which are 3-story frame structure and 3.6 m high. A single building covers an area of 480 m^2. The ground floor of the R&D building is mainly occupied by exhibition halls, restaurants, and reception rooms, while the second and third floors are mainly occupied by offices. The expected goal of the energy-saving design of the demonstration project is 65% energy-saving for the single building as a whole, with the contribution of the enclosure to the overall energy-saving of the building reaching 20%-30% [16].

3.4.2. Architectural Scheme Design

(1) 3DMax-Aided in the Overall Architectural Design. On the basis of CAD plan design, 3DMax is used to carry out 3D simulation of the building, including virtual simulation of the environment scene around the building and 3D simulation of the building entity, so that the building can be shown realistically in front of people's eyes. Since 3DMax has mature and complete rendering functions, it can achieve good rendering effect with high realism [17]. In the simulation design process, the designer has the freedom to move arbitrarily in real time. According to his own perspective, the scene generated by the system rendering can be changed in time to generate a new scene, thus being able to modify and improve in real time according to his own design ideas.

(2) Enclosure Structure Scheme Design. In order to study and analyze the energy-saving effects of different enclosure structures, the following enclosure schemes (as shown in Table 1) are designed for each of the three buildings according to the requirements of energy-saving design objectives, which are referred to as scheme 1, scheme 2, and scheme 3 in the later part of the research.

4. Analysis of Results

4.1. Simulation of Building Energy Consumption. The DeST-c software was used to carry out the energy consumption simulation [18]. The building model was first established in DeST-c based on the building plan, and then, the following operations were performed.

4.1.1. Parameter Settings

(1) *Parameter Setting for the Enclosure Structure.* The thermal parameters of the enclosure of the three buildings were calculated according to the material construction of the different enclosures, as shown in Figures 2–4, and the parameters were set in DeST-c [19, 20]

(2) *Air Conditioning System Parameter Setting.* Considering the climate characteristics, the indoor relative humidity was set to 60% in DeST-c. The heating season was set from November 15 to March 1 of the

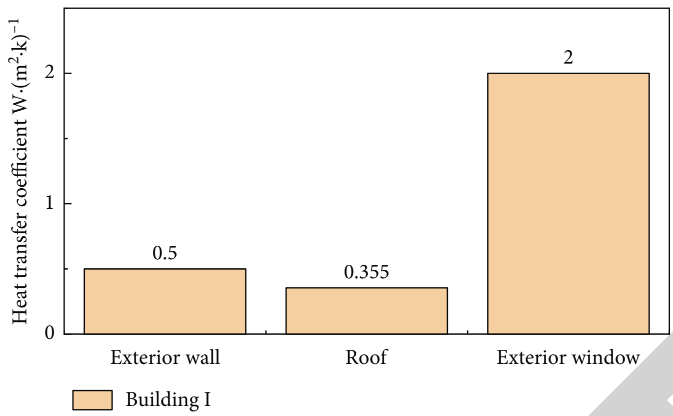

Figure 2: Heat transfer coefficient of the enclosure structure of building I.

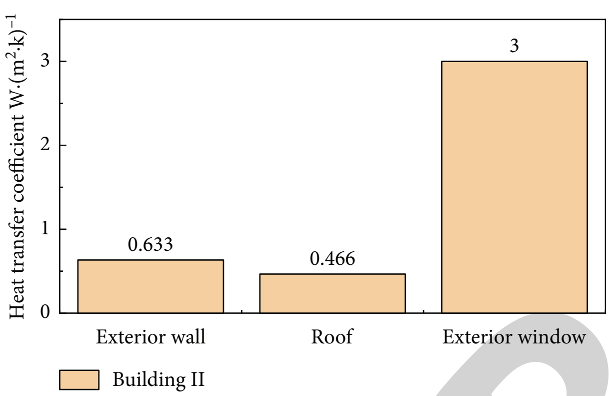

Figure 3: Heat transfer coefficient of the enclosure structure of building II.

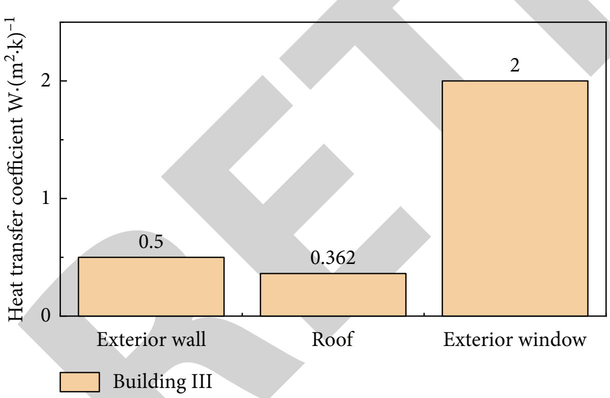

Figure 4: Heat transfer coefficient of the enclosure structure of building III.

following year, and the indoor temperature was set to 18-20°C. The air conditioning season was set from May 15 to October 1, and the indoor temperature was set to 26°C. The number of air changes during the air conditioning time was set to 0, and the number of air changes during the nonair conditioning time was set to 0.5 times/h. According to the characteristics of different rooms in the R&D building, the internal disturbance parameters were set separately in the modeling [21]. According to the characteris-

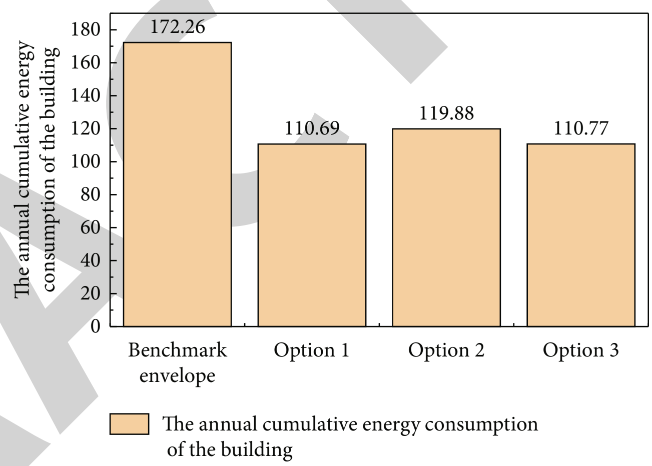

Figure 5: Simulation results of annual cumulative energy consumption of the building.

tics of different rooms in the R&D building, the internal disturbance parameters were set separately in the modeling

4.1.2. Energy Consumption Simulation. Once the various parameters were set, the building could be simulated for energy consumption in DeST-c. In order to analyze the energy-saving effect of the enclosure structure scheme, the enclosure structure under the baseline building conditions specified in the energy-saving design standards for public buildings was used as the comparison scheme, i.e., the baseline enclosure structure scheme [22]. The energy consumption simulation results of the R&D building under different enclosure structure schemes are shown in Figure 5. The energy-saving rates of the enclosure structures of the three buildings for the overall building were 35.742%, 30.408%, and 35.696%, respectively.

4.2. 3DMax-Based Simulation of Building Energy Efficiency. After the 3D simulation of the building by 3DMax, it was imported into the virtual reality software VRP. At the same time, the data of material structure and thermal performance of the enclosure structure were input into the database to realize the management of the properties of the enclosure structure [23]. The energy consumption simulation results were then stored into the attributes of the building scheme. In this 3D visualization platform, there were many function menu buttons. And by dragging and clicking the mouse, the following functions can be realized: (1) arbitrary rotation and scaling of the building model and multiviewing of the building scheme effect, (2) editing and viewing the material structure and thermal performance of different scheme enclosure structures, and (3) viewing and calling the energy-saving effect of different enclosure structure scheme buildings, including annual hour-by-hour energy consumption, all-day hour-by-hour energy consumption, and energy-saving rate [24].

5. Conclusions

The application of two subsystems of virtual simulation technology, "virtual reality" and "energy simulation," in building energy efficiency was analyzed and discussed. It was feasible to combine them with building energy efficiency design and research.

Using 3DMax to assist in the overall design of energy-efficient buildings and combining with VRP virtual reality software, the 3D simulation and property management of energy-efficient buildings fully realized the advantages of predictability, economy, safety, and speed of virtual simulation, which provided a systematic and visualized platform for the design of energy-saving buildings, energy consumption simulation analysis, and energy-saving effect display.

Through the application analysis of the demonstration project example, the energy-saving rate of the enclosure structure of the three buildings to the overall building was 35.742%, 30.408%, and 35.696%, respectively, which met the requirements of the energy-saving design standard of public buildings and the expected energy-saving target of the project. It was feasible. The smaller the heat transfer coefficient of the enclosure structure, the more significant the energy-saving effect.

Data Availability

The data used to support the findings of this study are available from the corresponding author upon request.

Conflicts of Interest

The authors declare that they have no conflicts of interest.

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Retraction

Retracted: Application Research of Data Encryption Algorithm in Computer Security Management

Wireless Communications and Mobile Computing

Received 18 July 2023; Accepted 18 July 2023; Published 19 July 2023

This article has been retracted by Hindawi following an investigation undertaken by the publisher [1]. This investigation has uncovered evidence of one or more of the following indicators of systematic manipulation of the publication process:

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[1] Q. Gong, "Application Research of Data Encryption Algorithm in Computer Security Management," *Wireless Communications and Mobile Computing*, vol. 2022, Article ID 1463724, 7 pages, 2022.

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Research Article

Application Research of Data Encryption Algorithm in Computer Security Management

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In order to promote the research process of information security in the whole society, improve the safety factor of computer data communication, strengthen computer security management, the author proposes a computer data encryption strategy that combines the strong security of the 3DES encryption algorithm and the asymmetric encryption advantages of the RSA algorithm. Through the detailed analysis of DES encryption algorithm and 3DES encryption, creatively uses the RSA encryption algorithm to improve the single 3DES algorithm, consolidates the performance of the 3DES encryption algorithm to ensure data communication, and ensures the data integrity, better improve encryption performance. Experiments show that: The proposed encryption algorithm improves security performance by 10 times, and the response efficiency is only 1 ms away from other algorithms, compared with other algorithms, it has better encryption performance and is suitable for actual computer data communication scenarios. Conclusion: The encryption algorithm proposed by the author has achieved good results in terms of security performance and response efficiency, it is suitable for actual computer data security communication and can effectively improve computer security management.

1. Introduction

With the wide application of network technology, the establishment and development of personal communication, e-mail, electronic payment, automatic retail business, etc., various computing and communication systems have become an important part of the human living environment, they collect, analyze, store, display and disseminate information in multimedia formats, and as independent products or combined with other physical products to become human political, economic, military and cultural services. People should be concerned about their own information security issues [1]. Most of modern social work data is transmitted at high speed by computer as a carrier, whether it is personal or corporate data, there is a danger of being hacked and deciphered, resulting in different degrees of loss, as shown in Figure 1. In this context, how to use all kinds of information safely and effectively has become an important cornerstone to ensure the development of human society; How to ensure that information is not illegally stolen, eavesdropped, forged and tampered with during the transmission and processing of information on the public network, that is, the issue of information authentication and confidentiality, has become a problem that people are concerned about, therefore, the theory of encryption algorithm and its implementation technology have become an important research field in modern information security science and technology, and have been paid more and more attention [2]. On the other hand, with the continuous improvement of the level of social informatization, especially the rapid development of Internet technology, there are more and more network applications, how to protect the confidential data in the application, it can also effectively prevent external attacks, which is a major problem faced by network applications [3]. Therefore, in order to promote the research process of information security in the whole society, improve the security factor of computer data communication, and strengthen computer security management, the article deeply explores the computer security technology, creatively constructs a hybrid encryption strategy, uses the triple DES algorithm to improve the data encryption security factor, and uses the RSA algorithm to encrypt the triple DES algorithm key to achieve double

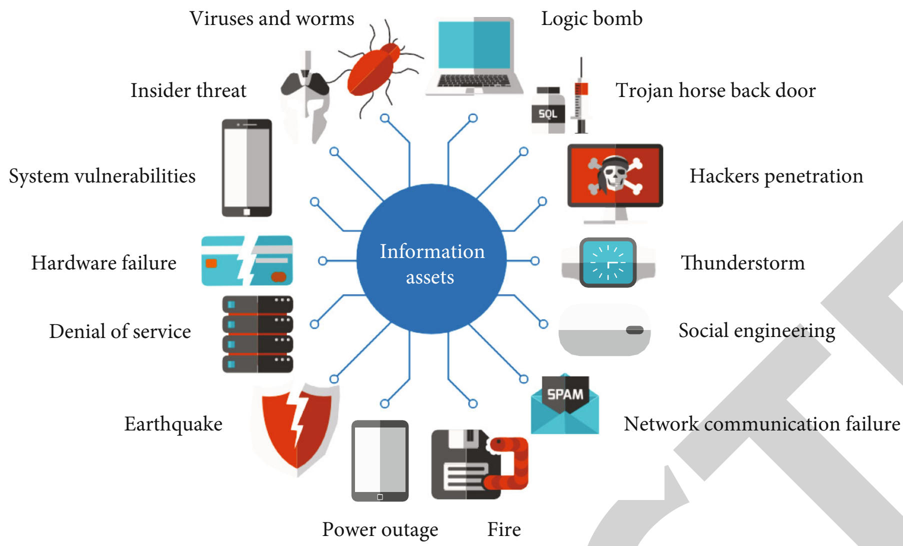

Figure 1: Computer security issues.

encryption guarantee, so as to realize the computer Communication security [4].

2. Literature Review

For computer security data encryption algorithm, Zhao, C. et al. proposed a general AES encryption algorithm, choosing a data encryption scheme with fixed key length and fixed data block length [5]. This can ensure the security of data encryption while ensuring the speed of encryption and decryption, and at the same time, it can also reduce the complexity of program design, and thus reduce the development workload. Lin, C. et al. proposed a secure hash algorithm MD5, inputting two different plaintexts will not get the same output value, and the original plaintext cannot be obtained according to the output value, that is, the process is irreversible [2]. Cai, W. et al. proposed an IDEA algorithm, which belongs to the class of block encryption algorithms in cryptography. IDEA uses a key with a length of 128 bits and a data block size of 64 bits. In theory, IDEA is a "strong" encryption algorithm, and there is no effective attack scheme for this algorithm [6]. Ebinazer, S. E. et al. proposed a Blowfish encryption algorithm, the core of the algorithm lies in the sub-key generation, which expands the variable-length key into a sub-key array with a total length of 4168 Bytes. A large number of subkeys are used in the algorithm, and the subkeys depend on the user key, the updated subkey array is used in the actual encryption and decryption process. Another feature of it is that two parts of the file are encrypted at the same time in each round, which increases the strength of the cipher [7]. Liu, Xin, etc. proposed algorithms such as square and Shark, the biggest advantage of these algorithms is that they can theoretically prove that the algorithm is secure for differential cryptanalysis and linear cryptanalysis. And with the collection of the AES algorithm, the research on its block cipher has entered a new research stage, the 15 candidate algorithms of AES reflect the current level of block cipher [8]. Liu, Q. et al. proposed the AES encryption algorithm, which is an advanced encryption standard in cryptography, the encryption algorithm adopts a symmetric block cipher system, the minimum supported key length is 128 bits, 192 bits, and 256 bits, for 128 bits, the algorithm should be easy to implement in various hardware and software [9]. Alenezi, M. et al. proposed a selective data encryption algorithm (SDEA). The principle of the algorithm is to use different privacy classification methods to selectively encrypt data under the unit time limit, the purpose is to achieve the minimum execution time required by the practical application, use selective data encryption algorithms to maximize the protection of big data privacy [10]. Based on the current research, the author addresses the need for data encryption for data managed by computer security, a strong security combined with 3DES encryption algorithm is proposed, computer data encryption strategy based on the advantages of RSA algorithm asymmetric encryption, through the detailed analysis of DES encryption algorithm and 3DES encryption, creatively use the RSA encryption algorithm to improve the single 3DES algorithm, and the superiority of the performance of the encryption algorithm is confirmed by experiments.

3. Research Methods

3.1. Encryption Theory and Experiments Have Confirmed the Superiority of the Encryption Algorithm Performance. Symmetric encryption is also known as private key encryption algorithm, high-efficiency encryption and fast encryption are its main features. The encryption and decryption processes use the same key in the symmetric encryption algorithm, so the security of the symmetric encryption algorithm is directly related to the confidentiality of the key. If symmetric encryption is used in the process of ensuring data security, both parties should agree on the key before transmitting data, and at the same time, the determined key should be properly stored [11]. If one of the parties leaks the key, the entire communication process will be cracked, data

Encryption Standard (DES) is a typical system of symmetric encryption. When doing asymmetric encryption algorithms, there should be keys for two different processes, encryption and decryption. The public key (referred to as "public key") is used for encryption, and the private key (referred to as "private key") is used for decryption. In order to decrypt data encrypted by the public key, the corresponding private key must be used; At the same time, the corresponding public key must be used to decrypt the data encrypted by the private key [12]. The public key can be published and sent to other requesting users. However, the private key must not be leaked, and should only be kept by Party B. During data transmission, the transmission security problem of the key in the symmetric encryption algorithm can be well solved. However, when the asymmetric encryption algorithm is performed, it takes a lot of time to encrypt and decrypt, compared with the symmetric encryption algorithm, the speed is far from enough, and it is more suitable for the encryption of a small amount of data.

3.2. Security Analysis of Computer Data Communication Based on DES Algorithm. The DES data encryption algorithm is an encryption standard in many foreign countries, at the same time, it gives a high degree of affirmation to this algorithm, and believes that this encryption algorithm is more consistent with its own data encryption requirements: First, the data protection function of the DES data encryption algorithm is relatively strong, and at the same time, it can effectively prevent the illegal leakage of data, and can timely prevent the occurrence of malicious modification of undetected related data; Second, the DES data encryption algorithm is extremely complex and difficult to decipher. At present, the exhaustive method is the only way to decipher the encryption algorithm in the world, in other words, if someone wants to decipher the DES data encryption algorithm, they must spend a lot of time and energy, and compared with the related benefits they get, it is ultimately a multiplier effect. Even if the modern computer chosen can perform millions of calculations per second, it will take about 2000 years to find out the deciphering method using the exhaustive method; Third, although the DES data encryption algorithm is relatively complex, its overall cryptographic system does not need to have overly complex characteristics, for the encryption key system, the DES encryption algorithm is the basic and core part; Fourth, in the process of summarizing the DES data encryption algorithm, it can be found that the secondary encryption method is extremely effective, it is widely used in data encryption in the communication and financial industries, and the ATMs that we encounter in our daily lives use this data encryption algorithm [13]. Based on the DES data encryption algorithm to ensure the communication security between computers, it is to encrypt the plaintext data generated by the computer communication with the secret key to obtain the communication ciphertext, and then transmit the ciphertext to the receiving end to decrypt the recovered plaintext based on the key, this is the basic principle of computer secure communication. The DES algorithm divides data into multiple groups, and uses this block-encrypted symmetric encryption algorithm on both the input and output ends, but the key settings are different; The 64-bit plaintext is input from the input end of the encryption algorithm, and the 64-bit ciphertext is output from the output end; The DES key has a length of 56 bits, which has the flexibility to be modified at any time [14]. In essence, the DES data encryption algorithm is highly scientific and open to the outside world. Therefore, in terms of computer communication technology, it is relatively simple to analyze and improve the DES data encryption algorithm. The main methods are as follows: When actually optimizing the computer communication technology, the corresponding technology type can be used in combination with the DES data encryption algorithm, and the computer mode and analysis strategy can be appropriately selected. After the technicians have a detailed understanding of the calculation method and working principle of the DES data encryption algorithm, with the help of the data encoding and powerful programming language of the computer system, effectively analyze and improve the entire DES data encryption algorithm system, compare the different applications of each algorithm for different encryption objects and computing environments, at the same time, the computer can also use the hard disk data to calculate the application program in the DES data encryption algorithm, so as to avoid leaking file information due to incorrect data. At the same time, the program of the same type should also be set in the computer encryption card, and a backup should be made [15]. During the establishment of the data encryption module, because the computing speed of computer communication technology and computer software is very fast, and at the same time, the calculation process is also very meticulous, so in the process of designing and perfecting the DES data encryption program, the expansion problem of the algorithm should be considered. Therefore, the principle of DES data encryption algorithm practice is summarized as follows: DES data encryption algorithm uses 56-bit security key to encrypt 64 data in real time, and generates key encryption after 16 rounds of encoding activities; During each round of encoding work, the S box stores 64 data and keys; Data replacement work is performed at the beginning and end of 16 rounds of encoding and between two rounds of encoding, the key is based on a special replacement rule to obtain a 48-bit key, and the data sequence is mixed; Based on the above encryption operation, the original communication data position is reconstructed, which can be safely output, after the receiving end receives the data, the decryption operation is performed to restore the original state of the communication data, thereby realizing the safe communication transmission of computer data.

3.3. Encryption of Computer Data Plaintext Based on 3DES. With the enhancement of the software and hardware capabilities of computer operations, the general DES encryption algorithm is easy to be cracked. In order to improve the security of computer data communication, the key length of the DES encryption algorithm is extended, and the attack on the encryption method by the brute force method is reduced, and the 3DES algorithm with improved form and improved security performance is obtained, it is equivalent

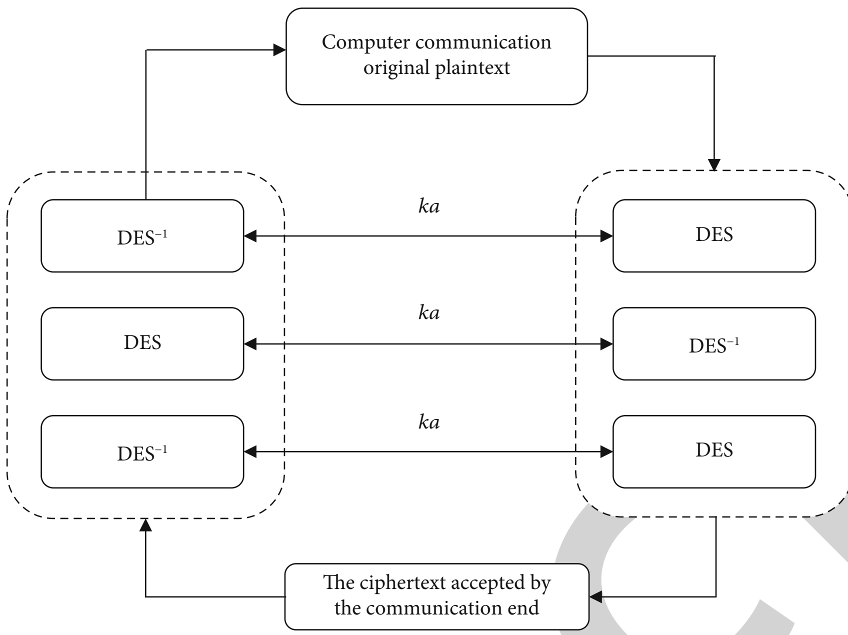

Figure 2: Principle analysis of 3DES data encryption algorithm.

to applying the DES encryption algorithm three times to each data block, expanding the encryption application range of the original DES algorithm [16]. The 3DES data encryption algorithm sets three keys to encrypt the computer communication data, the defined keys are ka, kb, and kc, respectively, thereby extending the key to a length of 168 bits, Figure 2 shows the principle of the 3DES algorithm based on three key encryption.

The data plaintext and ciphertext in the communication process are defined as W and M, respectively, and the plaintext is encrypted by ka, kb and kc. The encryption process of the 3DES algorithm is described as W = Ekc[Dkb[Eka[M]]], and the decryption process is described as M = Dka[EKb[Dkc[W]]]. Considering that the length of the 3DES key is extended and the encryption efficiency is weakened, in order to prevent the encryption speed from being too low, kc = ka + kb, the corresponding key length is 112 bits, which can guarantee the security requirements of most computer communications.

3.4. 3RSA Encryption Algorithm. In order to consolidate the 3DES encryption algorithm to ensure the performance of data communication, the RSA encryption algorithm is used to improve the single 3DES algorithm, and the 3DES algorithm key is encrypted, in this way, the security can be enhanced on the basis of ensuring the operation efficiency of the algorithm encryption, and provide a double guarantee for the security of computer communication; This method is a new hybrid data communication encryption technology formed by drawing on the advantages of 3DES algorithm and RSA encryption algorithm. The RSA encryption algorithm belongs to the asymmetric encryption algorithm, which uses both public key and private key [17]. The RSA algorithm has good security for encrypted communication data, and the algorithm is easy to implement, it can be said that RSA is the most widely used among many asymmetric encryption algorithms. Before the server receives the communication data, the RSA algorithm is used to perform encryption processing to generate the key. In the process of generating the private key based on RSA, the message needs to be mapped into an integer, that is, a block cipher, and the data owner knows the private key algorithm. In the process of RSA decryption, the key function is to verify, the data integrity is guaranteed, and the security of computer users is greatly improved. Key generation, plaintext encryption, and ciphertext decryption are the main steps of the RSA algorithm, and a key needs to be generated before encryption. The steps of RSA algorithm key generation are as follows:

Step1: Choose two arbitrary prime numbers c and v to determine the input for key generation.

Step2: Find the product $i = c * v$ of two prime numbers, then $\varphi(i) = (c - 1) * (v - 1)$.

Step3: Select an integer e above c and v as the encryption key under random conditions, and let the greatest common divisor gcd $(e, \varphi(i)) = 1$.

Step4: Define y as the decryption key of the algorithm, and $(ye) = mod\varphi(i) = 1$, further deduce $(ye) = k\varphi(i) + 1$, and the value of k is an integer not less than 1; If you want to get the key y, you need to know e and $\varphi(i)$.

Step5: Among the parameters of the above process, i and e are values that can be disclosed, and y is a value that needs to be stored secretly. The encryption and decryption methods of the RSA algorithm are shown in formula (1) and formula (2):

$$W = E(M) = M^{e} modi \tag{1}$$

$$W = D(W) = M^{v} modi \tag{2}$$

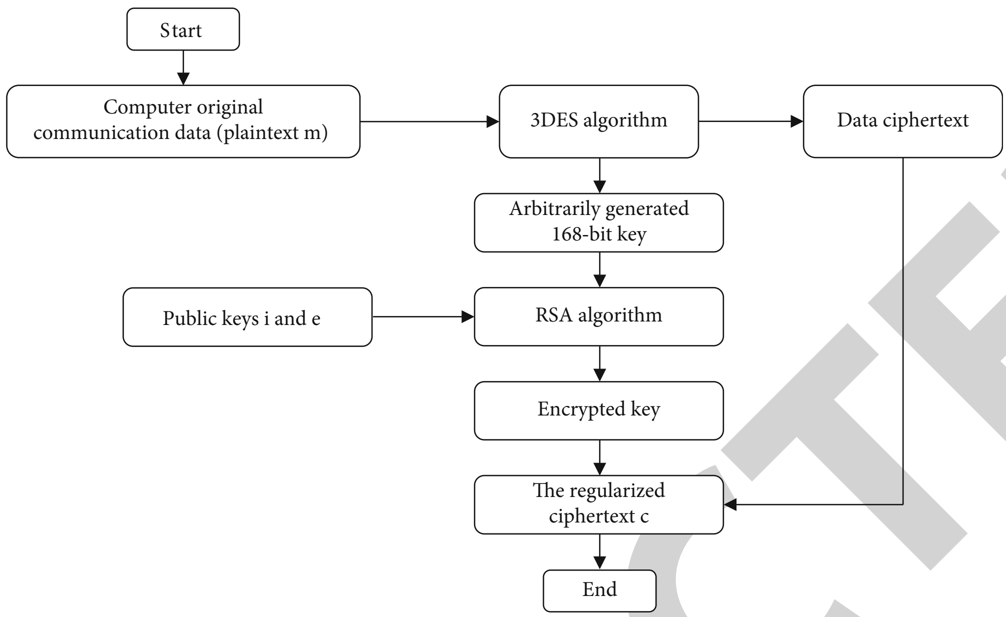

Figure 3: Data communication encryption process based on RSA algorithm and 3DES algorithm.

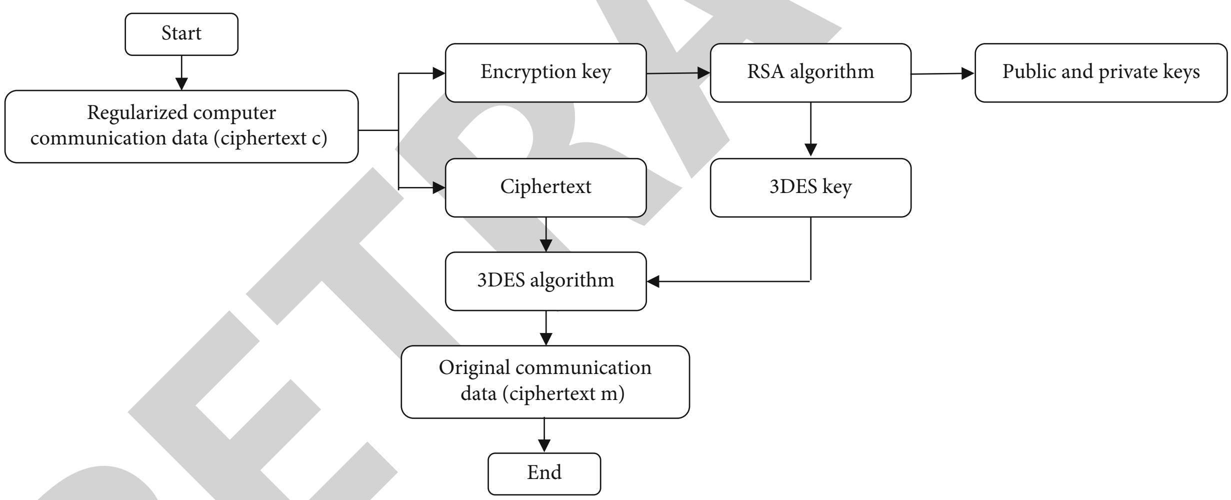

Figure 4: Data communication decryption process based on RSA algorithm and 3DES algorithm.

In the above formula, the plaintext and ciphertext are W and M, respectively, and the mod function is the remainder function. In the above process, the probability of calculating the key y only if the values of i and e are known is 0, so under the RSA algorithm, only the data owner has the key, which ensures the security of data transmission.

3.5. Computer Communication Encryption and Decryption Combining 3DES Algorithm and RSA Algorithm. Figures 3 and 4, respectively, show the process of encrypting and decrypting data communication by combining the RSA algorithm with the 3DES algorithm, the function of the RSA algorithm is to encrypt the key of the 3DES algorithm to provide double guarantees for data security transmission.

The analysis of the encryption process of computer communication data is as follows:

First, in the data encryption operation, the 3DES key is obtained based on the arbitrary number and operation function, that is, the 168-bit key K; Then the plaintext of the computer data to be transmitted is encrypted, the tools used are the key K and the algorithm 3DES, the result is ciphertext, and the generated public key is stored in the server by i and e; Based on the RSA algorithm, the 168-bit key K of 3DES is encrypted, the encrypted key is set to XK, and XK is fused with the ciphertext, which is the final ciphertext for transmission [18].

The analysis of the computer communication data decryption process is as follows: After the receiving end obtains the encrypted data, it reads the public key in the server, first decrypts the key k of the 3DES algorithm based on the public key and the private key, then decrypts the communication ciphertext based on the key k, and finally reads the data transmitted by the sending end securely.

4. Analysis of Results

A data transmission encryption and decryption simulation test platform is built in a local area network communication environment, the sender's computer is named A, and the receiver's computer is named B. 5 groups of data of the same size are selected for communication, and 50 brute force attacks are artificially set to crack the data transmission security key. In order to verify the security performance of the author's method to encrypt communication data, 3DES encryption algorithm, DES encryption algorithm and article algorithm are used, at the same time, data encryption simulation experiments are carried out, the analysis results of the security performance and encryption and decryption efficiency of each algorithm are as follows. Under 50 brute-force attacks, after the data communication encrypted by the three algorithms, the average damage degree of each transmission is shown in Figure 5.

Among them, the author's algorithm has the least damage to data communication after encryption, only the second and third groups of data were damaged by 0.012% and 0.011%, the third and fourth groups of data encrypted by the 3DES encryption algorithm had weak security performance, and 0.11% and 0.10% of the data were damaged. In contrast, the encryption performance of the DES encryption algorithm is not ideal, and about 0.10 to 0.32% of the data is damaged in the transmission of data through the local area network. It can be seen that the data security performance encrypted by the author's algorithm is the best. The 3DES encryption algorithm is to solve the problem of insufficient security of the original DES encryption algorithm. Since a large number of practical application cases have proved that the security performance of the DES encryption algorithm does not meet the requirements of modern data transmission, the key length of the DES algorithm is increased to 168 bits, the author uses the encryption algorithm after the key extension, which improves the encryption performance [19]. Compared with the 3DES encryption algorithm, the author uses RSA to encrypt the 3DES key, which further improves the effectiveness of data encryption.

As can be seen from Figure 6, the DES encryption algorithm takes the shortest time, and the 3DES encryption algorithm takes the longest time, this is because the 3DES encryption algorithm increases the key length on the basis of the original algorithm, so the operation time is prolonged. Although the author's algorithm is not as efficient as the DES algorithm, the difference is only about 1 ms, and the optimal encryption effect is guaranteed at the same time. Therefore, in general, among the three algorithms, the article algorithm has the best security performance in computer communication.

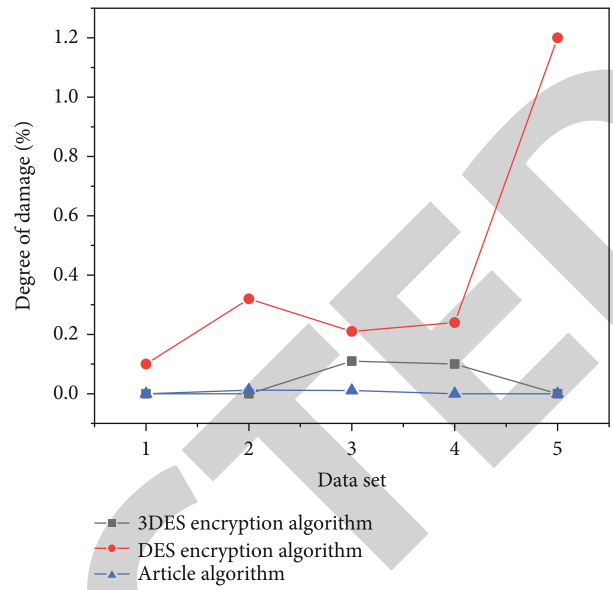

Figure 5: Data encryption transmission performance damage %.

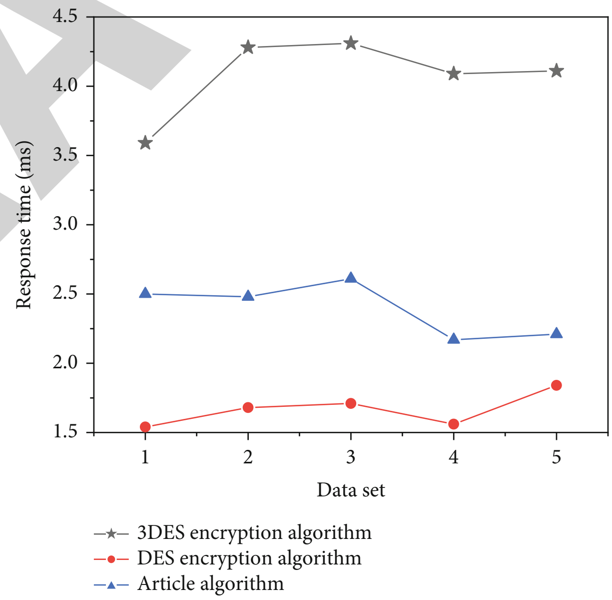

Figure 6: Data encryption response time ms.

5. Conclusion

The author combines the strong security of the 3DES encryption algorithm and the asymmetric encryption advantages of the RSA algorithm, a new computer communication data encryption strategy is formed. After experimental verification, the encryption algorithm proposed by the author has achieved good results in terms of security performance and response efficiency, it is suitable for actual computer data communication scenarios and can effectively improve computer security management.

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Retraction

Retracted: Census and Inventory Method of Pollution Sources Based on Big Data Technology under Machine Learning

Wireless Communications and Mobile Computing

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[1] N. Liu, X. Sun, J. Mi, and S. Zhang, "Census and Inventory Method of Pollution Sources Based on Big Data Technology under Machine Learning," *Wireless Communications and Mobile Computing*, vol. 2022, Article ID 3706065, 7 pages, 2022.

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Research Article

Census and Inventory Method of Pollution Sources Based on Big Data Technology under Machine Learning

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In order to strengthen the supervision and management of environmental pollution **and** timely understand and record the basic information of potential environmental pollution of enterprises and institutions, this paper proposes a general survey and inventory method of pollution sources based on big data technology under machine learning. Firstly, this paper evaluates and screens the data provided by government departments, constructs a machine learning classification model, and uses a variety of classification algorithms to compare and analyze according to the basic idea of machine learning to deal with practical problems. Then, the calibration data set constructed is used as the training set to predict and classify the national industrial and commercial data, provincial industrial and commercial data, and municipal industrial and commercial data provided by government departments. The experimental results show that the naive Bayesian classification algorithm is the best algorithm, and the F1 values of each data set are increased by 32.92%, 21.42%, and 14.91%, respectively. The classified prediction of the screened Internet data shows that the accuracy of the final Internet supplementary data is 17.26%, which is similar to the industrial and commercial data of the city. The availability of the machine learning model established in this paper is prove**n**.

1. Introduction

For a long time since the reform and opening up, China has been blindly pursuing rapid economic development and rarely taking environmental protection measures. Almost all localities have followed the social and economic development model of "pollution before treatment," which has caused great damage to the natural environment. For a time, there were negative reports on environmental health caused by serious poisoning caused by various pollutants and health disease events in many places across the country [1]. Later, all walks of life in China began to pay attention to the issue of environmental sustainable development and realized that "green water and green mountains are golden mountains and silver mountains." Although China's environmental protection work started late, it has achieved initial results with the joint efforts of the Chinese government and enterprises.

Generally speaking, the construction of China's environmental information system can be roughly divided into three development stages: the 1980s experienced a decade of exploration, the 1990s gradually moved towards maturity, and the early 21st century began to move towards marketization. In the stage of exploration and development, the research of information system focuses on the research of systematic theories and methods [2], and a series of preliminary construction work has been carried out at the national level and the local government level. In the later mature stage, the development technology of China's environmental information system is gradually maturing. The research in this stage is combined with the actual development to further improve the functions of the environmental information system [3]. China's environmental monitoring system and environmental protection industry and production enterprises complement each other. On the one hand, environmental information system can provide experimental data and experimental platform for environmental protection-related research and analysis. On the other hand, environmental protection-related research and analysis continue to promote the development and continuous improvement of an environmental information system.

2. Literature Review

With the development of environmental protection in China, many environmental protection-related data have been accumulated, such as ground monitoring data, remote sensing monitoring data, and geographic information data. These data resources are distributed in different government departments such as environmental protection, water conservancy, agriculture, forestry, and meteorology. In terms of the application of big data in the field of environmental protection, Wj et al. put forward the method of using machine learning technology to integrate satellite data into the model, conduct objective analysis of big data, and conduct cross research with ground monitoring data, which can fill in and correct ground detection data, real-time detect pollution source changes, and more accurately predict air quality changes [4]. Guan et al. studied and established a big data platform for information service integration for the early warning direction of meteorological and geological disasters in China's petroleum industry [5]. Ge et al. used the HDFS technology in Hadoop, combined with ground detection data and remote sensing meteorological data transformed by ARL, to establish a big data platform for air pollution prevention and control in a certain region [6]. Miszczak et al. conduct a general survey of results of pollution sources and analysis of pollution sources in a city and put forward pollution prevention and control measures [7]. Bloetscher et al. identified beverage manufacturing, papermaking and paper products, food manufacturing, and agricultural and sideline food processing industries as typical industries to reduce oxygen demand pollution through the summary, analysis, and research on the census data of pollution sources and focused on the generation, emission, and treatment of five-day biochemical oxygen demand in four industries [8]. Liu et al. analyzed the production, emission characteristics, and pollution status of pollutants in Jingjiang City, Jiangsu Province, by using the census data of pollution sources and social statistical data and pointed out that while industrial pollution is paid attention to, domestic pollution and agricultural pollution cannot be ignored [9]. Wen et al. analyzed the main environmental problems within the jurisdiction according to the results of the general survey of pollution sources in a city and put forward corresponding countermeasures and suggestions in combination with local conditions [10].

The purpose of this paper is to build a model that can effectively use the business scope of an enterprise to predict whether an enterprise belongs to the scope of pollution source census and to correct the departmental data by using the massive business scope data provided by government departments and the actual household survey results of pollution sources. Combine the prediction model to judge the screened Internet big data, and explore the availability of Internet big data for the supplement of basic unit directory. Then, the paper summarizes the methods that can improve the efficiency of compiling the list of basic units in the general survey and inventory stage of pollution sources.

3. Research Methods

3.1. Data Sources and Research Methods

3.1.1. Data Source. The data used in this study include government department data and public data.

The data sources of government departments mainly come from the information management systems of industrial and commercial departments at national, provincial, and municipal levels.

Public data refers to the Internet data obtained by the third-party team, which focuses on industries and regions for the census of pollution sources and uses web crawlers to publicly collect. The collected enterprise data sources include enterprise category interest point data based on public map services, Internet web page public data, and data obtained through commercial channels, involving Tianyancha, Alibaba, Qichacha, Liepin.com, Zhilian Recruitment, and atubo yellow pages, and nearly 240000 enterprise data have been obtained.

3.1.2. Research Methods

(1) Big Data Availability Analysis Method. In recent years, with the rapid development of information technology, the scale of data has also exploded. Big data has been widespread in all walks of life, and these data have become an important wealth of the information society. However, such a large number of data sets are prone to data quality problems. Therefore, exploring the availability of big data has become a difficult problem for us. It is generally believed that a correctly available big data set should have at least the following five properties: consistency, accuracy, integrity, timeliness, and entity identity [11].

In the general research process, the collected data shall be summarized and sorted according to the fixed principles to form a research database. Analyze the availability of the original data from the above five dimensions to realize the classification, collation, and pretreatment of the obtained data, so as to provide data support for subsequent research.

(2) Machine Learning: Natural Language Processing. Machine learning is the core of artificial intelligence and one of the main ways of big data analysis. Its application is widely distributed in various artificial intelligence fields. It mainly uses induction rather than deduction [12]. As an important technical foundation of artificial intelligence, computers not only have the ability to quickly process data through algorithms but also have the ability to predict and classify problems after training. Under the trend of increasing data volume, they have great development potential.

Natural language processing (NLP) is a technology and application that processes languages and words by using computers [13]. In recent years, with the arrival of the big data era, the rapid improvement of machine computing

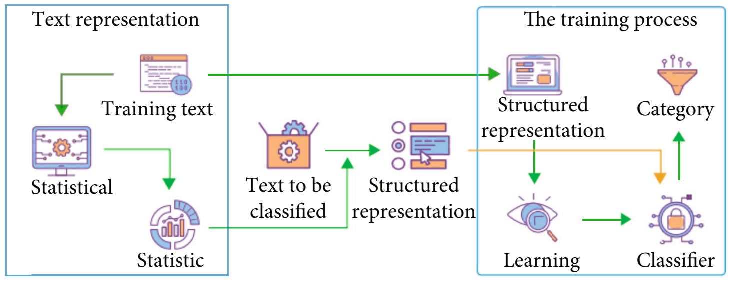

Figure 1: Text classification system based on statistics.

power and the wide application of machine learning algorithms have brought new breakthroughs in the application of natural language processing.

In the text classification problem, the machine learning method based on statistics is widely used. The general idea is to extract some documents evenly from all the documents, mark the category, and take this as the training set and then find the relationship between words and categories in the training set. Make use of mathematical expressions to explain the above summarized links and guide classification prediction. Because this method has a good theoretical basis, it is easy to obtain satisfactory classification results. As shown in Figure 1, it is the schematic diagram of the text classification system based on statistics [14].

The TF-IDF algorithm is essentially a statistical method. It uses the number of words appearing in the document as the evaluation standard of importance. If a word appears very frequently in an article (TF is high) and less frequently in other articles (IDF is high), it is considered that the word can better represent the article and is suitable for classification. Therefore, we can take the word frequency as the evaluation method to describe the importance of words to the specified document and the reverse file frequency as the evaluation method to judge the importance of words relative to all document sets and combine the above two to select features.

Suppose that for the word t_i in a document d_i, the word frequency of t_i can be expressed as follows [15]:

$$\mathrm{TF}_{ij} = \frac{n_{ij}}{\sum_k n_{k,j}}, \tag{1}$$

where n_i and j represent the number of times the word t_i appears in document d_i, and the denominator represents the total number of times all words appear in document d_i.

The IDF of a word, as shown in formula (2), can be obtained by dividing the total number of files by the number of files containing the word and taking the logarithm.

$$\mathrm{IDF}_{ij} = \log \frac{|D|}{\left|\{j : t_i \in d_j\}\right| + 1}. \tag{2}$$

$|D|$ represents the total number of all documents, and the content of the denominator represents the total number of documents containing the word t_i. In addition, in order to prevent the denominator in the formula from being zero, we add 1 to the denominator.

Multiply TF and IDF as the value of the feature space coordinate system; that is, the TF-IDF value is as follows:

$$\mathrm{TF} - \mathrm{IDF} = \mathrm{TF}_{ij} \times \mathrm{IDF}_{ij}. \tag{3}$$

By using the algorithm of TF-IDF, we can obtain the importance of the target words in the document [16] and then complete the screening of words, so as to obtain the representative text feature items, which lays a foundation for the subsequent classification and prediction.

3.2. Enterprise Industry Category Screening and Correction Method for Machine Learning. Incorrect industry classification of enterprises will not only make it impossible to accurately establish a list of enterprises in key industries for pollution source census and greatly reduce the efficiency of preliminary census preparation but also increase the workload of census personnel in filling out the census registration form [17]. The human settlements and environment committee of a city hopes to make full use of the 3.18 million full-caliber industrial and commercial articles of a city to supplement the inventory of basic units as far as possible. It is undoubtedly extremely difficult to use manpower to manually judge the industry category according to the business scope. If the machine learning algorithm can be used to rematch and calibrate the industry categories of enterprises, the work efficiency will be greatly improved.

In order to correct the errors in the industry category of enterprises and avoid the omission of the data set submitted by the department, the study plans to explore the identification of the production and business scope of enterprises through the machine learning algorithm based on the national industrial and commercial data, provincial industrial and commercial data, and the full-caliber industrial and commercial data of a city provided by the human settlements and environment committee of a city, so as to screen and correct the enterprise industry and verify the feasibility of the method.

We hope to establish a machine learning model based on the above data and use the business scope field to predict the enterprise industry. The experimental process is shown in Figure 2. The enterprise industry classification prediction specifically adopts the following processes [18]: data collection and marking, document preprocessing, Chinese word segmentation, removal of stop words, structured representation

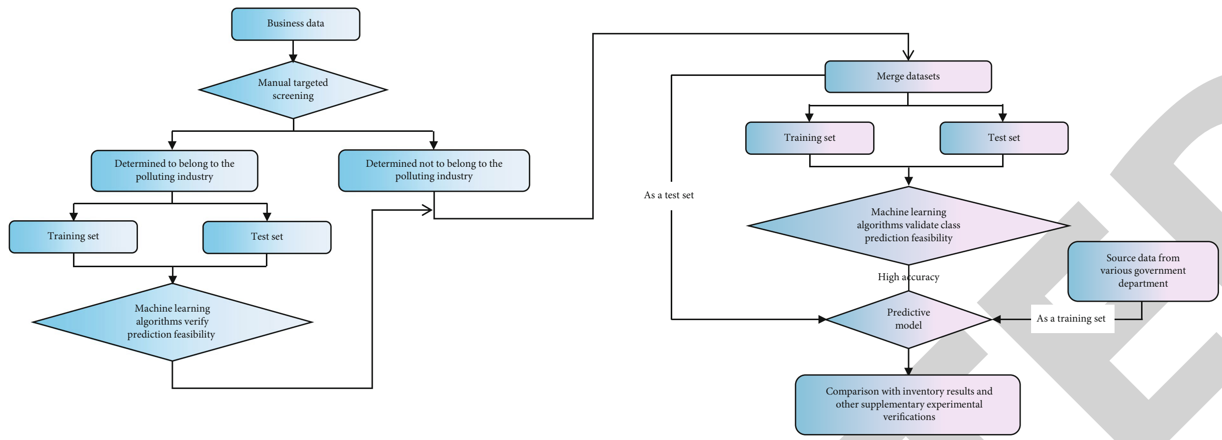

Figure 2: Flowchart of the industry classification prediction experiment.

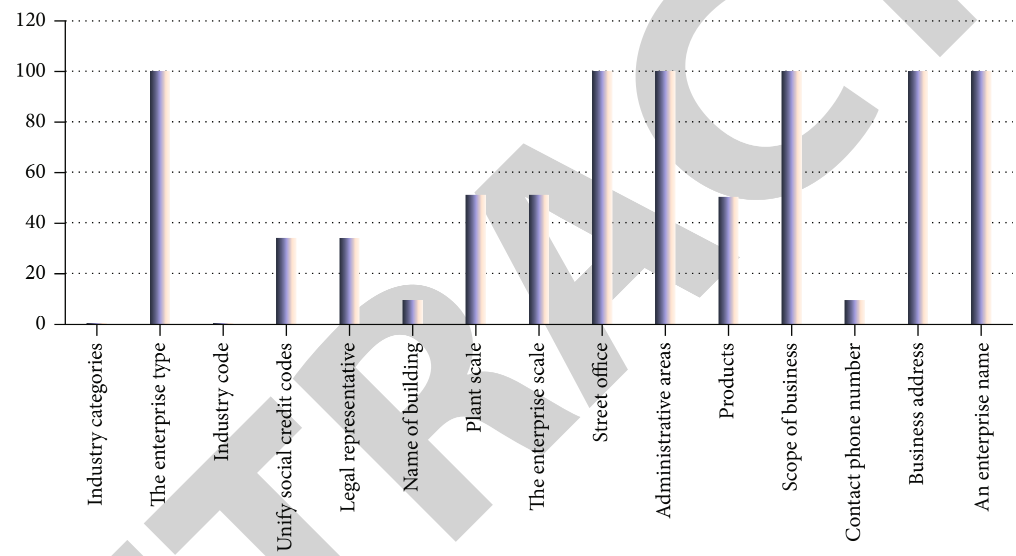

Figure 3: Statistics of the filling degree of each field of the Internet data source.

(construction of TF-IDF weighted word vector space), classification model selection, training and testing, performance evaluation, and model use.

3.3. Internet Big Data Supplements the List of Basic Units. For the data collected from Internet data sources [19], the method similar to the statistical analysis of department data is used to analyze and evaluate the quality of data sources. The evaluation results are shown in Figure 3. Take the summary data set of the Internet data source as the sample.

Using the constructed machine learning model, the verified accurate calibration data set is used as the training set, and the naive Bayesian classification algorithm with good verified performance is used to carry out the experiment. 500 data sets are randomly selected from the data set as the test set. The established machine learning model is used to predict the industry category of the enterprise. At the same time, according to the business scope of the enterprise, whether it belongs to the target industry of pollution source census is manually judged and marked. The results obtained are compared with the machine learning prediction results

Table 1: Evaluation of classification results of each algorithm.

Algorithm	Accuracy	Recall	F1 value
Naive Bayes	99.80%	99.80%	0.998
Decision tree	97.90%	97.90%	0.979
Logistic regression	90.90%	90.60%	0.907
KNN	79.80%	78.40%	0.791

to calculate the relevant evaluation parameters. At the same time, in order to avoid the experimental contingency, the data set was repeated three times. The accuracy rate, recall rate, and F1 value are still used as evaluation indicators for evaluation.

4. Result Analysis

4.1. Analysis on the Results of Screening and Correction of Enterprise Industry Categories Based on Machine Learning. The target industry data of 28 types of pollution sources have been calibrated for testing to determine the quality of

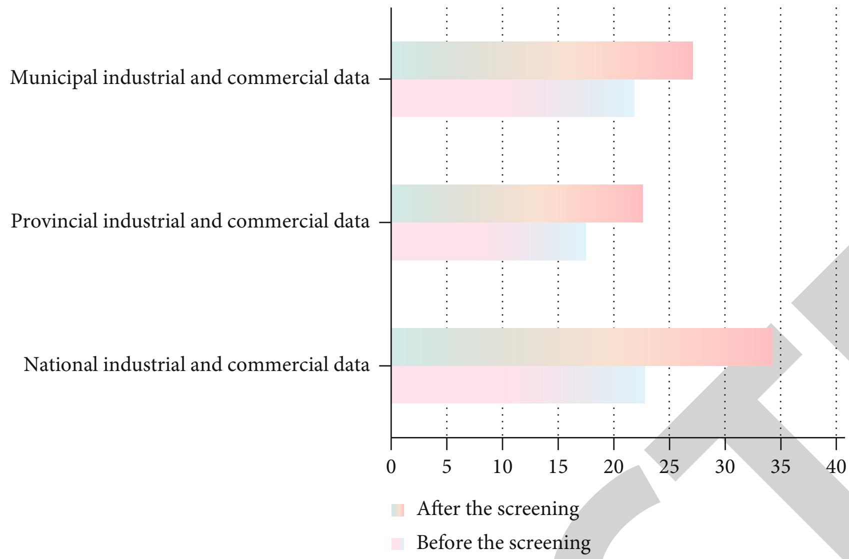

Figure 4: Comparison of accuracy rate of each data set after screening.

the artificially constructed data. Divide the 4690 constructed target industry data of pollution source census by industry, half as the training set and half as the test set, classify the internal 28 industries according to the above experimental steps, and use the naive Bayes classification algorithm, logistic regression classification algorithm, decision tree classification algorithm, and KNN (k-nearest) classification algorithm for prediction [20].

The results and comparison of industry category prediction models are shown in Table 1.

From the above results, it can be seen that this data set has a good representation effect for 28 different industries, and the accuracy of the naive Bayesian algorithm is the highest, with F1 value reaching 0.9980. Therefore, it is determined that the next part of the experiment can be carried out based on this data set.

In the current economic environment of rapid enterprise change, a large number of enterprises are closed down or relocated, resulting in a large number of classified forecast hits that cannot be checked and verified. Moreover, due to the limitations of actual working conditions, this household inventory is mainly a dragnet inventory within the scope of key industrial parks. At the same time, there are still a large number of problems existing in the actual work in the first general survey of pollution sources. It is difficult to be accurate and complete in the household inventory, and the inventory results will still be far from the actual situation. Based on the above reasons, the index of accuracy obtained by checking the household feedback test will be lower than the conventional cognition [21]. However, the accuracy rate is still much higher than that of the department data without screening. The comparison before and after screening is shown in Figure 4.

Before and after classification, the accuracy of each data source is less than 40%. When the accuracy and recall cannot be well considered, the F1 value is selected as the index of comprehensive evaluation. After classification and screening, the efficiency of the list has generally been improved to a certain extent, and the F1 value has been increased by 32.92%, 21.42%, and 14.91%, respectively [22].

4.2. Supplement Results of Internet Big Data to the Directory of Basic Units. For the obtained Internet supplementary data, the actual feedback results of household inventory are still used for preliminary verification. After matching the feedback data, 2988 pieces of actually identified existing data are obtained; that is, the accuracy rate of Internet supplementary data is 17.26%. Since there is no original data comparison for this part of the data and the recall rate index cannot be calculated, this part only uses the accuracy rate for comparative evaluation. We can find that in the accuracy indicators, the Internet supplementary data is lower than the department data and is only similar to the municipal industrial and commercial data before screening in the department data [23]. The accuracy and comparison between the Internet big data supplementary data and the department data before and after screening are shown in Figure 5.

After screening and industry category judgment, the accuracy rate of the above Internet supplementary data is 17.26% after the initial test of the actual inventory and household feedback. The same as the content analyzed in Section 3, due to the actual conditions, the accuracy of the household inventory and feedback test is still low compared with that of the conventional cognition. At the same time, the usability of the model in the Internet source data will be in doubt. In view of this situation, it is planned to conduct a supplementary experiment, randomly select decimal data from the Internet data for inspection, conduct inspection through a manual review, judge the actual performance of the Internet supplementary data under the machine learning classification model, and explore the actual accuracy of the data set in combination with the Internet data screening principle to assist in verifying the availability of the machine learning model [24].

According to the above experimental process, the results of the Internet supplementary data supplementary experiment are shown in Table 2.

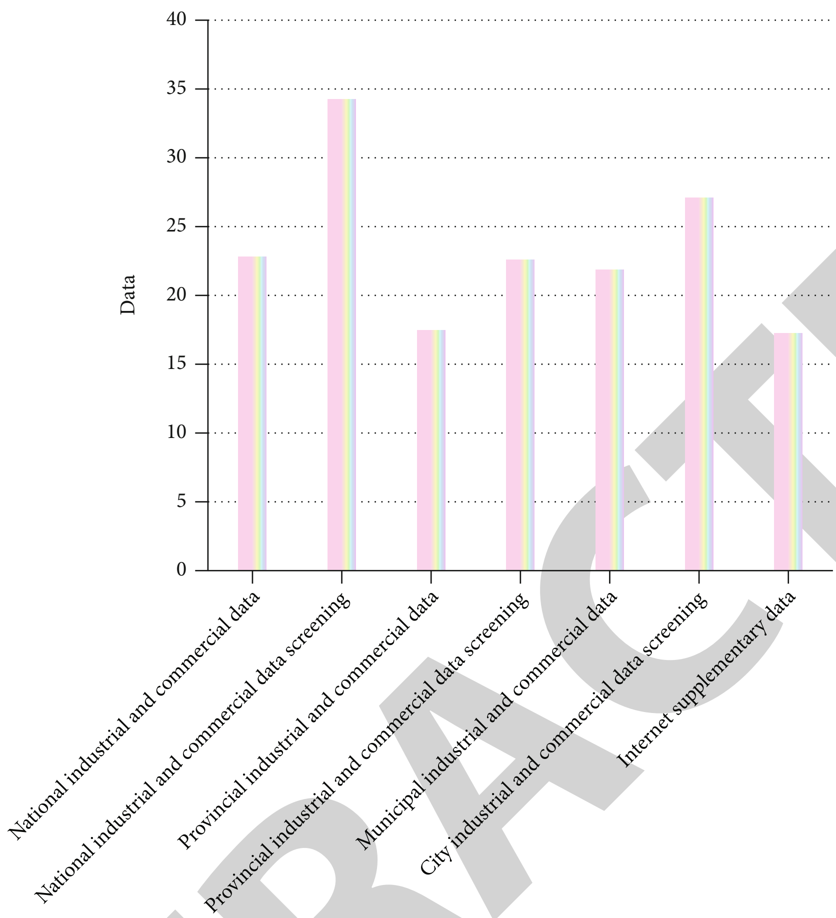

Figure 5: Comparison chart of data accuracy.

Table 2: Supplementary experimental results of Internet supplementary data.

	First experiment	Second experiment	Third experiment	Average value
Accuracy	76.67%	75.81%	78.64%	77.04%
Recall	82.24%	81.72%	82.39%	82.12%
F1 value	0.7936	0.7865	0.8047	0.7949

Through the above results, the average accuracy is 77.04%. Although each indicator is lower than the national and provincial industrial and commercial data, it is similar to the municipal industrial and commercial data. Therefore, it is concluded that the obtained Internet supplementary data are basically in line with the target industry scope of the pollution source census. At the same time, in combination with the screening principles developed through the availability of big data, the reliability of the obtained data has been basically guaranteed [25, 26].

5. Conclusion

After systematically studying the relevant regulations and requirements of China's pollution source census at the present stage and the existing problems, in order to improve the efficiency of compiling the list of basic units in the pollution source census and inventory stage, this paper constructs a machine learning classification model, predicts the actual industry categories of enterprises through the business scope of enterprises, and realizes the correction and screening of the industry category fields in the data of government departments. Finally, it summarizes the optimization methods for the compilation of the list of basic units in the pollution source census and inventory stage, so as to improve the work efficiency in the inventory stage and save human and material resources.

Data Availability

The data used to support the findings of this study are available from the corresponding author upon request.

Conflicts of Interest

The authors declare that they have no conflicts of interest.

Acknowledgments

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Retraction

Retracted: Data Mining Technology for Agricultural Equipment Machinery and Information Network Data Resources

Wireless Communications and Mobile Computing

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This article has been retracted by Hindawi following an investigation undertaken by the publisher [1]. This investigation has uncovered evidence of one or more of the following indicators of systematic manipulation of the publication process:

(1) Discrepancies in scope
(2) Discrepancies in the description of the research reported
(3) Discrepancies between the availability of data and the research described
(4) Inappropriate citations
(5) Incoherent, meaningless and/or irrelevant content included in the article
(6) Peer-review manipulation

The presence of these indicators undermines our confidence in the integrity of the article's content and we cannot, therefore, vouch for its reliability. Please note that this notice is intended solely to alert readers that the content of this article is unreliable. We have not investigated whether authors were aware of or involved in the systematic manipulation of the publication process.

Wiley and Hindawi regrets that the usual quality checks did not identify these issues before publication and have since put additional measures in place to safeguard research integrity.

We wish to credit our own Research Integrity and Research Publishing teams and anonymous and named external researchers and research integrity experts for contributing to this investigation.

The corresponding author, as the representative of all authors, has been given the opportunity to register their agreement or disagreement to this retraction. We have kept a record of any response received.

References

[1] Z. Fan, N. Zhang, X. Zhang, D. Wang, and G. Wu, "Data Mining Technology for Agricultural Equipment Machinery and Information Network Data Resources," *Wireless Communications and Mobile Computing*, vol. 2022, Article ID 3899618, 8 pages, 2022.

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Research Article

Data Mining Technology for Agricultural Equipment Machinery and Information Network Data Resources

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In order to realize the automation and intelligence of agricultural equipment mechanical state detection and improve the efficiency and accuracy of agricultural machinery equipment detection technology, this paper proposes an intelligent agricultural machinery equipment state detection method based on computer data mining. This method uses support vector machine to classify the equipment status and uses ant colony algorithm to solve the optimization problem. Its basic logic is to collect the status data of agricultural machinery equipment, extract the status detection characteristics of agricultural machinery equipment, and use computer data mining to establish an automatic state detection model of agricultural machinery equipment. The application results show that the correct rate of the state detection of agricultural machinery equipment is more than 95%, and the false detection rate of the state of agricultural machinery equipment is far lower than that of other current state detection methods of agricultural machinery equipment. *Conclusion*. This method can realize high-precision real-time detection of agricultural machinery equipment and has higher practical value.

1. Introduction

Agricultural mechanization and agricultural equipment are the important foundation for changing the mode of agricultural development and promoting the sustainable development of agriculture. They are the key areas and core support for promoting the construction of agricultural modernization. In 2018, the guiding opinions of the State Council on accelerating the transformation and upgrading of agricultural mechanization and agricultural machinery and equipment industry made an important judgment that "agricultural production has changed from mainly relying on human and animal resources to mainly relying on mechanical power and entered a new stage dominated by mechanization", pointing out the prominent problem of "the current unbalanced and insufficient development of agricultural mechanization and agricultural machinery and equipment industry". The general requirements of "promoting the transformation of agricultural machinery and equipment industry to high-quality development and promoting the overall, high-quality and efficient upgrading of agricultural mechanization" were clarified. The strategic plan for Rural Revitalization (2018-2022) also points out that efforts should be made to strengthen key technology research, promote the deep integration of advanced technologies such as digitalization and intelligence with agricultural mechanization, significantly improve the effective supply capacity of agricultural machinery, and lead the high-quality and efficient development of modern agriculture. It is of great significance for promoting the high-quality and efficient development of China's agriculture to implement the spirit of the above documents, carefully understand the research and application status of foreign agricultural machinery, and then find out the key objectives for the development of China's agricultural mechanization.

At present, China is in an important period of agricultural modernization, and the demand for intelligent agricultural machinery and equipment is also growing [1, 2]. However, the intelligent level of the existing agricultural machinery and equipment in China is low, which is inconsistent with the current requirements for automation and high-efficiency operation, and is not conducive to the rapid development of China's agricultural modernization [3, 4]. In the coming period, the development of agricultural equipment in China will face new opportunities, new demands, and new challenges, and there is still a broad space for the development of agricultural equipment manufacturing. Therefore, strengthening the intelligent innovation of agricultural machinery and improving the level of agricultural mechanization in China with information technology has become an urgent and crucial task for the development of agricultural mechanization [5].

Accelerating the process of agricultural informatization is an important strategic measure to promote the development of agriculture and rural economy, increase farmers' income and become rich, and stabilize rural society. As a typical model of China's agricultural development in the new era, ecological agriculture has been widely recognized and accepted in theory and practice. It is considered as an inevitable choice to solve the plight of modern agriculture, reduce the pressure on population, resources, and environment, and the basis for the marketization and internationalization of China's agricultural products [6]. Agricultural data has the characteristics of large amount, multidimensional, dynamic, incomplete, and uncertain. The information data of ecological agriculture has strong regional and timeliness. Mining data information, improving information quality, and timely providing predictive, seasonal, and instructive practical information has become an urgent problem to be studied and solved [7, 8].

Data mining technology is a data management technology based on information technology. From the root, this technology belongs to the category of database technology. It is an advanced processing process to extract various valuable data for a large number of one-sided, fuzzy, and interfering practical application data [9, 10]. The rules for processing these data include the integration of a series of technologies such as statistics, artificial intelligence, and database. It is a typical interdisciplinary and has made great achievements in many fields [11, 12]. As for the quality control of agricultural machinery, data mining technology can comprehensively classify and manage the application and fault information of agricultural machinery, so that a large number of messy information of the whole agricultural machinery quality control can be rationalized. The results are helpful to the overhaul and maintenance of agricultural machinery and improve the working stability and service life of agricultural machinery [13, 14], as shown in Figure 1.

2. Literature Review

Lamrhari et al. processed and analyzed the collected environmental data, built an effective agricultural big data architecture, assisted producers and consulting companies in making decisions, improved agricultural productivity and monitoring ability, improved the decision-making process, and achieved the goal of better management of natural resources [15]. Wu et al. elaborated that the agricultural information age cannot be driven by big data. Driven by data, the agricultural monitoring and early warning system is expected to move towards full automation, real-time management, and accurate service [16]. Alves and Cruvinel developed a system with data source, big data processing environment and application program in 2016. The system can monitor soil data in real time, analyze soil fertility, and provide farmers with soil testing and formula fertilization suggestions [17]. Kim et al. analyzed the huge amount of data on the circulation of agricultural products, established a sales strategy suitable for local festival planning, and made a sales decision support system using the big data of agricultural products [18]. Wang et al. conducted research on the collection of agricultural data platform, built a network capture system based on jsoup, and provided consumers with valuable market information through correlation analysis and regression analysis, which helped to improve the common awareness of the agricultural product market [19]. In the processing of agricultural big data, foreign countries have also put forward many new technical methods. Tsai et al. published an article on MapReduce in 2004 introducing the distributed principle of the technology and its advantages in processing big data [20]. In terms of data calculation, Gil-Garcia et al. proposed an environmental domain planning and decision-making process based on spectral clustering algorithm, which effectively improved the clustering efficiency and accuracy of data. In terms of data presentation, the authors of [21] applied data visualization technology to the impact of agricultural activities and climate change on water resources, providing a new solution for places lacking water resources.

According to the randomness of the state change of agricultural machinery equipment, in order to solve the shortcomings of current agricultural machinery equipment state detection methods, an intelligent agricultural machinery equipment state detection method based on computer data mining is designed. First, collect the status data of agricultural machinery equipment and extract the status detection features of agricultural machinery equipment. Then, the self-test model of agricultural machinery equipment state is established by using computer data mining. Finally, the simulation test of agricultural machinery equipment status detection is carried out to analyze the feasibility and superiority of this method.

3. Research Methods

3.1. Data Mining Technology

3.1.1. Support Vector Machine Classification Method. Computer data mining technology is the result of the integration of computer technology and data analysis technology. Support vector machine is a classical computer data mining technology, which has not only classification ability, but also regression ability [22–24]. Because the state detection of agricultural machinery equipment is a classification problem, this paper focuses on the classification principle of support vector machine. The state of agricultural machinery equipment is usually classified as normal state or abnormal state, and the abnormal state is mainly shown as fault state. If H1 represents normal state and H2 represents abnormal state, support vector machine can distinguish the normal

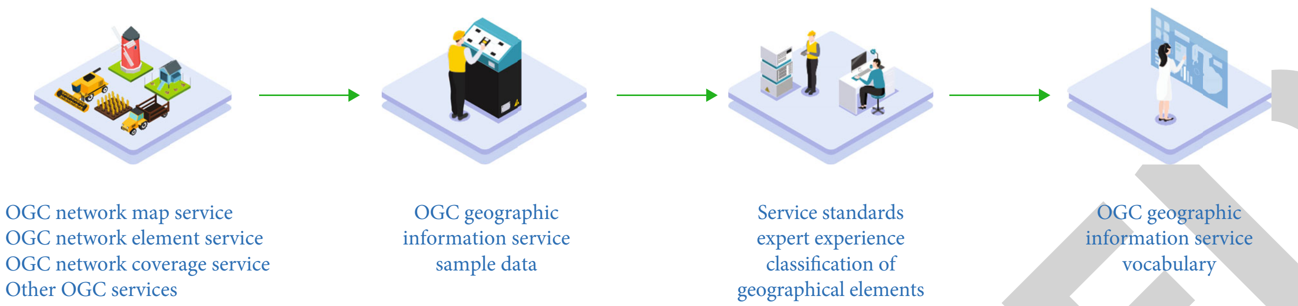

FIGURE 1: Information network data resources.

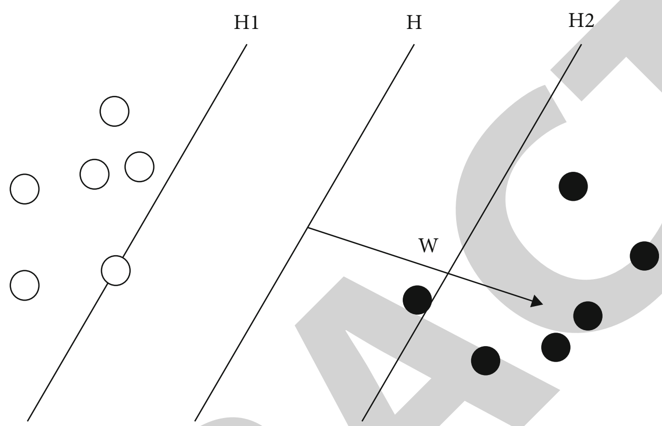

FIGURE 2: Classification principle of support vector machine.

state and abnormal state of agricultural machinery equipment by establishing a classification plane. For details, as shown in Figure 2, the electric energy data acquisition system of power users is a system for real-time collection, processing, and monitoring of power consumption information of power customers [25]. Based on this system, the useful functions such as automatic collection of power information, anomaly monitoring, power quality monitoring, power analysis and management, relevant information release, distributed energy monitoring, and information exchange of intelligent power equipment can be realized.

Set the data set of agricultural machinery equipment status detection as $\{x_i, y_i\}$, $(i = 1, 2, \cdots, l)$, $x \in R^n$, and $y \in \{+1, -1\}$, where l is the data scale of agricultural machinery equipment status detection, n is the number of characteristics of agricultural machinery equipment status detection, and y is the status type of agricultural machinery equipment. It supports mapping data to a high-dimensional space to a processor. At this time, the classification plane can be described as follows:

$$\omega \cdot \psi(x) + b = 0, \tag{1}$$

where $\psi(x)$ is the mapping function, and the following conditions shall be met:

$$\begin{aligned} \omega \cdot \psi(x_i) + b \geq 0, \quad & \text{if } y_i = 1, \\ \omega \cdot \psi(x_i) + b \leq 0, \quad & \text{if } y_i = -1, \end{aligned} \tag{2}$$

where ω is the normal vector used to describe the straight line. In the process of condition detection of agricultural machinery equipment, the established classification plane has a certain error. Therefore, relaxation variable ξ_i and penalty parameter C are introduced to stabilize the classification error and calculation complexity. In this way, the solution of equation (3) can change a basic optimization problem, specifically

$$\begin{gathered} \min_{\omega,b,\xi} \frac{1}{2} \|\omega\| + \mathrm{C} \sum_{i=1}^{l} \xi_i, \\ \text{s.t. } y_i[(\omega \cdot x_i) + b] \geq 1 - \xi_i. \end{gathered} \tag{3}$$

The dual form of equation (4) is obtained by using Lagrange coefficient α_i, i.e.,

$$\begin{gathered} \min_{\alpha} \left[\sum_{i,j=1}^{n} y_i y_j \alpha_i \alpha_j (\psi(x_i)\psi(x_j)) - \sum_{i=1}^{n} \alpha_i\right], \\ \text{s.t.} \qquad 0 \leq \alpha_i \leq C, \ \sum_{i=1}^{l} y_i \alpha_i = 0. \end{gathered} \tag{4}$$

Among them, the vector corresponding to nonzero α_i is the support vector, which directly determines the state detection effect of agricultural machinery equipment. The discriminant function of agricultural machinery equipment state detection can be established, as shown below:

$$f(x) = \operatorname{sgn}\left[\sum_{i=1}^{l} y_i \alpha_i (\psi(x_i) \cdot \psi(x)) + b\right], \tag{5}$$

where

$$\operatorname{sgn}(x) = \begin{cases} +1, & x \geq 0, \\ -1, & x \leq 0. \end{cases} \tag{6}$$

The working process of inner product operation $(\psi(x_i) \cdot \psi(x))$ is very complex, which affects the efficiency of condition detection of agricultural machinery equipment. Therefore, kernel function $K(x_i, x)$ is introduced instead of $(\psi(x_i) \cdot \psi(x))$ to speed up the condition detection of agricultural machinery equipment. Select radial basis Gaussian function as $K(x_i, x)$, as shown below:

$$K(x_i, x) = \exp\left(-\frac{\|x_i - x\|^2}{\sigma^2}\right), \tag{7}$$

where σ is the core width.

In the modeling process of agricultural machinery equipment state detection, the parameters C and σ affect the effect of agricultural machinery equipment state detection. Ant colony algorithm is used to determine the values of C and σ.

3.1.2. Ant Colony Algorithm. Ant colony algorithm solves the problem by simulating the process of ants looking for food [26]. Let the position of ant k at the t-th time be i; then, its crawling probability to position j is as shown below:

$$p_{ij}^{k}(t) = \begin{cases} \dfrac{\tau_{ij}^{\alpha}(t)\eta_{ij}^{\beta}(t)}{\sum \tau_{is}^{\alpha}(t)\eta_{is}^{\beta}(t)}, & j, s \notin tabu_k, \\ 0, & \text{otherwise}. \end{cases} \tag{8}$$

Among them, η_{ij} is the pheromone heuristic factor on the path in the process of ant crawling; τ_{ij} is the pheromone on the path between position i and position j; $tabu_k$ is the path search tabu table of ant k; α is the weight of pheromone; and β is the weight of the heuristic factor, and its value changes as shown in

$$\beta = \beta_0 \left(1 - \frac{n}{N_{\max}}\right), \tag{9}$$

where n is the number of iterations; β_0 is the initial value of the weight of the heuristic factor; and $N_{\max}$ is the maximum number of cycles.

After searching all positions, the ants update the information concentration of the path, as shown in the following:

$$\tau_{ij}(t+1) = \rho \cdot \tau_{ij}(t+1) + \sum_{k} \Delta\tau_{ij}^{k}, \tag{10}$$

where ρ is the residual factor of pheromone and $\Delta\tau_{ij}^{k}$ represents pheromone change factor.

3.2. Intelligent Detection Method of Agricultural Machinery Equipment Status Based on Data Mining

3.2.1. Collection of Status Data of Agricultural Machinery Equipment. When the state of agricultural machinery equipment changes, many parameters will change accordingly. Vibration signal is an important parameter to describe the state change of agricultural machinery equipment. Therefore, wireless sensors are used to collect the vibration signals of agricultural machinery equipment, and the collected vibration signals of original agricultural machinery equipment are preprocessed to extract effective status data of agricultural machinery equipment.

3.2.2. Extracting the State Characteristics of Agricultural Machinery Equipment. The vibration signal of agricultural machinery equipment is decomposed by wavelet packet. The decomposed signal of the i-th layer is $f_{ij}(t_j)$, and the vibration signal $x(t)$ of agricultural machinery equipment can be expressed as follows:

$$x(t) = \sum_{j=0}^{2^i - 1} f_{ij}(t_j). \tag{11}$$

$f_{ij}(t_j)$ represents the reconstructed signal of the wavelet packet decomposition of the motor signal on the node (i, j) of the i-th layer. After the state changes, the energy of the vibration signal will change accordingly. The state of agricultural machinery equipment can be detected according to the energy spectrum. The energy spectrum calculation formula is shown as follows:

$$E_{ij}(t_j) = \int_T \left|f_{ij}(t_j)\right|^2 \mathrm{d}t = \sum_{j=1}^{m} \left|x_{ij}\right|^2, \tag{12}$$

where x_{ij} is the amplitude of $f_{ij}(t_j)$.

The total energy of agricultural machinery equipment status vibration signal is shown in the following:

$$E = \sum_{j=1}^{2^i - 1} E_{ij}(t_j). \tag{13}$$

The proportion of subband energy of vibration signal of agricultural machinery equipment decomposed by the i-th wavelet packet to the total energy is shown in

$$P_{ij} = \frac{E_{ij}}{E} \times 100\%. \tag{14}$$

P_{ij} is used as the detection feature of agricultural machinery equipment state, that is, the input vector of support vector machine classification, and the agricultural machinery equipment state is used as the output vector of support vector machine.

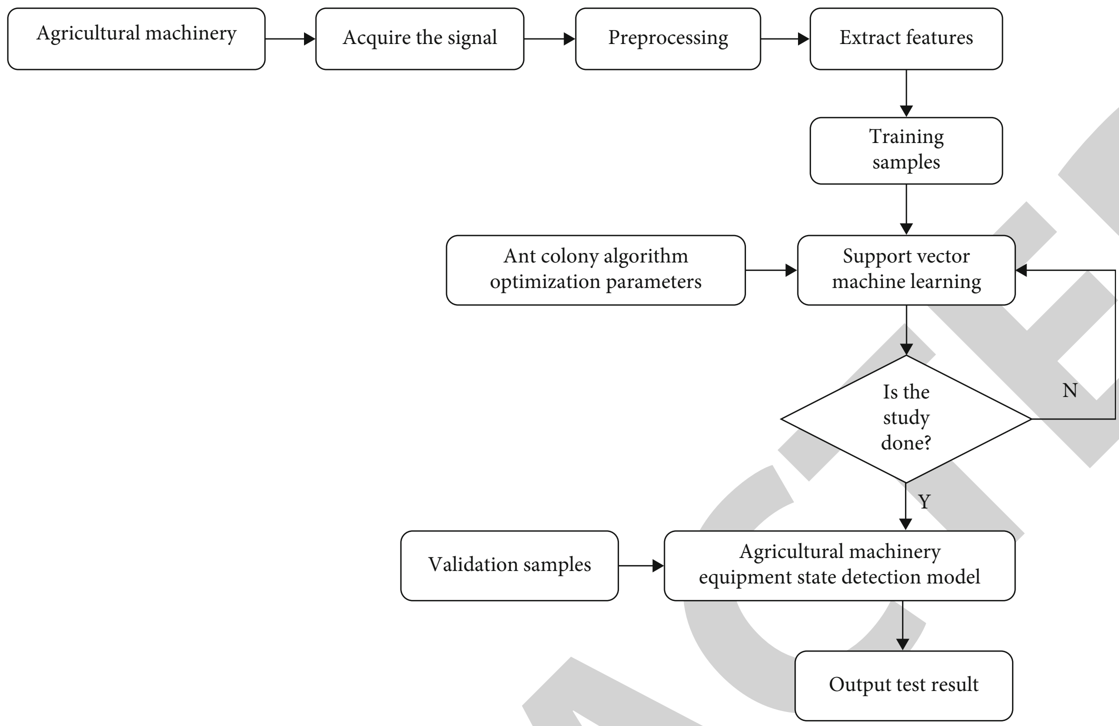

Figure 3: Intelligent detection process of agricultural machinery equipment status based on computer data mining.

Table 1: Number of status samples of various agricultural machineries and equipment.

Agricultural machinery equipment no.	Name of agricultural machinery	Normal sample	Abnormal sample
1	Peanut sheller	40	15
2	Small rotary cultivator	30	10
3	Rice harvester	100	40
4	Crop straw crusher	20	8
5	Soil tiller	50	20

Table 2: Value of C and Q determined by ant colony algorithm.

Agricultural machinery equipment no.	Name of agricultural machinery	C	σ
1	Peanut sheller	350.266	1.658
2	Small rotary cultivator	218.602	1.923
3	Rice harvester	272.863	1.817
4	Crop straw crusher	665.457	1.584
5	Soil tiller	630.898	1.393

3.2.3. Condition Detection Model of Agricultural Machinery Equipment. The working steps of the intelligent detection method of agricultural machinery equipment status based on computer data mining are as follows:

(1) Wireless sensor is used to collect vibration signals of agricultural machinery equipment, extract effective vibration signals of agricultural machinery equipment, and remove some invalid signals

(2) Wavelet packet is used to process and analyze the vibration signal of agricultural machinery equipment, calculate the energy value of different subfrequency signals, and then calculate the proportion of subfrequency signal energy in the total energy, and get the characteristic vector of agricultural machinery equipment detection

(3) The feature vector of agricultural machinery equipment detection is used as the input, and the status of agricultural machinery equipment is used as the output to establish the sample set of agricultural machinery equipment detection

(4) A certain number of samples are randomly selected from the sample set to form the training, and the unselected samples are used as the verification set. Generally, the number of training samples is much more than the verification samples

(5) Ant colony algorithm and support vector machine learn the training set of agricultural machinery equipment detection, determine the values of C and Q, and establish the agricultural machinery equipment detection model

(6) Using the validation samples to calculate the detection accuracy and false detection rate of the detection model of agricultural machinery equipment and

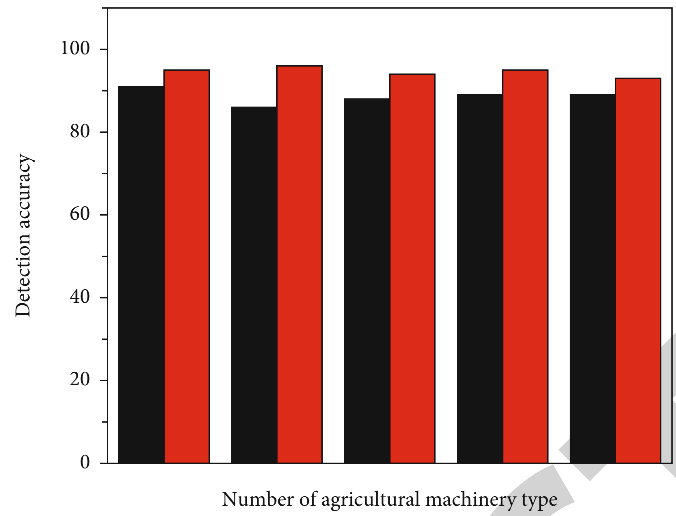

Figure 4: Accuracy of intelligent detection of agricultural machinery equipment status.

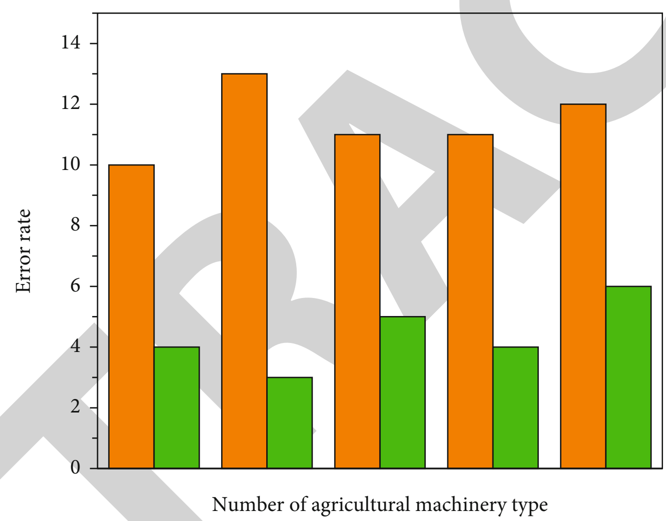

Figure 5: Error detection rate of agricultural machinery equipment status.

analyze the detection effect of agricultural machinery equipment

The intelligent detection process of agricultural machinery equipment status based on computer data mining is shown in Figure 3.

4. Result Analysis

4.1. Simulation Platform. In order to test the effectiveness of the intelligent detection method of agricultural machinery equipment status based on computer data mining, the selected simulation platforms are as follows: Intel Core i3-6100 CPU, Zhiqi Ripjaws4 DDR4 8G RAM, Intel 600P 256 GB SSD, Win 10 operating system. The intelligent detection model of agricultural machinery equipment status is realized by Java programming. The selected objects are peanut sheller, small rotary cultivator, rice harvester, crop straw crusher, and soil cultivator. The sample numbers of normal and abnormal status are shown in Table 1.

4.2. Result Analysis and Discussion. Select the intelligent detection method of agricultural machinery equipment status based on expert system for comparative test and use ant colony algorithm to determine the values of C and Q, as shown in Table 2.

The detection accuracy and false detection rate of the intelligent detection method of agricultural machinery equipment status based on expert system and computer data mining are shown in Figures 4 and 5. According to Figures 4 and 5,

(1) The state change of agricultural machinery equipment is random, and the knowledge base rules of expert system are limited, which cannot completely describe the state change law of agricultural machinery equipment. The detection accuracy is low, and the detection effect is not ideal

(2) The effect of the state detection method of agricultural machinery equipment based on computer data

Table 3: Detection time of agricultural machinery condition.

Agricultural machinery equipment no.	Name of agricultural machinery	Expert system	Paper method
1	Peanut sheller	5.851	2.192
2	Small rotary cultivator	5.192	2.726
3	Rice harvester	5.139	2.368
4	Crop straw crusher	5.765	2.525
5	Soil tiller	5.095	2.956

mining has been significantly improved, the detection accuracy is high, and the probability of detection errors is greatly reduced, which shows that the computer data mining technology can describe the randomness of the state changes of agricultural machinery equipment, and the detection results are more reliable

Finally, the state detection time of agricultural machinery equipment is counted, and the results are shown in Table 3. It can be seen from Table 3 that the state detection time of agricultural machinery equipment based on expert system is long, and the intelligent state detection time of agricultural machinery equipment based on computer data mining is short. This shows that the intelligent state detection of agricultural machinery equipment based on computer data mining is fast and meets the real-time condition of intelligent state detection of modern agricultural machinery equipment.

5. Conclusion

According to the variability of agricultural machinery equipment status, aiming at the defects of current agricultural machinery equipment status detection, a method of agricultural machinery equipment status detection based on computer data mining is designed, and the support vector machine and ant colony algorithm in computer data mining are introduced to model the agricultural machinery equipment status detection. The comparative experimental results show that this method is obviously superior to the traditional agricultural machinery equipment state detection methods in terms of the accuracy of agricultural machinery equipment state detection or the efficiency of agricultural machinery equipment state detection. This method can effectively describe the state change law of agricultural machinery equipment. It is a reliable and fast state detection method of agricultural machinery equipment.

Data Availability

The data used to support the findings of this study are available from the corresponding author upon request.

Conflicts of Interest

The authors declare that they have no conflicts of interest.

Acknowledgments

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Retraction

Retracted: Electronic Communication Fault Signal Recognition Based on Data Mining Algorithm

Wireless Communications and Mobile Computing

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This article has been retracted by Hindawi following an investigation undertaken by the publisher [1]. This investigation has uncovered evidence of one or more of the following indicators of systematic manipulation of the publication process:

(1) Discrepancies in scope
(2) Discrepancies in the description of the research reported
(3) Discrepancies between the availability of data and the research described
(4) Inappropriate citations
(5) Incoherent, meaningless and/or irrelevant content included in the article
(6) Peer-review manipulation

The presence of these indicators undermines our confidence in the integrity of the article's content and we cannot, therefore, vouch for its reliability. Please note that this notice is intended solely to alert readers that the content of this article is unreliable. We have not investigated whether authors were aware of or involved in the systematic manipulation of the publication process.

Wiley and Hindawi regrets that the usual quality checks did not identify these issues before publication and have since put additional measures in place to safeguard research integrity.

We wish to credit our own Research Integrity and Research Publishing teams and anonymous and named external researchers and research integrity experts for contributing to this investigation.

The corresponding author, as the representative of all authors, has been given the opportunity to register their agreement or disagreement to this retraction. We have kept a record of any response received.

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[1] J. Luo, "Electronic Communication Fault Signal Recognition Based on Data Mining Algorithm," *Wireless Communications and Mobile Computing*, vol. 2022, Article ID 9641328, 8 pages, 2022.

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Research Article

Electronic Communication Fault Signal Recognition Based on Data Mining Algorithm

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In order to solve the technical problem of fault signal recognition in the field of communication, this paper proposes an electronic communication fault signal recognition method based on data mining algorithm. Firstly, the K-means clustering algorithm is used to determine the cluster number k according to some attributes or class characteristics of the communication class samples, and the communication sample types are classified into a certain class so that the communication sample data in the cluster can be closely distributed and the data within a certain class range can be calculated by Euclidean distance formula. Then, this paper clusters the data. In the clustering data, BP neural network model is used to train and calculate the obtained clustering data again, which can map and deal with the complex nonlinear relationship between the fault information data of different clustering categories. The results show that the final error accuracy can be raised to about 20% by using the method in this paper. *Conclusion*. The algorithm designed in this paper can quickly predict the factors affecting the communication and find the communication fault information.

1. Introduction

Network communication plays a very important role in the rapid development of information technology. With the rapid development of information technology, the communication network is also developing rapidly with an unprecedented trend. The types of services provided by the communication network to people are constantly increasing and updating. It is playing a more and more important role in the whole human social economy, social activities, and daily life [1]. All these show that the communication network is no longer just a medium of mutual communication, but a distributed information processing platform that provides comprehensive services for human beings. Therefore, only scientific and effective management of communication network can ensure the accurate and uninterrupted operation of important communication services. Among them, the fault management of communication network is a very important link [2].

With the development of the Internet and high-tech industries, a large number of data are produced all the time in the manufacturing industry, service industry, and all aspects of human life. How to extract the essence from the massive historical data and obtain valuable knowledge and laws for human society and scientific and technological progress is one of the issues favored by many scholars [3]. Datamining technology is a deep-seated data analysis method. Using data mining technology, we can obtain potentially valuable information from massive historical data and express the mined useful information in the form of rules or concepts. Applying these rules or concepts to fault diagnosis can provide support for decision-making.

Data mining is an interdisciplinary research field. The so-called data mining is the process of finding information of interest from a large number of irregular and potential data [4]. The typical application of data mining in the communication field is to analyze and discover the correlation rules of alarms based on historical alarm data and use the discovered rules to analyze and predict the possible faults of network components, thus reducing the work intensity of network management personnel and improving the work efficiency [5]. Data mining can analyze the existing alarm information (including historical alarm data and current alarm data) to obtain the association rules between alarms.

These valuable rules can be used for the location and detection of network faults and the prediction of serious faults. According to the analysis of the current alarm information, we can get the possibility of various subsequent situations, which plays a role in preventing dangerous events, so that the communication network can operate safely [6]. The advantage of data mining method is that it does not need to know the network topology relationship. When the network topology changes, it can automatically find new alarm correlation rules by analyzing the historical alarm records [7, 8]. Therefore, the alarm correlation analysis system based on data mining can quickly adjust to the dynamic communication network and solve the new problems in the communication network.

2. Literature Review

In the context of the increasing number of substations, in order to ensure the safe and stable operation of substations, higher requirements are put forward for substation duty personnel. As the most important helper of duty personnel, the importance of the monitoring background is becoming increasingly prominent. The substation monitoring background has four types of signals: telemetry, remote signaling, remote control, and remote regulation, which covers all the power equipment (primary, secondary, and automation equipment) in the substation. It can not only monitor the normal operation of the substation, but also, when the power equipment fails, the monitoring background can timely send an alarm signal to remind the personnel on duty. With the increase of the number of substations, the number of power equipment is increasing, which means that the types and number of substation monitoring background alarm signals are also increasing. If there are no new technologies and methods to improve the monitoring background, the substation duty personnel will be more and more overwhelmed [9].

Data mining technology refers to extracting interesting (nontrivial, implied, and potentially useful) information or patterns from large databases. Since the 1990s, it has been gradually studied and applied. Xie and others proposed the diagnosis function of fault information extracted from the system model by using data mining and algorithm [10]. Cui and others proposed several evaluation methods to determine the relative significance of input variables in the data mining model. Several methods are applicable to classification tasks, and the practicability and accuracy are evaluated according to the characteristics of fault diagnosis [11]. Bai and others studied the ability of using data mining to predict faults and find anomalies early [12]. Farhadi and others studied and defined the alarm information syntax model and theoretically studied the feasibility of mining correlation data from alarm data containing a lot of noise using the alarm correlation rule data mining algorithm [13]. Asami and others proposed to build a fault diagnosis platform, exchange and share diagnosis and maintenance information, and make maintenance plans according to their own experience and site conditions [14]. Zhou and others introduced the data mining model in the relay protection fault information processing system and proposed a data mining technology based on rough set theory [15] in view of the possible distortion of information in the formation and transmission of real-time information based on diagnosis. Moayedi and others introduced data mining technology into the research of Power System SCADA alarm information noise data identification. Based on the decision tree algorithm commonly used in data mining technology classification and analysis methods, a data classifier is designed and implemented. They judge and analyze SCADA alarm information of power system, discover classification rules, and then eliminate SCADA remote signaling noise data, which is an effective attempt of data mining technology in the analysis and research of power system alarm information [16]. Li and others use association rule mining for attribute reduction, modify the threshold for interactive mining, directly extract the best combination of attribute reduction, and then use the reduction decision table formed by the best combination of attribute reduction and interactive mining of association rules to carry out diagnostic reasoning for fault information in various cases [17]. Liu and others proposed a new distribution network fault diagnosis technology based on hybrid data mining method in view of some defects of single data mining method in distribution network fault diagnosis [18].

This paper classifies the communication fault information through the clustering analysis algorithm and then quickly diagnoses the communication data fault type according to the BP neural network model, which provides a valuable technical reference for the healthy and green operation of the smart grid. At the same time, it also has good academic research significance and engineering application value.

3. Research Methods

3.1. Fault Information Analysis Framework System. In this paper, a communication fault information recognition method based on data mining algorithm is designed, which combines the clustering analysis algorithm with BP neural network to extract, process, analyze and calculate the interference information in the communication system, and obtain the fault signal. In the design of this paper, a fault information analysis architecture diagram is also proposed, as shown in Figure 1. In Figure 1, it mainly includes information collection part, information calculation part, and data information management part.

In the information acquisition part, a large number of information acquisition units are set up in the communication information system. The information acquisition unit includes a variety of sensors, such as vibration sensor, temperature sensor, humidity sensor, and magnetic field sensor. These sensors are used to collect various vibration, temperature, humidity, and other signals in the communication system. Then, users extract the features of these sensing information, input the extracted features to the computer processing system for storage, and perform data analysis, diagnosis, and display at the computer processing system. In this paper, the clustering algorithm is used to classify

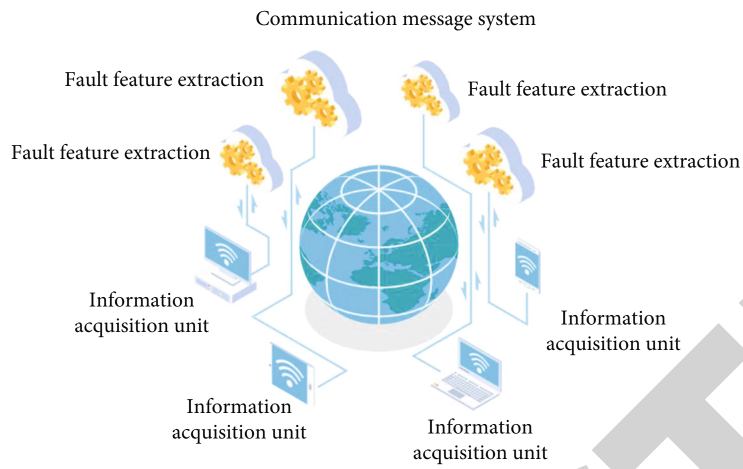

Figure 1: Schematic diagram of fault information analysis framework system.

the collected information data, classify and learn the interference factors that affect the communication, and obtain the range of fault information. Then, the BP neural network model is used to further analyze and calculate a small category of data. By mapping and processing the complex nonlinear relationship of a certain data type, the accurate estimation and detection of fault information in the communication system can be realized. The final data is monitored by the monitor, and the user is informed of the fault condition through the waveform display [19].

In the design of this system, the data processed by clustering algorithm and BP neural network model are available for user diagnosis and analysis in the general monitoring center. In the general monitoring center, the user can clearly see the processing data and clearly describe the fault signal according to the data processing. Fault data can also be transferred to the cloud through the Internet, and data storage can be realized in the cloud. The data in the general monitoring center is remotely transmitted to the remote upper management center through the industrial CAN bus or other communication protocols (TCP/IP) and the remote communication network for monitoring by the management personnel at a higher level. According to the monitoring data, the value of the lower management unit is used as the control guide.

3.2. Fault Information Analysis Algorithm. In this paper, the model of the K-means cluster algorithm and the BP neural network algorithm are combined to solve the communication failure signal as shown in Figure 2. A cluster is a set of statistical analysis methods that divides a research object into relative quality groups (clusters) that can group a collection of physical or abstract objects into many categories of similar objects. The BP network algorithm model is a multilayer transmission network prepared according to the error feedback algorithm and can learn and store a large number of input and output pattern mapping relationships. In this way, the accuracy of information fault signal evaluation is greatly improved. The following describes [20] in detail.

3.2.1. Clustering Analysis Algorithm. In the design of this paper, K-means algorithm of clustering analysis algorithm is used to cluster the fault information types, and K-means algorithm can deal with the unlabeled data. As shown in Figure 3, the main steps are as follows:

(1) Extract the sample data and select the center point of the initial cluster. That is, K fault information sample data are randomly extracted from the sample data including temperature, vibration, power grid fault, load, humidity, harmonic, magnetic field, and power grid ripple, and the sample data is taken as the center of the initial value dataset (sample cluster). In this step, the steps of data preprocessing are included. In this step, a threshold for the number of iterations can be set

(2) Divide the points of the sample cluster and divide the points of each sample data cluster into sample clusters represented by centers that are relatively close to them, i.e., points that are relatively close to the center point of the original cluster divided into one class. In this step, we enter the distance formula to obtain the following equation:

$$\mathrm{d}(x, y)^2 = \sum_{i=1}^{n} (x_i - y_i)^2 = x^{-} y_2^2, \qquad (1)$$

where x and y, respectively, represent different samples; n represents the dimension of the fault data sample; and $\mathrm{d}(x, y)$ is the Euclidean distance. Using the above formula, the distance between each fault signal sample data and these central sample parameters is calculated according to the center point of the cluster sample of each fault data, and the corresponding fault information data is redivided according to the minimum distance.

(3) The center point of each sample data point in a different sample cluster is used to represent the center point of the sample cluster. According to the difference of parameter data, the distance between the center point of each sample data and these cluster

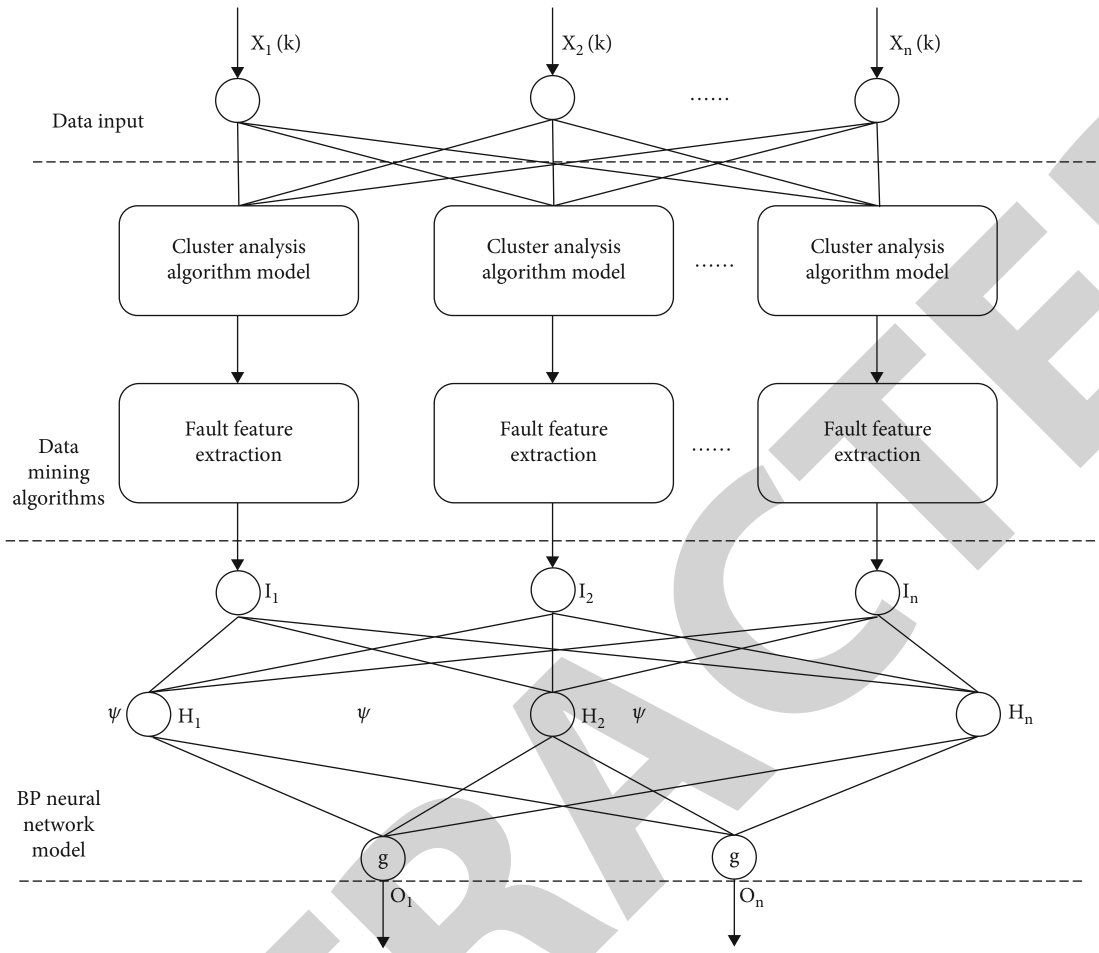

Figure 2: Schematic diagram of fault information analysis algorithm.

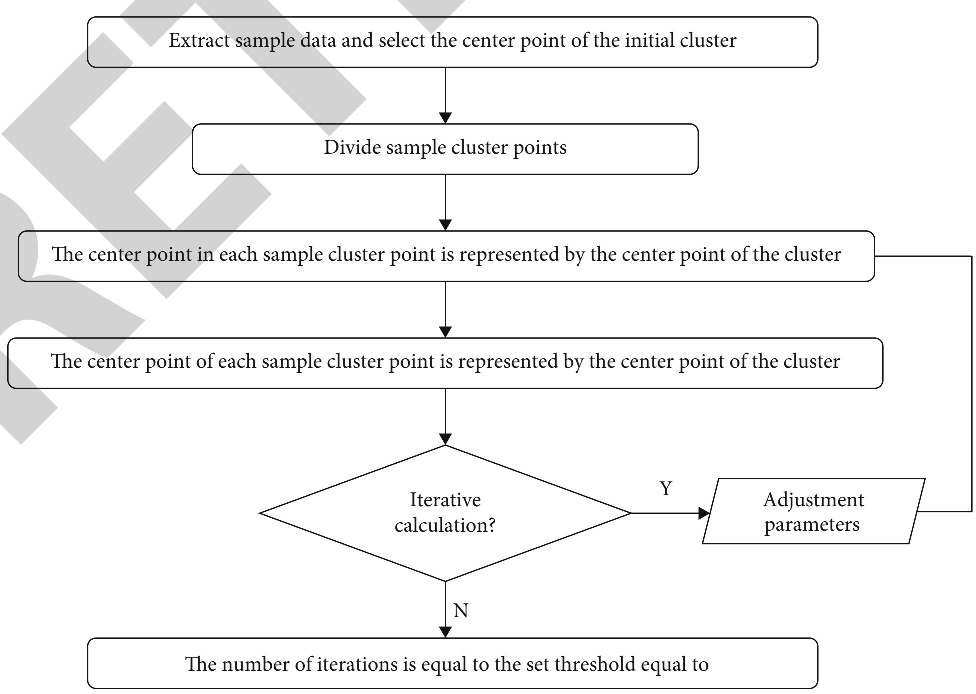

Figure 3: Clustering analysis algorithm flow.

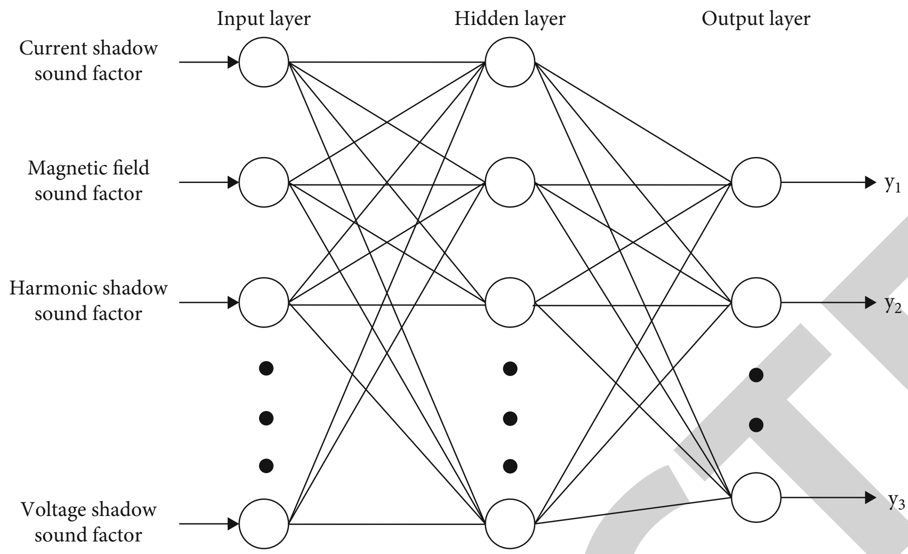

Figure 4: Algorithm model of BP neural network model.

Table 1: Calculation of test sample data.

Data type	Sample data	Test time/S	Recall rate/%	Accuracy rate/%	Model accuracy/%
Grid ripple	200	10	90.6%	92.1%	90.8%
Current	200	10	91.2%	92.5%	90.5%
Load	200	10	90.8%	92.3%	90.9%
Harmonic	200	10	91.1%	92.4%	90.6%

information data centers can be calculated again according to the center points of different cluster information sample data, and the corresponding fault information sample data can be recalculated according to the above minimum distance. Divide again. The minimum data calculated for each hour is the D matrix, followed by

$$\boldsymbol{D} = \begin{bmatrix} x_{11}, x_{12} \cdots\cdots x_{1n} \\ x_{21}, x_{22} \cdots\cdots x_{2n} \\ \cdots\cdots \\ x_{k1}, x_{k1}, x_{k2} \cdots\cdots x_{kn} \end{bmatrix}, \tag{2}$$

where X is the set of minimum values.

3.2.2. BP Neural Network Algorithm Model. Following the above processing method, the BP network algorithm model is used to map more complex nonlinear relationships in the trauma information sample in a timely manner. Because the BP network algorithm model has high learning efficiency, fast diagnosis speed, and high accuracy, it can quickly diagnose the types of communication data failures in the clustered data, making the information for dealing with communication failures more accurate.

When using the above method, first select the results obtained by the cluster analysis algorithm, and then conduct training and education. The BP neural network model (as shown in Figure 4) consists of three layers: the input layer, the latent layer, and the output layer. The input layer usually contains various types of data such as temperature, vibration, mains damage, load, humidity, harmonics, magnetic fields, and mains waves. By constantly adjusting the weight and threshold in the neural network, it gradually approaches the required level data. As a result, the output error is ultimately reduced. Follow these formulas to adjust your BP neural network model.

The formula for adjusting the output layer weight system is

$$\Delta\omega_{ki} = \eta o_k^p \left(1 - o_k^p\right)\left(t_k^p - o_k^p\right) o_i^p. \tag{3}$$

The formula for adjusting the weight coefficient of the hidden layer is

$$\Delta\omega_{ij} = \eta O_i^p \left(1 - O_i^p\right) \sum_{k=1}^{L} O_k^p \Delta O_k^p \Delta\omega_{ki} O_j^p. \tag{4}$$

The quadratic accurate function model of the input mode pair in each fault information sample is

$$J_p = \frac{1}{2} \sum_{p=1}^{N} J_P = \frac{1}{2} \sum_{K=1}^{L} \left(t_k^p - o_k^p\right). \tag{5}$$

The total accurate function expression for N fault information samples is shown in

$$J = \sum_{p=1}^{N} J_p = \frac{1}{2} \sum_{p=1}^{N} \sum_{k=1}^{L} \left(t_k^p - o_k^p\right)^2. \tag{6}$$

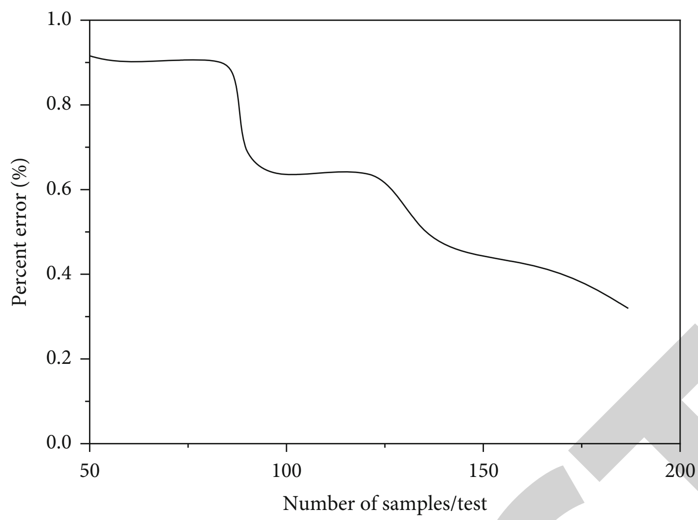

Figure 5: Calculation results of BP neural network model.

At the beginning of calculation, in order to improve the learning accuracy when extracting complex communication information, the sample data is first standardized. Assuming that the type of input communication fault information is m and the sample is x_{ij}, the standardization of input data x_{ij} is carried out according to the steps of the following formulas:

$$Z_{ij} = \frac{\left(x_{ij} - \bar{x}_j\right)}{\delta_j}, \tag{7}$$

$$\mathrm{x_j} = \frac{1}{\mathrm{N}} \sum_{\mathrm{i=1}}^{\mathrm{N}} \mathrm{x_{ij}}, \tag{8}$$

$$\delta_j^2 = \frac{1}{N-1} \sum_{i=1}^{N} \left(x_{ij} - \bar{x}_j\right)^2, \tag{9}$$

where $i = 1, 2, \cdots, N$; $j = 1, 2 \cdots, m$, in the above formula and Z_{ij} is the data after standardization. The standardized formula can be

$$y_i' = \frac{q(y_i - y_{\min} + b)}{(y_{\min} - y_{\min} + b)}, \tag{10}$$

where y_i is the output fault information sample; y_i' is the standardized fault information sample data, and $y_{\max}, y_{\min}$ are the maximum and minimum values in the output fault data samples. Of which $0 < q < 2$; $0 < b < 2$, then the number of hidden layer nodes is determined to be between 7 and 9, the value from input layer to hidden layer is between 0.2 and 0.6, and the value from hidden layer to output layer can be between 0.2 and 0.3. According to the above formula, a neural network model can be established.

4. Result Analysis

When simulating the clustering analysis algorithm, the hardware environment is selected: the Pentium (R) CPU is 256 memory, the hard disk capacity is 80 g, the software environment is Windows XP operating system, JDK1.5, and the BP neural network model is simulated based on MATLAB. Four kinds of grid fault information (grid ripple, current, load, and harmonic) are selected as the test. When verifying the correctness of clustering, F-measure is selected as the evaluation standard to evaluate the accuracy of clustering classification algorithm by using the accuracy and recall in information retrieval. The calculation formula is: as follows

Accuracy calculation formula:

$$\mathrm{recall}(i, j) = \frac{n_{ij}}{n_j}, \tag{11}$$

Recall rate calculation formula:

$$\mathrm{recall}(i, j) = \frac{n_{ij}}{n_i}, \tag{12}$$

$$F(i, j) = \frac{2 * \mathrm{recall}(i, j) \times \mathrm{presision}(i, j)}{\mathrm{recall}(i, j) + \mathrm{presision}(i, j)}, \tag{13}$$

The final value of F:

$$F1 \sum_{n}^{n_i} \max \{F(i, j)\}, \tag{14}$$

The calculation table of test sample data is shown in Table 1.

Then, start the BP neural network model in the MATLAB interface, and select according to the sample type, and the error data curve calculated by the BP neural network model is shown in Figure 5.

Through the above experiments, this paper uses the clustering classification algorithm to classify various data that affect the communication information types, such as temperature, vibration, power grid fault, load, humidity, harmonic, magnetic field, and power grid ripple, according to different categories, and then adjusts the weights and thresholds in the neural network to gradually approach the required results, so as to minimize the output error. Using the method in this paper, the final error accuracy is raised to about 20%. Therefore, the algorithm designed in this paper can quickly predict the factors affecting the communication and find the communication fault information.

5. Conclusion

This paper classifies the communication fault information (temperature, vibration, power grid fault, load, humidity, harmonic, magnetic field, power grid ripple, etc.) through the clustering analysis algorithm, which is conducive to increasing the recognition degree of different communication numbers. Then, according to the BP neural network model, it further quickly diagnoses the fault type of communication data, making it more accurate to process the communication fault information. In the whole calculation process, the calculation speed is increased. The accuracy of the user training data from the clustered communication fault data is helpful for the user to quickly diagnose the fault data types in the communication system, enable the user to quickly find and solve problems, and provide valuable technical reference for the healthy and green operation of the smart grid. At the same time, it also has good academic research significance and engineering application value.

Data Availability

The data used to support the findings of this study are available from the corresponding author upon request.

Conflicts of Interest

The authors declare that they have no conflicts of interest.

Acknowledgments

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Retraction

Retracted: Research on Optimization Strategy of Task Scheduling Software Based on Genetic Algorithm in Cloud Computing Environment

Wireless Communications and Mobile Computing

Received 18 July 2023; Accepted 18 July 2023; Published 19 July 2023

This article has been retracted by Hindawi following an investigation undertaken by the publisher [1]. This investigation has uncovered evidence of one or more of the following indicators of systematic manipulation of the publication process:

(1) Discrepancies in scope
(2) Discrepancies in the description of the research reported
(3) Discrepancies between the availability of data and the research described
(4) Inappropriate citations
(5) Incoherent, meaningless and/or irrelevant content included in the article
(6) Peer-review manipulation

The presence of these indicators undermines our confidence in the integrity of the article's content and we cannot, therefore, vouch for its reliability. Please note that this notice is intended solely to alert readers that the content of this article is unreliable. We have not investigated whether authors were aware of or involved in the systematic manipulation of the publication process.

Wiley and Hindawi regrets that the usual quality checks did not identify these issues before publication and have since put additional measures in place to safeguard research integrity.

We wish to credit our own Research Integrity and Research Publishing teams and anonymous and named external researchers and research integrity experts for contributing to this investigation.

The corresponding author, as the representative of all authors, has been given the opportunity to register their agreement or disagreement to this retraction. We have kept a record of any response received.

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[1] Z. Yu, "Research on Optimization Strategy of Task Scheduling Software Based on Genetic Algorithm in Cloud Computing Environment," *Wireless Communications and Mobile Computing*, vol. 2022, Article ID 3382273, 9 pages, 2022.

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Research Article

Research on Optimization Strategy of Task Scheduling Software Based on Genetic Algorithm in Cloud Computing Environment

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In order to improve the task scheduling strategy, a method based on genetic algorithm in cloud computing environment was proposed. First, the independent task scheduling algorithm and associated task scheduling algorithm commonly used in cloud computing are studied and compared, respectively, and their application characteristics, advantages, and disadvantages are analyzed in detail. Second, an independent task scheduling strategy based on multipopulation genetic algorithm is proposed for independent task scheduling in cloud environment, considering the scheduling time, scheduling cost, and system resource utilization of task set. The implementation steps of the algorithm are given in detail. Finally, the simulation experiment is carried out on Cloud Sim platform. The experimental results show that computing resource M is 10, subtask N is 2000, population size S is 80, and ETC matrix and RCU array are randomly generated by the system. As the number of iterations increases, the scheduling scheme formed by MCGA and CGA is more obvious and close to the subtask execution cost optimization. Finally, the optimized scheme is basically formed. However, the scheduling scheme formed by TGA has no obvious optimization effect on the subtask execution cost. It is proved that the algorithm proposed in this paper can effectively optimize the task scheduling efficiency and improve the utilization of cloud computing resources at the same time, providing a feasible idea and method for task scheduling in the cloud computing environment.

1. Introduction

Since the beginning of the 21st century, the network technology has undergone tremendous changes, and the development of information and service industry has become increasingly mature. The Internet age was born as people grew dissatisfied with the weak processing power of mainframe computing and personal computers and wanted to connect as many computers as possible. Under the computing model of the internet, the application programs are deployed centrally, and the operation management of the system is simplified [1]. More importantly, a variety of pure services and software as a service (SAAS) are beginning to emerge and gain acceptance. It was the emergence of software as a service that unveiled the mystery of cloud computing [2]. Virtualization technology is playing an increasingly important role in cloud computing applications. It can integrate network devices, storage servers, computer clusters, and a large number of applications in different locations and regions into a collaborative resource pool. This mature application facilitates users to provide efficient performance, simple mode, easy to expand, stable, and reliable computing and storage services. For the user of cloud computing system, he does not need to know where the resources he uses come from but only needs a simple link and a client-side way to buy the cloud computing resources or cloud computing service information he wants according to his own needs [3]. Users use this information based on the amount of use, according to the need to pay (Figure 1).

2. Literature Review

Cloud computing has a lot in common with grid computing. Many scholars have tried to explore the feasibility of resource scheduling in cloud environment by using resource scheduling algorithms in grid environment [4]. For resource

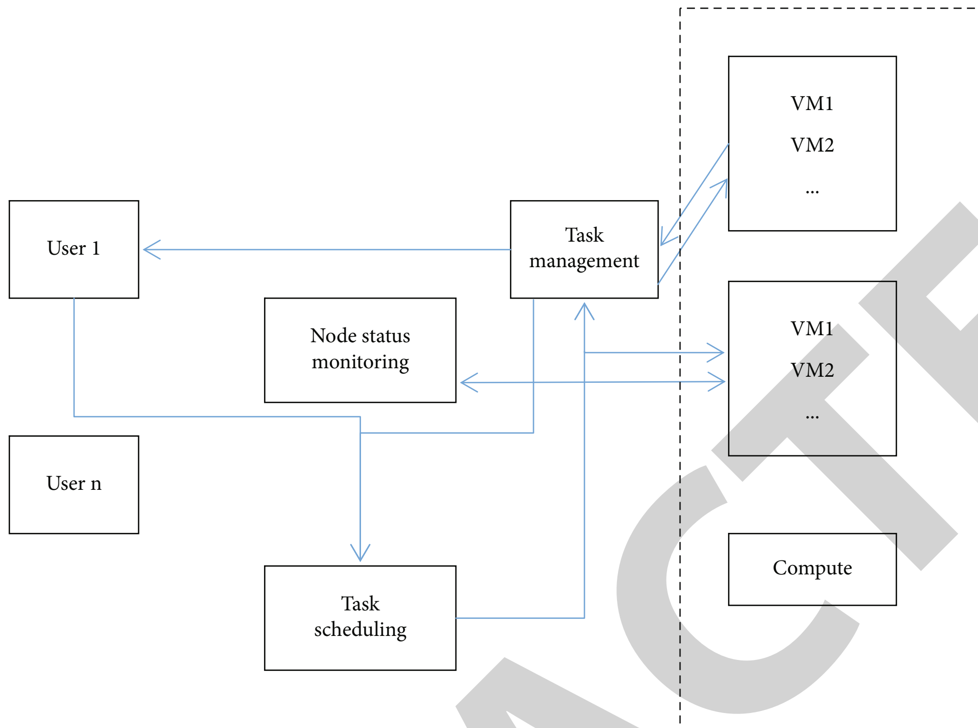

Figure 1: Cloud computing task scheduling model.

scheduling in distributed environment such as grid, many scholars at home and abroad have done a lot of research and proposed a lot of resource scheduling strategies and algorithms. The essence of resource scheduling is to allocate tasks to appropriate resources so that the task completion time is as little as possible, and the resource utilization is as high as possible on the premise of meeting the QoS requirements of users [5]. The min-min algorithm calculates the minimum completion time of each task and then selects the resource with the minimum time from all the resources with the minimum completion time to match it with the task. After the max-min algorithm obtains the minimum completion time of each task, the resource with the largest minimum completion time is selected from the resources, and then the task is matched with computing resources [5]. Sreenu and Sreelatha introduced a grid computing task scheduling algorithm based on genetic algorithm, whose purpose is to improve resource utilization and throughput as much as possible [6, 7]. Elaziz et al.'s cloud computing scheduling strategy is proposed based on MPSO algorithm, in view of the cloud computing service cluster resource scheduling and load balancing optimization problem, the dynamic variation particle group collaboration and reverse flight thought are introduced into the particle swarm optimization algorithm, so as to control the global search and local search, try to avoid falling into local optimum (Figure 2) [8]. Huang et al., in view of the shortcomings of genetic algorithm, proposed an improved algorithm to optimize scheduling and considered using the genetic algorithm with double fitness function to find the nodes where the average time and total time of task scheduling were smaller [9]. Based on this, this paper proposes a method based on genetic algorithm in cloud computing environment. First, independent task scheduling algorithms and associated task scheduling algorithms commonly used in cloud computing are studied and compared, respectively. Second, an independent task scheduling strategy based on multipopulation genetic algorithm is proposed for independent task scheduling in cloud environment, considering the scheduling time, scheduling cost, and system resource utilization of task set. It is proved that the algorithm proposed in this paper can effectively optimize the task scheduling efficiency and improve the utilization of cloud computing resources at the same time, providing a feasible idea and method for task scheduling in the cloud computing environment.

3. Cloud Computing Task Scheduling

3.1. Description of Task Scheduling Problems in Cloud Computing Environment. Currently, most cloud computing environments adopt the Map/Reduce programming model proposed by Google. This programming pattern is divided into two stages: Map (mapping) and Reduce (reduction) [10]. Through these two stages, a large task in the task set is decomposed into several smaller tasks, which are then assigned to several virtual resource nodes such as for execution, and finally, the running results are returned. How to dispatch the decomposed tasks reasonably without changing the service level agreement (SLA), on the one hand, these tasks can meet the basic QoS requirements of users, including resource utilization rate, quality of service, completion time, economic benefit, and other indicators; on the other hand, the time span of task execution should be shortened

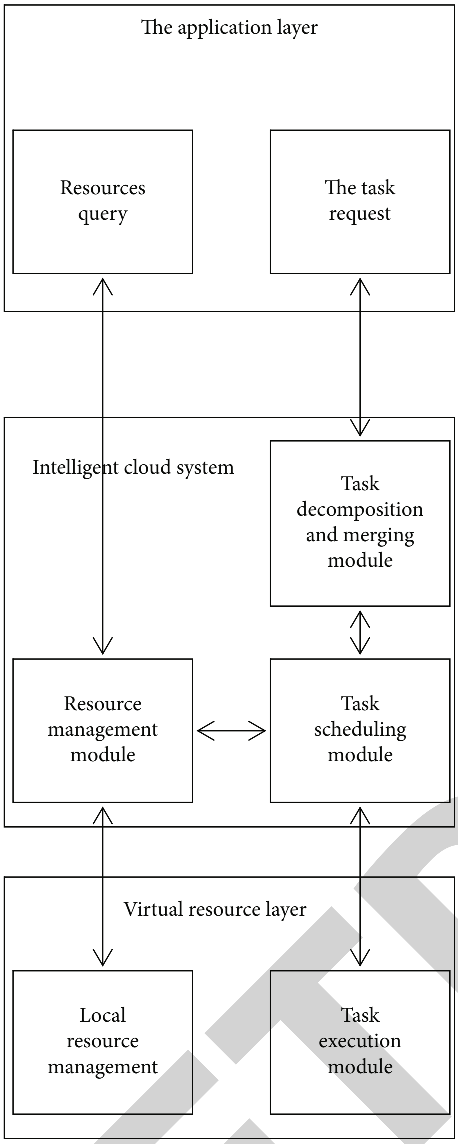

Figure 2: Cloud computing scheduling framework based on MPSO algorithm.

accordingly [11]. Finally, it is critical to increase the resource utilization of cloud computing platform as much as possible.

To clarify the scheduling problem in the cloud computing environment, the task scheduling problem in the cloud computing environment can be described as follows: in the cloud computing environment, n independent subtasks are assigned to M VM nodes for execution [12]. Where task set $T = \{\text{subtask}_1, \text{subtask}_2, \text{subtask}_3, \cdots, \text{subtask}_n\}$ and VM resource node $\text{VM} = \{vm_1, vm_2, \cdots, vm_m\}$, $\text{subtask}_j (j = 1, 2, \cdots, n)$ represent the JTH task, and $\text{VM}_i (i = 1, 2, \cdots, m)$ represent the ith VM resource. The allocation relationship between task set T and virtual resource nodes can be expressed by sparse matrix δ:

$$\delta = \begin{bmatrix} \text{subtusk}(1, 2, \cdots, n) \\ \text{VM}(1, 2, \cdots, m) \end{bmatrix}. \quad (1)$$

Cloud computing uses virtualization technology to virtualize VMS of different types and performance from nodes and schedule VM resources to perform user tasks. This step is transparent to the user, who feels like he or she is monopolizing a machine [13].

The total working time of VM p_i is the sum of the time required by VM p_i to complete all tasks assigned to VM p_i, denoted as $\text{sumTime}[p_i]$, and v_x refers to p_i task assigned to VM p_i. For the task request set submitted by users, multiple VMS in the data center process the task set in parallel. Therefore, M VMS is parallel on the time axis. The totalTime spent on processing the task set is the maximum working time of all VMS, denoted as totalTime.

$$\text{sumTime}(p_i) = \sum_{v_x \in V} \text{ETC}(i, x), \quad (2)$$

$$\text{totalTime} = \max_{i=1}^{M} \{\text{sumTime}(p_i)\}. \quad (3)$$

When taking the optimal time span and cost control as the optimization objective, task scheduling needs to reasonably configure the task set in view of the fact that tasks are independent from each other, and at the same time ensure a low task completion time and execution cost [14].

3.2. Cloud Computing Task Scheduling Optimization. The urgent need for data processing power and the booming development of the Internet directly gave birth to cloud computing. As a business computing model, cloud computing provides computing power and other services to users as commodities through the Internet, so that users can obtain computing power, storage, and bandwidth on demand, and then pay according to the set pricing model [15]. In the cloud computing environment, a large number of heterogeneous resources are centralized to form a virtual resource set. This resource aggregation method eliminates the differences between software and hardware of heterogeneous servers by virtue of virtualization technology and virtualizes computing resources into virtual resource pools that can be arbitrarily combined and allocated according to user requirements. The size of the pool can be dynamically expanded according to the changes of applications and user scale [16]. In addition, the resource pool can obtain certain autonomy through software, enabling it to self-maintain and manage virtual computing resources without human participation. These resource pools are also called "clouds" because of their large scale, no specific form, and flexible dynamic expansion. This management mode of cloud computing greatly improves the utilization of resources and reduces the cost of cloud data center operation and management, thus attracting wide attention [17].

The task scheduling problem in cloud computing environment is a problem. Based on the particularity of cloud environment, this chapter designs a scheduling system framework in cloud computing environment. The overall architecture of task scheduling in the cloud computing environment consists of users, datacenters, and cloud information

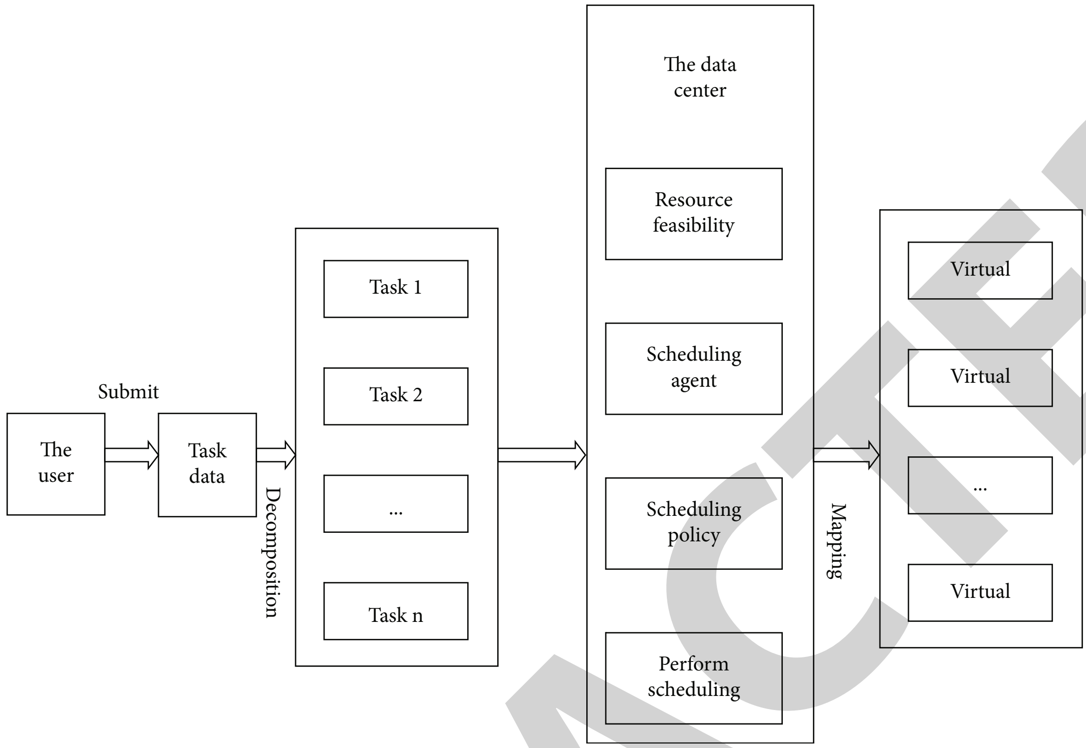

Figure 3: Overall frame diagram of task scheduling in cloud computing environment.

services. The overall framework of task scheduling in the cloud computing environment is shown in Figure 3.

According to the above scheduling framework diagram, some terms in the scheduling framework are explained below:

(1) *Users*. As the name suggests, it refers to people who use cloud services

(2) *Task Set*. A collection of all tasks submitted by the user

(3) *Task Queue*. Is a critical step to complete a specific operation that controls the behavior of a task at run time [18]

The time span of scheduling is the most intuitive criterion to measure the performance of scheduling algorithm and is the primary function to be considered when designing and implementing scheduling algorithm. On the basis of ensuring a reasonable scheduling length, the scheduling cost of the task set can be appropriately controlled to improve the economics of task scheduling [19]. Considering the actual application requirements, this paper tries to comprehensively consider the optimal scheduling length and cost control of the task set by means of weighting and takes the load of virtual machines as the evaluation and screening basis of the scheduling scheme, so as to ensure the load balance of the system to a certain extent. As it overlapped with the selected optimization objective and the requirements were slightly complex, this paper did not consider the QoS optimization objective [20, 21].

3.3. Algorithm Implementation. Darwin's theory of biological evolution is the ideological source of genetic algorithm, and the principle of the algorithm is to follow the "survival of the fittest" and "superior slightly out." Genetic algorithm is a simulation of an artificial population evolution process, and through the selection, hybridization, and variation mechanisms, the population after several generations always reaches the optimal (or nearly optimal) state [22]. The overall flow of the algorithm is shown in Figure 4.

As can be seen from Figure 1, the algorithm can be roughly divided into encoding and decoding, calculation of fitness value, selection, crossover, mutation, and other major steps. The following is a detailed description of each step.

(1) Encoding and decoding

The encoding problem is the first problem to be solved by the heritage algorithm. Usually, real coding and binary coding are used in two ways, each of which has its own advantages. The advantages of binary coding are high stability, large population diversity, but the storage space is large, and decoding process is difficult to understand. The real code is easy to understand and there is no decoding process, using real numbers to represent the gene is more convenient and concise [23]. In this paper, real-number coding is adopted for chromosome coding. The number of subtasks is the length of the chromosome, and the number of computing resources occupied by subtasks is represented by the value of each gene in the chromosome, as shown in Figure 2.

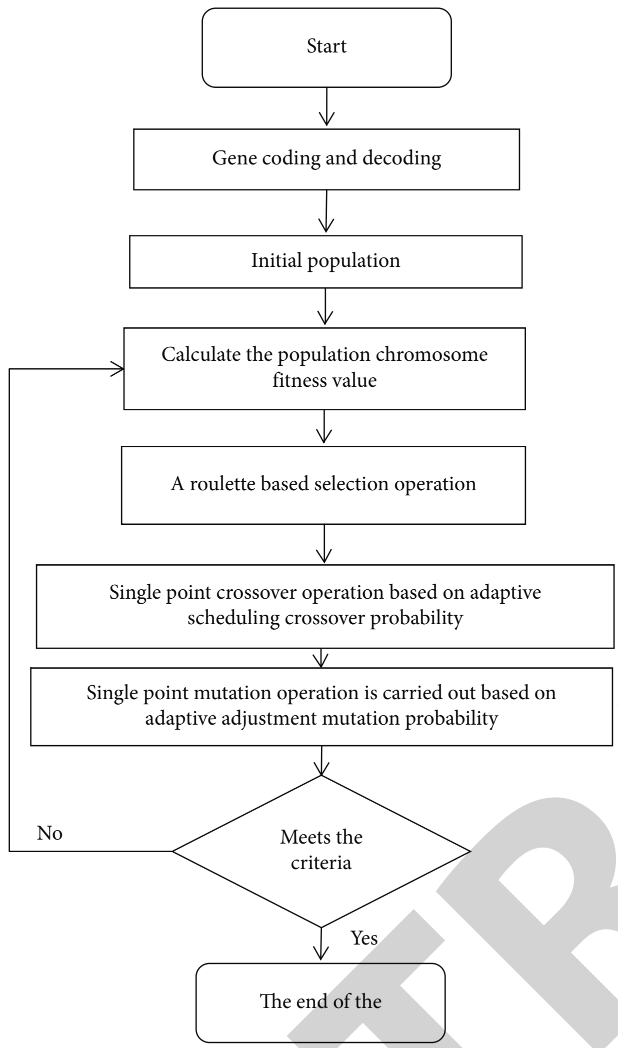

Figure 4: Flowchart of genetic algorithm.

Resources	R_1	R_2	R_3	...	R_M
	↑	↑	↑	↑	↑
	T_1	T_2	T_3	···	T_i
Task	T_{i+1}	T_{i+2}	T_{i+3}	···	T_{2i}
	...	...	...	...	...

Figure 5: Task scheduling chromosome coding.

Combined with Figure 5, it can be seen that N tasks are scheduled to M computing resources, and the number of these N tasks is $T_1, T_2, \cdots, T_i, \cdots T_N$;. M computing resources are numbered $R_1, R_2, \cdots, R_M$. In this case, the number of tasks N is much larger than the number of resources M. An example is given in Figure 5. The chromosome length is the number of tasks N, and these N tasks correspond to different computing resources. Then, the chromosome decoding is shown in the dotted box in Figure 5.

$$\begin{aligned} R &: (T_1, T_{i+1}, \cdots), \\ R_2 &: (T_2, T_{i+2}, \cdots), \\ R_3 &: (T_3, T_{i+3}, \cdots). \end{aligned} \tag{4}$$

Through the decoded sequence of chromosome, ETC(i , j) matrix, and RCU(j) sequence, the time and cost required for each computing resource to perform all subtasks on the resource (M) can be calculated:

$$\text{Time}_M = \sum_{i=1}^{\text{Total}} \text{ETC}(i, M), \tag{5}$$

$$\text{Cost}_M = \text{RCU}(M) \times \text{Time}_M. \tag{6}$$

Then, the total time function and total cost function of the resource scheduling scheme formed by this chromosome coding to complete all tasks are

$$\text{Time}_{\text{total}} = \max_{j=1}^{M} \sum_{i=1}^{\text{Total}} \text{ETC}(i, M), \tag{7}$$

$$\text{Cost}_{\text{total}} = \sum_{j=1}^{M} \text{RCU}(M) \times \text{Time}_M. \tag{8}$$

(2) Selection of fitness function

Traditional genetic algorithm takes a single target for the design of fitness function, such as most of the function optimization problem can be seen as the maximum or minimum value of form, but in the cloud resource environment resource scheduling problem, the cloud resource providers and users pay attention to the content of the different, and the selection of fitness function is different. In this paper, multiobjective optimization-oriented cloud resource scheduling is studied [24]. Four objectives, namely, completion time, cost, CPU utilization, and memory utilization, are selected to quantify the satisfaction degree of resource scheduling. In resource allocation and scheduling, consider the overall load of resource clusters. Resource cluster K contains M computing resources. The cluster load includes CPU load, memory load, and network load.

Set the CPU load of resource cluster K at time T to $ldcpu_{kt}$. The calculation formula is as follows:

$$ldcpu_{kt} = \frac{1}{N} \sum_{j=1}^{N} \frac{\sum_{i=1}^{n} cpuused_{kitm}}{\sum_{i=1}^{n} cpu_{ki}}. \tag{9}$$

Let the memory load of application cluster K at time T

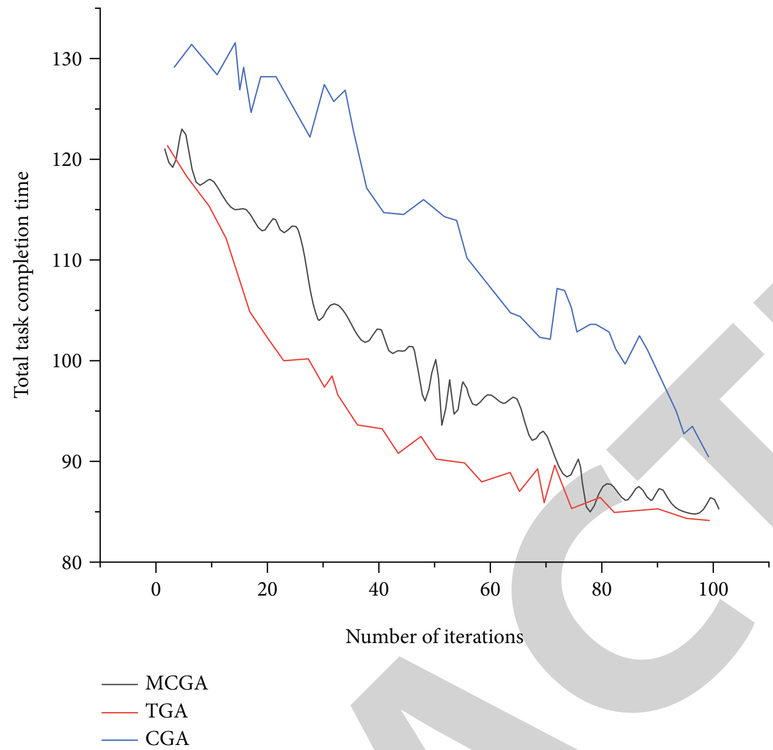

Figure 6: Comparison of total task completion time.

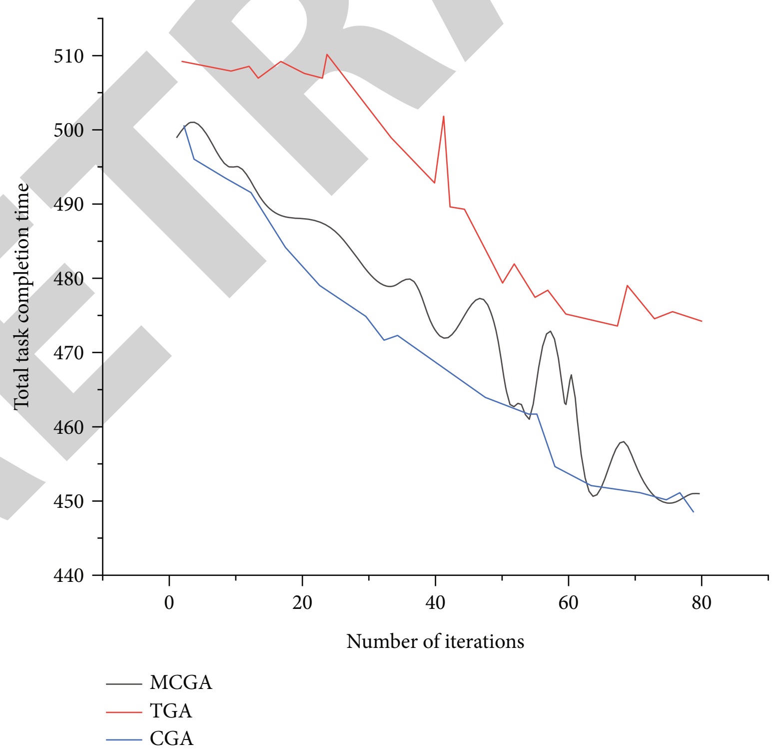

Figure 7: Comparison of total task completion costs.

be $ldmem_{kt}$, and the calculation formula is as follows:

$$ldmem_{kt} = \frac{1}{N}\sum_{j=1}^{N}\frac{\sum_{i=1}^{n} memused_{kitm}}{\sum_{i=1}^{n} mem_{ki}}. \tag{10}$$

Let the network load of application cluster K at time T be $ldnet_{kt}$:

$$ldnet_{kt} = \frac{1}{N}\sum_{j=1}^{N}\frac{\sum_{i=1}^{n} netused_{kitm}}{\sum_{i=1}^{n} net_{ki}}, \tag{11}$$

where N indicates the number of times that monitoring data is collected within Δt time. cpu_{ki}, mem_{ki}, net_{ki} indicate the CPU, memory, and network capacity of the I the computing resource of cluster K. $cpuused_{kitm}$, $memused_{kitm}$, $netused_{kitm}$ indicate the CPU usage, memory usage, and network usage of the I the computing resource in cluster K at the time of TM monitoring [25]. Because we can conclude that the lower the total running time and total cost of all tasks is, the better, and the cluster CPU, memory, and bandwidth utilization are best maximized. Therefore, we give the fitness function of resource scheduling as follows:

$$f = -\omega_1 \text{Time}_{\text{total}} - \omega_2 \text{Cost}_{\text{total}} + \omega_3 ldcpu + \omega_4 ldmem + \omega_5 ldnet. \tag{12}$$

In the formula, $\text{Time}_{\text{total}}$ represents the total running time of the task, $\text{Cost}_{\text{total}}$ represents the total running cost of the task, *ldcpu* represents the CPU utilization, *ldmem* represents the memory utilization, and *ldnet* represents the bandwidth utilization. $\omega_1, \omega_2, \omega_3, \omega_4, \omega_5$ represent the weight coefficient, and $0 \le \omega_i \le 1, \sum_{i=1}^{5} \omega_i = 1$.

(3) Cross operations

In order to ensure and enhance the global search ability of genetic algorithm, it is necessary to conduct crossover operation between two individuals in the population, that is, exchange the gene positions and values of two individuals. Set the crossover probability as corss_rate, and adopt formulas (10) and (11) for adaptive adjustment of the crossover probability.

$$\text{corss\_rate} = \frac{k_1\left(f_{\max} - f'\right)}{\left(f_{\max} - \bar{f}\right)}, f' \ge \bar{f}, \tag{13}$$

$$\text{corss\_rate} = k_2, f' \ge \bar{f}. \tag{14}$$

In the equation, corss_rate represents the crossover probability, $f_{\max}$ represents the maximum fitness value of the population, f' represents the larger fitness value of the two individuals to be crossed, and $\bar{f}$ represents the average fitness value of the generation population. k_1, k_2 are the coefficient between 0 and 1. When the fitness function value is large, the crossover probability should be small, which can not only prevent individuals with large fitness from being destroyed but also speed up population convergence. However, when the fitness function value is small, the crossover probability should be higher, so that new individuals can be recombined. Therefore, $k_1 = 0.32$, $k_2 = 0.75$ is set in this paper. At the same time, this paper adopts the way of two-point crossover to carry on the chromosome body crossover operation, and the intersection point is randomly selected.

(4) Mutation operation

Mutation operation is carried out on a single individual, which can improve the local search ability of genetic algorithm, maintain the diversity of population, and prevent the phenomenon of early maturity. Let the mutation probability mutate_rate, which is adaptive adjusted by the following formula.

$$\text{mutate\_rate} = \frac{k_3\left(f_{\max} - f'\right)}{\left(f_{\max} - \bar{f}\right)}, f' \ge \bar{f}, \tag{15}$$

$$\text{mutate\_rate} = k_4, f' \ge \bar{f}. \tag{16}$$

In the formula, mutate_rate represents the mutation probability, $f_{\max}$ represents the maximum fitness value of the population, f represents the fitness value of the individual to be changed, and $\bar{f}$ represents the average fitness value of the generation population. k_3, k_4 are the coefficient between 0 and 1, and the probability of variation is generally between 0.0001 and 0.1. Therefore, $k_3 = 0.08, k_4 = 0.05$ are set in this paper.

(5) Convergence conditions

The standard deviation of the fitness function value of the optimal span is adopted to judge the termination condition, as shown in formula (15):

$$\sqrt{\frac{\sum_{i=1}^{S}\left(f(i) - \bar{f}\right)^2}{S}} < \xi ; \xi \in (0, 1), \tag{17}$$

where S represents the population size, $f(i)$ represents the fitness value of the ith individual of the population of this generation, $\bar{f}$ represents the average fitness value of the population of this generation, and ξ represents the convergence threshold. In this paper, $\xi = 0.1$ is taken to mean that the algorithm iteration is terminated when the standard deviation is less than 0.1, and the genetic evolution of the population continues if this condition is not met.

4. Experimental Results and Analysis

The cloud computing simulation tool Cloud Sim was used for the experimental simulation. Under the same environment and conditions, the TGA (time constraints GA) and CGA (cost constraints GA) algorithms of MCGA proposed in this paper were compared and tested.

If the fitness value of the optimal individual in the elite population can keep a certain algebraic unchanged, the algorithm can be considered as converging. At this point, the iteration terminates, and the corresponding optimal solution is output. In addition, to avoid excessive search, an upper limit is usually set on the evolutionary algebra of the algorithm, and when the iteration reaches this upper limit, the algorithm is forced to terminate. In the experiment in this section, the maximum evolution algebra of the algorithm is set as 150 generations, and the minimum preservation algebra of the optimal individual is set as 10 generations.

The initial conditions of the algorithm are as follows: computing resource M is 10, subtask N is 2000, population size S is 80, and ETC matrix and RCU array are randomly generated by the system. In this paper, the time and cost required for the execution of the total task are selected as the results for display. The experimental results are shown in Figures 6 and 7.

As can be seen from Figure 3, at the beginning, the optimal scheduling scheme obtained by running the algorithm MCGA, TGA, and CGA in this paper has little difference in the completion time required to execute subtasks. As the number of iterations increases, the optimal subtask scheduling scheme formed by MCGA and TGA is more obvious to optimize the total time required for executing subtasks, and finally, the optimal solution is basically reached. However, the scheduling scheme formed by CGA has no obvious optimization effect.

Also, it can be seen from Figure 4 that, in the early stage of algorithm iteration, the scheduling scheme formed by algorithm MCGA, TGA, and CGA in this paper has almost the same cost for performing subtasks. However, with the increase of the number of iterations, the scheduling scheme formed by MCGA and CGA is more obvious and close to the optimization of subtask execution cost, and finally, the optimal scheme is basically formed. However, the scheduling scheme formed by TGA has no obvious optimization effect on the execution cost of subtasks. Through comparison, it can be seen that the improved genetic algorithm proposed in this paper considers time, cost, and other factors at the same time, so that the cloud resource scheduling has a good effect in terms of time and cost constraints and can meet the needs of cloud resource providers and users [26].

In this paper, the cloud computing environment is simulated by Matlab. In order to verify the effectiveness of the algorithm proposed in this paper in large-scale graph task scheduling, the comparison experiment between CETS and other algorithms is given in this section. Related parameter settings of the experiment, where represents the population number set in the multipopulation algorithm, CVz/MIC bar and M/RAD are randomly generated by the system. If the fitness value of the optimal individual in the elite population remains unchanged for 10 generations, the algorithm can be considered to have converged and terminated accordingly. In addition, the algorithm will be forced to terminate if the iteration reaches 150 generations.

5. Conclusion

The first level is the scheduling from task set to virtual machine set, and the other level is the scheduling from virtual machine set to physical machine set. This paper mainly studies the task scheduling on the first level. At this level, the scheduling object is a small granularity task set formed by segmentation, and the task scheduling strategy is to seek the mapping relationship between this task set and the virtual resource set available on the cloud platform. With the emergence of cloud computing, resource allocation and scheduling in cloud data centers have become an important factor determining the efficiency of cloud computing, and the cloud resource scheduling has become a hot topic of research. In this paper, on the basis of genetic algorithm, by improving the execution process of genetic algorithm, to scheduling task completion time, cost, CPU utilization, memory bandwidth utilization five goals to quantify the satisfaction of resource scheduling, forming a cloud resource scheduling research plan, and USES the Cloud Sim platform conducts a practical analysis to simulate the cloud computing environment. The experimental results show that the improved genetic algorithm in this paper has a better effect in cloud resource scheduling, achieving more reasonable task scheduling, and producing ideal task scheduling results. In the next work, the resource load balancing of dynamic task scheduling in cloud computing will be the focus of our research. Combined with cloud resource scheduling policies and algorithms under SLA constraints, a multipolicy cloud resource scheduling study will be carried out.

Data Availability

The data used to support the findings of this study are available from the corresponding author upon request.

Conflicts of Interest

The author declares no conflicts of interest.

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Retraction

Retracted: Research on Machine Learning Algorithm for Internet of Things Information Security Management System Research and Implementation

Wireless Communications and Mobile Computing

Received 18 July 2023; Accepted 18 July 2023; Published 19 July 2023

This article has been retracted by Hindawi following an investigation undertaken by the publisher [1]. This investigation has uncovered evidence of one or more of the following indicators of systematic manipulation of the publication process:

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The presence of these indicators undermines our confidence in the integrity of the article's content and we cannot, therefore, vouch for its reliability. Please note that this notice is intended solely to alert readers that the content of this article is unreliable. We have not investigated whether authors were aware of or involved in the systematic manipulation of the publication process.

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[1] W. Jiang, "Research on Machine Learning Algorithm for Internet of Things Information Security Management System Research and Implementation," *Wireless Communications and Mobile Computing*, vol. 2022, Article ID 8933468, 6 pages, 2022.

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Research Article

Research on Machine Learning Algorithm for Internet of Things Information Security Management System Research and Implementation

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To study in the Internet information security and privacy problem, a method based on IoT card monitoring technology based on machine learning, the technology can use fuzzy c-means algorithm for online business audit, using the Naive Bayes algorithm to classify Internet content and text messages, on the analysis of the comparison of the measurement method based on distance and based on the similarity. The concept of divergence in information theory is used to measure the difference between probability distributions. Finally, the feasibility of the proposed method is validated using the data from the machine learning database. The experimental results show that under the same privacy gain, the data availability relationship between the three anonymous protection methods is roughly satisfied as follows: when the privacy gain is less than 0.85, $U_{\text{dverity}} < U_{\text{emonymity}} < U_{\text{eclorenes}}$; when the privacy gain is greater than 0.85, $U_{\text{uxanaymiy}} < U_{\text{uiversriy}} < U_{\text{closencs}}$. And it proves that on the premise of ensuring efficiency and accuracy, the system can find a large number of illegal IoT cards and effectively guarantee the security of IoT.

1. Introduction

As an important information technology, the Internet of Things has been widely used in all walks of life, such as the power system, water supply enterprises, transportation departments, and intelligent life, all of which exist in the application of the Internet of Things technology [1]. At present, the Business of the Internet of Things develops very rapidly in China, and the scale of the card opening of the Internet of Things is also increasing day by day. For example, the scale of the users of the Internet of Things card of China Mobile has exceeded 500 million, and the users of the Internet of things involve dozens of industries. The continuous growth of Internet of Things card business brings more problems to the management and security supervision of Internet of Things card [2]. Illegal personnel may use the Internet of Things card for malicious resale, illegal embezzlement, and embezzlement, take advantage of the low charge of the Internet of Things card to use the Internet of Things card as a common user card for sale, illegal arbitrage, and even use it to make nuisance calls, and send illegal SMS, which seriously affects the normal business of users. Subjects subject to privacy threats in the Internet of Things mainly include two categories: data and node location [3]. In recent years, Internet technology and virtual reality technology are developing rapidly at home and abroad, by means of virtual reality technology to the real world simulation expression in recent years, Internet technology and virtual reality technology are developing rapidly, with the aid of the expression of simulation and virtual reality technology to the real world IoT front sensor network access to all kinds of information, the object of perceived virtual reconstruction and reproduction, and Geographic information engineering applications can be established with true Three-dimensional landscape description, real-time interaction, and spatial analysis and query, which will make qualitative changes in the perception and expression ability of the Internet of Things [4]. The integrated application of virtual reality and Internet of things has been a lot of research and application achievements in the field of the water conservancy industry application, with the help of a professional hydrological process calculation model and flood calculation model, and based on virtual reality technology and the Internet of things technology of water conservancy engineering, a comprehensive simulation system can make the researchers for the loss caused by flood disasters quantitatively, intuitive evaluation [5]. By simulating the process of hydrology and engineering conditions under different hydrology and climate conditions, the simulation dispatching and effect demonstration of hydraulic engineering are carried out, which provides scientific basis for flood control decision-making [6].

Huang puts forward that in the Internet of Things, foreign intrusion poses a serious threat to network security, and the system must have a corresponding mechanism to deal with this security threat. The intrusion detection mechanism is a kind of protection mechanism for the system to deal with foreign intrusion [7]. Xin et al.'s technology in intelligent contract is with block chain, such as a way of digital contract, usually by program code into blocks in the chain, mainly through specific operation mechanism to ensure transaction, and the operation of the contract is not affected by external interference, intelligent way of contract first consultation by both sides of the contract content, if the two sides reach a consensus. The system will publish the contract content in the system according to the contract logic through the program code [8].

The analysis was compared based on distance and based on the similarity measurement method, based on the use of virtual reality and Naive Bayes algorithm for online content and message classification, based on distance and is based on the analysis comparison, and based on the similarity measurement method using the concept of information releasing degrees to measure the difference between the probability distribution.

2. Internet of Things Card Monitoring Technology Based on Machine Learning

The Internet of Things card business security risk monitoring system can realize the full flow detection of the Internet of Things cards in the whole network of Liaoning Province and find out the security risks and illegal use of industrial cards and Internet of Things cards. The module as a whole includes three levels.

(1) Basic data layer: this layer is used to collect and screen all traffic related to Internet of Things cards, including Internet log, DN log, call signaling data, suspected SMS data, contract data, and consumption data of Internet of Things card users. Based on the above data results, the important fields of data are extracted, the data of different data sources are normalized, and the calculated data is stored

(2) Intelligent analysis layer: this layer is used to analyze the data provided by the basic data layer based on artificial intelligence from the three aspects of business risk, network information security risk, and management risk and find out the suspected illegal use or security risks of industrial cards and Internet of Things card users

(3) Security visualization layer: this layer analyzes and displays illegal industry cards and Internet of Things card users from multiple dimensions such as user violation type and user risk type and can export display data, which is helpful for regulators to deal with illegal Internet of Things users offline [9]

The monitoring center platform is the integration of the functions of the whole application layer, and its function system includes an interactive sluice virtual simulation scene based on Unity3D engine, which supports *C#* Script and Java Script control. The data management module is responsible for receiving and storing the data uploaded by telemetry terminals, remote video management module of telemetry point, real-time monitoring module of water condition and working condition data, and the sluice remote scheduling module and several hydrology professional calculation models running in the system background as service.

2.1. Use FCM to Conduct Business Type Audit. The FCM algorithm is a data clustering method based on the optimization of the objective function, which can carry out multiclass clustering of data. The clustering result is the degree of membership of each data point to the clustering center, which is expressed by a numerical value. The algorithm allows the same data to belong to multiple different classes. And FCM is an unsupervised fuzzy clustering method, which does not need human intervention in the process of algorithm implementation. During the use of the Internet of Things card, the business behaviors and business types of the Internet of Things card are usually quite different from those of normal users. A normal user's plan starts from 58 yuan to 98 yuan and includes a certain amount of call duration (for example, 200 minutes) and a certain amount of Internet access traffic (for example, 20 GB). Therefore, for normal users, most services include SMS (currently receiving more, but sending less), MMS (currently receiving more, but sending less), traffic, call (calling and called), and value-added services. For users of the Internet of things card, the package fee is low, and users may only promise to use one or two services. For example, the Internet of Things card installed in the smart camera only needs traffic and SMS service, while the Internet of Things card installed in the smart meter only needs SMS service. In the training process of classification, we first prepared the business data of 100,000 normal users as a positive sample and then found the business data of 10 Internet of Things cards in different industries (10,000 samples for each industry) as a negative sample, a total of 11 categories. For the Internet of Things cards to be classified, the FCM algorithm can find out the probability (fuzzy value) that each sample belongs to different categories; so, we choose the FCM algorithm to classify business types.

For each of the above categories, calculate the center for each category c_j:

$$c_j = \frac{1}{n}\sum_{i=1}^{n} x_i, j = 1, 2, \cdots, 11. \tag{1}$$

Based on Equation (1), for the Internet of Things card users to be classified x_i, calculate the probability that the card belongs to different categories of IoT card, respectively μ_{ij}:

$$\mu_{ij} = \frac{1}{\sum_{k-1}^{c}} \left(\frac{\|x_i - c_j\|}{\|x_i - c_k\|} \right)^2. \tag{2}$$

Among them, $\|x_i - c_i\|$ according to the vector x_i Euclidean distance from center c_i of the class.

After calculating μ_{ij} by the above method, by constantly reviewing feedback to set category thresholds, we can identify IoT cards that are involved in business abuse (the use of the IoT card is similar to that of normal users) [10].

2.2. Measurement of Anonymity Protection Techniques. Aiming at the privacy protection technology of anonymity, this paper focuses on the measurement method of data accuracy, that is, the measurement of the difference of data availability before and after the addition of privacy protection method. The smaller the difference, the better the usability of the privacy protection method, and the worse the other way around. The quantification methods to measure the differences between individuals mainly include the quantification based on distance and the quantification based on similarity [11].

2.2.1. Distance-Based Quantization. Measure the distance between individuals in space. The farther the distance, the greater the difference between individuals. Distance measurement methods mainly include the following:

Euclidean distance, also known as Euclidean distance, refers to the distance between two points in n-dimensional space. The formula is as follows:

$$d(X, Y) = \sqrt{\sum_{i=1}^{n} (x_i - y_i)^2}. \tag{3}$$

Euclidean measurements need to ensure that all dimensions are on the same scale level.

Manhattan distance, also known as urban block distance or L1 normal form distance, is the sum of projected distances generated by line segments formed by 2 points in Euclidean rectangular coordinate system on the coordinate axis. The formula is as follows:

$$d(X, Y) = \sum_{i=1}^{n} |x_i - y_i|. \tag{4}$$

Minkowski distance, also known as Minkowski distance, is a measure in Euclidean space and a generalization of Euclidean distance and Manhattan distance. The formula is as follows:

$$d(X, Y) = \left(\sum_{i=1}^{n} |x_i - y_i|^p \right)^{1/p}. \tag{5}$$

The Manhattan distance for $p = 1$, the Euclidean distance for $P = 2$, and the Chebyshev distance for $p =$ infinity are as follows.

Chebyshev distance or L_∞ metric is a metric method in vector space. The formula of distance between 2 points is defined as follows:

$$d(X, Y) = \lim_{p \longrightarrow \infty} \left(\sum_{i=1}^{n} |x_i - y_i|^2 \right)^{1/p} = \max |x_i - y_i|. \tag{6}$$

Mahalanobis distance represents the covariance distance of data. Mahalanobis distance is an effective method to calculate the similarity of two unknown sample sets. Different from Euclidean distance, it takes into account the relationship between various properties. For two random variables X and Y that follow the same distribution, whose covariance matrix is diagonal, and whose standard variance is σ, the Mahalanobis distance formula is as follows:

$$d(X, Y) = \sqrt{\sum_{i=1}^{n} \frac{(x_i - y_i)^2}{\sigma_i^2}}. \tag{7}$$

2.3. Function Realization of the System

2.3.1. Implementation of Authentication Management Module. In the current Internet of Things system, the identity authentication of devices mainly has three modes, namely, static password authentication, dynamic password authentication, and biometric authentication. Static password authentication uses a preset password for authentication.

The password is static. If the user does not change it, the password will remain valid. The dynamic password is mainly calculated according to the built-in password chip. The password authentication must be completed together with the dynamic password and the built-in password chip. Biometric identification authentication is based on a certain feature of the human body, such as face recognition, fingerprint recognition, and expression recognition. According to the characteristics of the system, this paper designs a comprehensive identification method, which is mainly to send the manufacturer, type, and factory code of the equipment.

As the unique identification code for identity authentication, the structure of the authentication table mainly includes the device name, identification code, device characteristics, and remarks. When a device is connected to the network, the device obtains the three information and compares them with the data in the device access table. If the comparison is successful, the authentication succeeds.

2.3.2. Implementation of Operation Management Module. When the Internet of things to send information between devices and access to information, the receiving device information interaction system module, and send the request to the data transmission module, data transfer module sends authentication request to the block chain system, block chain contract application permission to verify the device automatically, and the verification results returned to the data transmission module; if verification goes through, then the data transfer module sends the information to the interaction module; otherwise, the interaction module will not be notified. Similarly, the same principle is used to complete the operation and management of the device for information receiving.

2.3.3. Implementation of Security Detection Module. The security detection function is mainly realized by CIDF program, which mainly includes three subroutines, namely, event generation program, event analysis program, and data writing program. The system first monitors the running status of the sent information and then sends the test results to the event analysis program. The event analysis program compares the message behavior with the malicious event database. If the comparison is successful, it indicates that the message belongs to the malicious message, and the message is returned to the system to restrict the permission of the device.

2.3.4. System Technical Architecture

(1) Perception Layer. The sensing layer is mainly composed of a sensor network composed of water condition and engineering condition information acquisition sensor units and sluice control equipment sensor units distributed in the telemetry points of each monitoring section to realize the whole-process and all-weather collection of water quantity, water level, water quality, and sluice operation information. The water condition and working condition information collection and sensing unit mainly include water level, flow rate, and water quality sensors installed in the sluice and monitoring section. The sensor unit of the gate control equipment mainly includes the monitoring and sensing unit of the gate automatic control system (gate opening and closing state, opening, current, voltage, pressure, temperature, vibration, etc.).

(2) Transmission Layer. The remote monitoring sensor unit is connected to the monitoring center server through wireless transmission. At present, the available wireless data transmission networks mainly include the following: for China Mobile GPRS and China Unicom CDMA 1X, the peak rate of GPRS is 115.2 kbit/s, and the peak rate of CDMA1x is 153.6 kbit/s, which can meet the communication bandwidth requirements of sensing unit and monitoring center server.

2.4. Virtual Visualization Combined with Internet of Things. Virtual tour technology can bring a sense of three-dimensional experience, and the interactive operation realizes the leap of man-machine relationship, making the tour experience more real. The gradient lifting algorithm is similar to the similar lifting algorithm. Its idea is to use Taylor expansion, take the negative gradient value of the first derivative of the loss function to represent the real loss value, reduce the gradient as the goal to realize the optimization of the model, and finally achieve the purpose of reducing the loss value. The formula can be obtained:

$$f_m(x) = f_{m-1}(x) - \gamma_m \sum_{i=1}^{N} \nabla_f L(y_i, f_{m-1}(x)), \tag{8}$$

where $f_{m-1}(x)$ is the model learned when the tree of lesson M is generated, and γ_m is the learning rate. Generally, linear search can be used to obtain the best learning rate value.

$$\gamma_m = \arg \min_{\gamma} \sum_{i=1}^{N} L\left(y_i, f_{m-1}(x_i) - \gamma \cdot \nabla_f L(y_i, f_{m-1}(x))\right). \tag{9}$$

Based on the above introduction, if the number of decision trees is increased infinitely and the value of M tends to infinity, the fitting results of the model can approach the real distribution of data infinitely, and then a model with very high precision can be obtained. However, when the model becomes very complex, it conversely reduces the generalization ability of the model, resulting in overfitting problems. Therefore, in addition to the model itself, regularization techniques are generally required to reduce overfitting.

3. Experimental Analysis

Through the interactive script editing environment of Unity3D engine, the Internet of Things card monitoring technology is defined and implemented, and the integration of business application modules and simulation scenes based on J2EE architecture is realized by using the HTML interactive characteristics of Unity3D.

In this paper, the experiment uses the university (UCI) machine learning database, the adult. In the data set including 32561 records, the data set is commonly used in table item properties that include the following: age, education level, marital status, race, sex, and occupation. The experiment to the "professional" as the sensitive attribute, to adopt different kinds of anonymous protection technology before and after the data, is available to evaluate the performance differences of various anonymous protection technologies. There are 14 values for the "occupation" attribute in the database, and the number and proportion of records contained in each value are shown in Table 1. Because there are empty records and records in the table with an empty "class" attribute, the sum of all the "class" attribute record values counted in Table 1 does not equal 32561.

The use of anonymous protection technology will not only improve privacy but also reduce data availability. The following two concepts are described in this paper. Data availability is as follows: the degree to which an anonymous data set is similar to the original data set, as measured by divergence. The higher the similarity (that is, the smaller the divergence), the higher the availability of anonymized data. Privacy gain is as follows: the degree of privacy improvement of the original data after anonymous processing, that is, the probability difference between the original data set and the anonymous data set that can accurately locate a certain record through the same attribute value.

Table 1: Number and proportion of different occupational records.

Professional attributes	Record number	The proportion of
Tech-support	928	0.2315
Craft-repair	4099	0.1246
Other-service	3299	0.3569
Sales	2556	0.2456
Exec managerial	2398	0.3214
Prof-specialty	4056	0.1246
Handlers-cleaners	5026	0.1579
Machine-op-inspct	7	0.2013

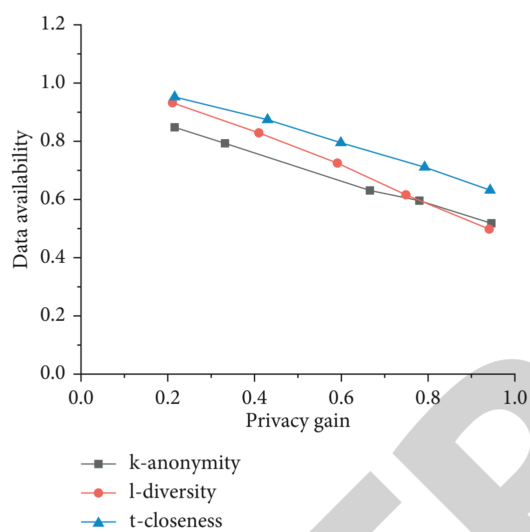

Figure 1: Privacy gains versus data availability.

Based on the two concepts above, this paper uses a measurement method based on divergence to compare the performance of three anonymous algorithms, which are K-anonymity, L-diversity, and T-closeness, with k values {10, 100,200, 500, 1000}, l is {3.0,3.5,4.0,4.5,5.0}, and T is {0.05,0.1,0.2,0.3,0.4}. The privacy gain and data availability relation of the three anonymous algorithms are compared as shown in Figure 1. The three solid lines in Figure 1, respectively, give the linear trend estimation of the three anonymous algorithms in the experimental environment. As can be seen from Figure 1, (1) when k, L, and t are different, the corresponding privacy gain and data availability are different. In addition, with the increase of k, L, and T, the privacy gain increases, and the similarity between the original data and anonymous data decreases, leading to the decline of data availability. (2) Under the condition of the same privacy gain, the data availability relationship roughly satisfied among the three anonymity protection methods is as follows: when the privacy gain is less than 0.85, $U_{\text{dverity}} < U_{\text{emonymity}} < U_{\text{eclorenes}}$; when the privacy gain is greater than 0.85,$U_{\text{uxanaymiy}} < U_{\text{uiversriy}} < U_{\text{closencs}}$.

In general, the default is standalone publishing. Clicking Unity's Build Setting will pop up a dialog box for client operating system to publish, and drag and drop the required scenes into current in order to realize the link jump. After clicking build button and setting resolution and rendering quality, generate an executable file in EXE format and a folder and keep the file and folder directory the same; otherwise, it will not run. After clicking Unity's Build Setting and selecting the Web Player option, build generates a web file and one. The Unity 3D file is then configured on the IIS server for web publishing. The server side will connect the web page and once the Unity 3D file is configured, the user can access it through a browser. Since Unity 3D publishing does not require an additional installer, it can be run directly by clicking on the EXE file after standalone publishing, and network publishing only needs to install a control of about 500 KB to run. After the platform is put into operation, it runs smoothly and has strong authenticity and interaction when operating equipment.

4. Conclusions

As the Internet of Things has been widely used in various industries, a large number of terminal devices are connected to the Internet of Things, which has brought great impetus to work and life. However, the information security problem of the Internet of Things has become increasingly prominent, especially in network management that is very difficult; for this, this paper puts forward the technology of information security platform based on block chain system design scheme, used to solve the technical problem, a certain scientific research achievements, but the system there has still some deficiencies; for the Internet of things system equipment, the lack of unified format of messages sent, every industry is fragmented, and message format cannot be unified. At present, there is no unified performance evaluation method and standard for anonymous privacy protection technology; so, it is necessary to develop a set of evaluation indicators and evaluation system to objectively and reasonably evaluate anonymous privacy protection technology. In the case of the same privacy gain, the data availability relationship roughly satisfied between the three anonymous protection methods is as follows: when the privacy gain is less than 0.85, $U_{\text{dverity}} < U_{\text{emonymity}} < U_{\text{eclorenes}}$; when the privacy gain is greater than 0.85,$U_{\text{uxanaymiy}} < U_{\text{uiversriy}} < U_{\text{closencs}}$.

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Conflicts of Interest

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Research Article

Application of Data Mining Technology in Software Intrusion Detection and Information Processing

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In order to improve the efficiency of the software intrusion detection system, the author proposes an application based on data mining technology in software intrusion detection and information processing. Apply data mining technology to software intrusion detection; first, analyze and research software intrusion detection technology and data mining technology, including the basic concepts of software intrusion detection, the realization technology of software intrusion detection, the classification of software intrusion detection systems, and the typical software intrusion detection system situation. By detecting and analyzing known intrusion data and using association rules, constructing the inspection system rule base enables the system to learn independently and improve itself and has good scalability, while improving the degree of automation and complete intrusion detection. Experimental results show that under the same test sample, the accuracy of the detection system model designed in this paper is 95.67%, higher than the other three detection systems, and the false alarm rate is lower than other systems, which has certain advantages. It is proved that the system in this paper can help improve the accuracy of software intrusion detection, significantly reduce the false alarm rate and false alarm rate of software intrusion detection, and provide reference for the optimization and improvement of software intrusion detection system and information processing. The system has a certain degree of self-adaptation, which can effectively detect external intrusions.

1. Introduction

In recent years, with the rapid development of the Internet, the Internet has a wider range of applications; the scale of Internet users has grown rapidly; the explosive increase of Internet information greatly promotes information exchange, interaction, and information sharing; and it greatly promotes the improvement of work efficiency and the simplicity and convenience of daily life [1]. However, the Internet has its own characteristics of individuality and openness. More and more computers are connected to become computer networks, and every computer on the network may become the target of attack, which makes the information security problem of the Internet more prominent. [2]. The information security of the Internet includes malicious issues such as network information tampering and counterfeiting, viruses, and hacking; it also includes nonmalicious security issues caused by information users who do not pay attention to information security and do not follow information security regulations; malicious information security and nonmalicious security are both serious threats to the information security of the Internet. Figure 1 shows a new data mining technology in the software intrusion detection framework [3]. Software intrusion detection refers to the process of identifying intrusions through various means; specifically, it refers to the collection of various user activity behavior data inside and outside the system; it also comprehensively analyzes various internal and external user activity data to discover and identify abnormal behaviors of the system.

In response to Internet network information security issues, research institutions and equipment manufacturers increase the research and application of Internet network information security technology and products, and a relatively complete firewall system, unified authentication, user authority management system, software intrusion detection

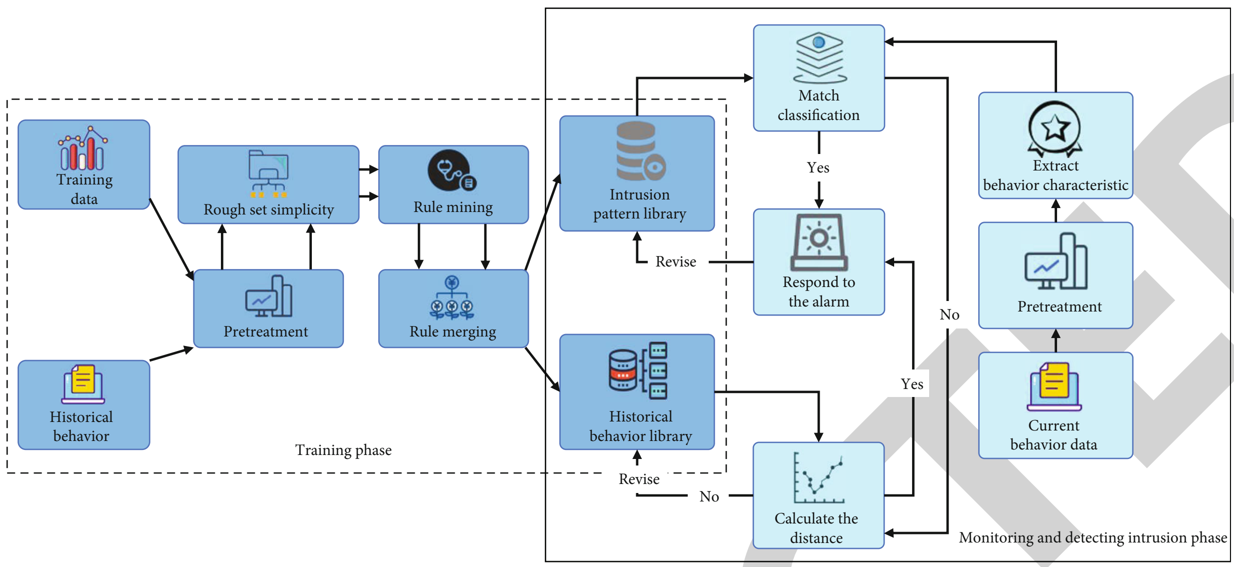

Figure 1: Data mining technology in the software intrusion detection framework.

system, secure router equipment, and other Internet information security products have been formed. Devices, including firewall systems and unified authentication systems, usually focus on defense functions and focus on preventing the system from being illegally invaded. However, Internet network information security requires equipment that prevents the system from being illegally invaded, and network software intrusion detection systems are also needed to monitor, attack, and counter-attack network security in real time [4]. At present, many research institutions and manufacturers have done a lot of research and practice on software intrusion detection technology and system application. However, improving the accuracy of software intrusion detection and reducing the false alarm rate and false alarm rate of software intrusion detection is the constant pursuit of research and application, which has strong theoretical and practical significance for the research of software intrusion detection technology [5]. Under the current trend of social life informatization, the application of software intrusion detection system is of great significance to financial institutions, government agencies, national defense and military departments, and other security-sensitive units. Timely detection and appropriate response to an intrusion can greatly reduce the damage and impact and help to quickly identify and bring perpetrators to justice [6]. Using data mining technology in updating the intrusion detection model, we should not only improve the accuracy of new intrusion data, but also remove the relatively backward detection data in the intrusion detection model in time, so as to comprehensively improve the performance of intrusion detection.

Based on this research, the author proposes an application of data mining technology in software intrusion detection and information processing, obtain hidden and unknown potentially useful information by mining a large amount of data, accurately obtain the correlation characteristics between intrusion data, avoid the huge workload caused by manual analysis and the interference of human factors, and reduce the operation and maintenance costs.

2. Literature Review

Data mining technology can be widely used in the computer field. Data mining refers to the automatic extraction of potential and useful new technology from the database; it is mainly used to find the internal connection between data and data, so as to make reasonable and appropriate inductive reasoning and make prediction judgments for extracting data from this [7]. Lin, P. L. and others used data mining technology for collaborative intrusion detection and propose a collaborative intrusion rule generation algorithm based on data mining; using distributed collaborative intrusion detection technology based on data mining, it can effectively detect coordinated intrusions, and it also has the ability to detect unknown coordinated attack patterns [8]. Wei, J. et al. analyzed the role of data mining technology in intrusion feature search; a feature mining model is applied in a mixed mode intrusion detection system based on network; and host is proposed [9]. Wan, J. and others analyzed how artificial intelligence methods are applied to intrusion detection systems and discussed the main related technical issues, and a case is used to illustrate the effect of applying clustering methods on enhancing the classification performance of network connections [10]. In order to effectively improve information security, Alidjinou, E. K. and others improve the performance of computer intrusion detection system, and data mining technology can be used and gradually play a very important function and role [11]. Mustiko et al., etc. through information screening or through the information already mastered, it can detect abnormal and known intrusions based on the correlation between different information, so as to comprehensively and scientifically verify the data in the computer, can effectively guarantee information security, at the same time, it can be the first time insecure or unknown in the network, or filter the hidden information, comprehensively improve the security of computer databases [12]. Wang, X. and others applied data mining technology in intrusion detection system, while giving full play to the characteristics of data mining technology, and a new type of intrusion detection model has also been formed [13]. By verifying the experimental data of the intrusion detection prototype experimental system based on data mining, Ngulde, S.I. et al. compared and analyzed the algorithm of the single intrusion detection model.Experimental results further confirm that the data mining model based on association rules and decision tree proposed in this paper is effective, especially in reducing the false positive rate of obvious effect, and has strong practical application [14]. Battini, N. et al. discussed the process of designing and implementing a network intrusion detection system based on data mining and used experiments to verify the prototype system of intrusion detection and to optimize and improve existing problems [15]. J. Zhou et al. used the research of intrusion detection technology based on data mining method as the core, discussed how to apply the clustering algorithm in data mining method in intrusion detection, and tried and proposed a nearest neighbor first algorithm based on the idea of "similar to the same kind" and the shortest distance algorithm [16]. Lin, Z. and others believe that computer intrusion detection systems have very distinct advantages, which is incomparable to previous detection systems. Data mining technology is widely used in intrusion detection system and greatly improved the performance of the intrusion detection system [17].

3. Research Methods

In the computer database, the application of software intrusion detection system plays a very important role and can effectively improve the stability of the computer; it can ensure the safety and efficiency of computer operation to a large extent. At the same time, in the computer database, the application software intrusion detection system can also guarantee the security of information.

3.1. Software Intrusion Detection

3.1.1. Software Intrusion Detection Technology and Classification. Software intrusion detection technology (intrusion detection system, IDS) in the 1980s, as a proactive defense technology, was proposed, by collecting key information in the computer for analysis; then, it can be concluded whether there are violations of security policies and attacked behaviors in the network [18]. Intrusion behavior is divided into internal invasion and external invasion. Internal intrusion mainly refers to the ultra vires behavior of legitimate users; external intrusion refers to the intrusion of hackers or illegal users; intrusion will threaten the integrity, validity, and privacy of network data; and the focus of different intrusion detection technologies is different [19]. Classification of intrusion detection, according to the different results of different objects, anomaly detection, and misuse detection, is divided according to different detection technologies. Network-based and host-based are divided according to different data sources. According to the detection time, it can be divided into real time and nonreal time. The software intrusion detection system model has a unified model and a Snort model, and it is mainly composed of event generator, response unit, and database. The model is shown in Figure 2.

3.1.2. Process Analysis of Software Intrusion Detection. Faced with intrusions, the detection of the network system mainly consists of 4 steps: ① data collection stage, through external sensors or different proxy hosts, in order to search for the initial information of the system, which mainly include user behavior and status and basic data of the network; ② data processing stage, for the different types of data collected, process it, transformed into a uniform format recognized by the computer, and improve the timeliness of testing; ③ data analysis, perform a preliminary analysis of the collected information, through pattern matching with known databases or statistical analysis using probability theory, and transmit the obtained uncertain dangerous data to the control module; and ④ system response, by matching with the rule base, take corresponding countermeasures, such as reconfiguring the router, isolating the intruder's IP, and modifying file attributes. The software intrusion detection process is shown in Figure 3.

3.2. Application of Data Mining in Software Intrusion Detection and Information Processing

3.2.1. Data Mining Technology. Data mining is in a large amount of fuzzy, noisy, and irregular data and discovers potential and relevant patterns or rules. The realization of data mining is mainly composed of 3 processes: ① the data preparation stage, including data target selection and discovery of operation objects, preprocessing and noise elimination of different types of data, and dimensionality reduction and transformation of data; ② data mining, according to different data mining models, determine the matching mining algorithm and discover potentially relevant data from a large amount of incomplete and irregular data, in order to predict the results; and ③ data representation and evaluation, perform association rules, classification, and cluster analysis on the information obtained by data mining, so as to get the value of mining data, and then express it in a simple and easy-to-understand form and realize the visualization of data. The structure of the data mining system is shown in Figure 4.

3.2.2. Data Mining Algorithm for Software Intrusion Detection. Data mining algorithm for intrusion detection of intrusion software is the most important part of the software intrusion detection system; different data mining algorithms have different advantages and disadvantages for different models; and statistical analysis, feature analysis, change and deviation analysis, and clustering are the frequently used analysis methods of data mining; the association rules are the focus of data mining algorithms and represent the relationship between data. The mathematical description of association rules is as follows: Suppose there is a database D, there are m pieces of information in the database, each message is T_i, each piece of information is composed of n units I, and the relationship between them is described as $D = \{T_1, T_2, \cdots, T_m\}$, $T = \{I_1, I_2, \cdots, \mathrm{In}\}$. The subset of the database

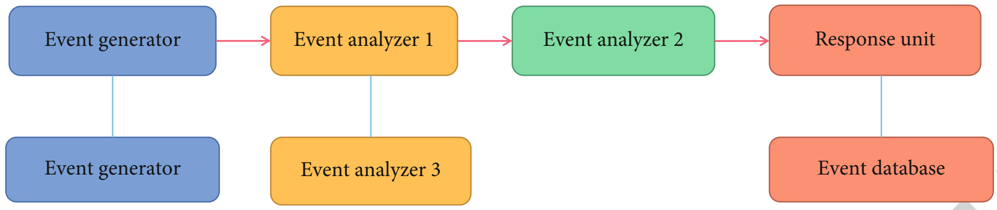

Figure 2: Software intrusion detection system model.

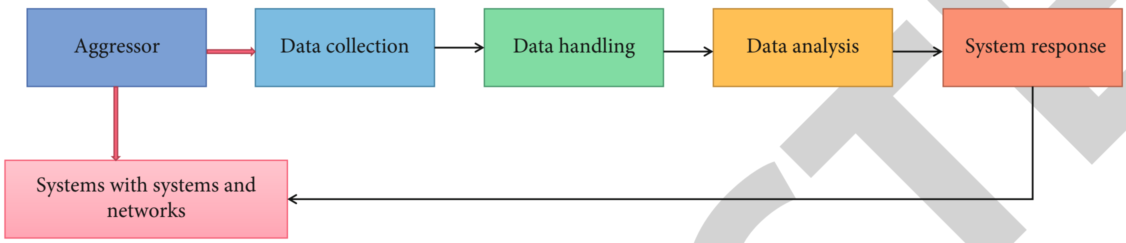

Figure 3: Software intrusion detection process.

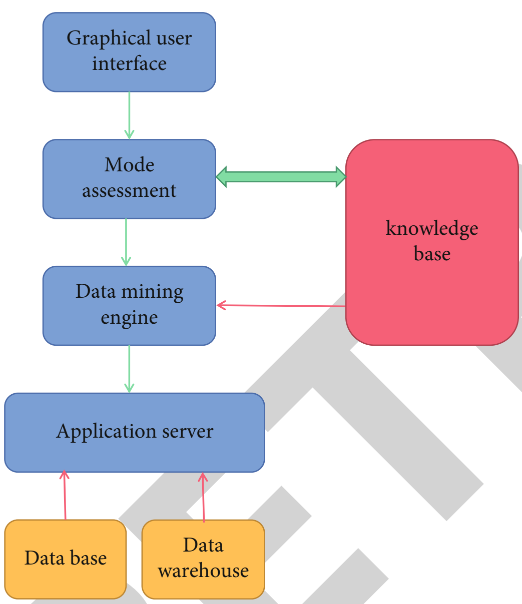

Figure 4: Data mining system structure.

is represented by A; if there is $|A| = K$, then call the item set A as K; database D contains the support degree of item set A, denoted by C_X. If there are item sets A and B, then, the association rules between them are

$$\text{Support}(A \Rightarrow B) = P(A \cup B), \tag{1}$$

$$\text{Confidence}(A \Rightarrow B) = P(A|B), \tag{2}$$

where support (A) is the support degree of item set A in database D, Confidence A is the confidence level, and the calculation method is

$$\text{Support}(A)/\% = \frac{C_x}{|D|} \times 100. \tag{3}$$

Therefore, we can use the support and confidence between item set A and B, in order to determine the association rules between the two projects, assuming that the confidence level Confidence$(A \Rightarrow B)$ of association rule $A \Rightarrow B$ is not less than the minimum confidence level of the item set, and the support of $A \Rightarrow B$ is greater than or equal to the minimum support; that means there is a strong association rule between item sets A and B; on the contrary, it means that the association rules between them are extremely weak. The correlation between item sets A and B can also be expressed by measurement.

$$r_{A,B} = \frac{\sum\left(A-\bar{A}\right)\left(B-\bar{B}\right)}{(n-1)\sigma_A\sigma_B}, \tag{4}$$

where the average value of A and B is $\bar{A}, \bar{B}$ and the standard deviation is σ_A, σ_B.

Association rules can extract the correlation between intrusions, and it can then discover potential and related intrusion patterns or rules; through the Apriori algorithm, data mining is performed on the existing intrusion data and get the association rules, and part of the code is:

3.3. Design of Software Intrusion Detection System Based on Data Mining. In the computer database, using intrusion detection system can effectively improve the efficiency and quality of data detection. In turn, the application of data mining technology can also effectively improve the function and role of the intrusion detection system. The two are in the process of structuring; the main method of use or the method of key use is the correlation analysis method. Through the autonomous function of computer system, we can find the different correlation between them. When the network connection is successful, the system can use the function of network connection to completely analyze the attributes of different parts, in order to analyze and sort out the internal relationship between them, and to effectively analyze from the original data of the network. The results

```
Aprioribegin
L_1=find_frequent_1-itemset(D);
For(k=2;L_{k-1}≠φ;k++);
{C_x=apriori(L_{k-1}, min_sup);
ForeachtransactiontD;//Scan database D
C_t=subset(C_k,t);//Select an associated subset from the candidate set
foreachcandidatecC_t:
returnTRUE:
returnFALSE
```

Pseudocode 1.

Table 1: Performance requirements of software intrusion detection prototype system.

System performance index	Specific performance requirements
1. The scale of system users	According to the user group scale of the software intrusion detection prototype system, the user scale of the intrusion detection prototype system is about 300 users
2. System response time limit	Software intrusion detection prototype system needs to provide business processing and response capabilities for 50 concurrent users
3. Concurrent processing capabilities of the system	The software intrusion detection prototype system page takes no more than 3 seconds to open; data query response time does not exceed 5 seconds

can be summarized through scientific, accurate, and objective analysis of the data without omission. Through the scientific, accurate, and objective analysis of the data, the analysis results can be summarized.

3.4. Overall Design of Software Intrusion Detection System. The performance requirements of the software intrusion detection prototype system mainly include the user scale of the system, concurrent processing capacity, and system response time limit; the specific performance requirements of the software intrusion detection prototype system are shown in Table 1.

In order to realize timely and effective analysis of network data, the author puts the core of the overall design of the software intrusion detection system, defined as the association rules between mining data and the sequence rules between data, according to the classification and identification defined by the rules. Since different system models correspond to different data mining algorithms, therefore, we first need to find a suitable software intrusion detection system. The Snort detection model is a lightweight open source software intrusion detection system and can effectively deal with most cyberattacks; however, the Snort detection model is not efficient, has false positives and false negatives, and cannot perform dynamic detection in real time; therefore, the Snort detection model needs to be improved [20, 21]. The overall design idea is as follows:

(1) Add a normal behavior module to the traditional Snort detection model, targeted rule association analysis, and cluster analysis of network behavior; filter out most of the known behavior information according to these rules; and then get abnormal data

(2) Match the abnormal data by adding a rule matching module, while reducing false positives and false negatives, improve the detection effect of the system

(3) Increase the rule dynamic generation module, so that the new system has a dynamic expansion mechanism; update and iterate the rule base in a timely and effective manner; and improve the completeness of the rule base

The improved Snort system model is shown in Figure 5.

3.4.1. The Realization of Software Intrusion Detection System and Information Processing. Network software intrusion detection based on data mining, through mining and analysis of a large amount of known data, finds out the attack characteristics as the basis for detection. First, data collection is required, and the completeness and accuracy of data collection are the key to system implementation. The author uses the typical representative KDDCUP99 data set, in which the data set is rich in information, contains untrained network data as a test set and a marked training set, and simulates the real network attack environment [22]. The training set contains complete basic information: DOS represents data with attack characteristics, normal represents normal behavior data, U2R represents cross-level access by internal low-level users, R2L represents abnormal visits by external programs, and probing represents the detection and surveillance activities of the system itself. Since the collected raw data contains noise, redundant information cannot do data mining directly; therefore, it is necessary to standardize the data, and the data after the standardized processing, the Apriori decision tree algorithm is used to obtain the association rules and then realize data mining [23, 24]. The algorithm implementation process is as follows:

(1) Standardize the collected data and find and discover the decision tree item set

(2) Loop processing to obtain the k-item set of the decision tree of the training set

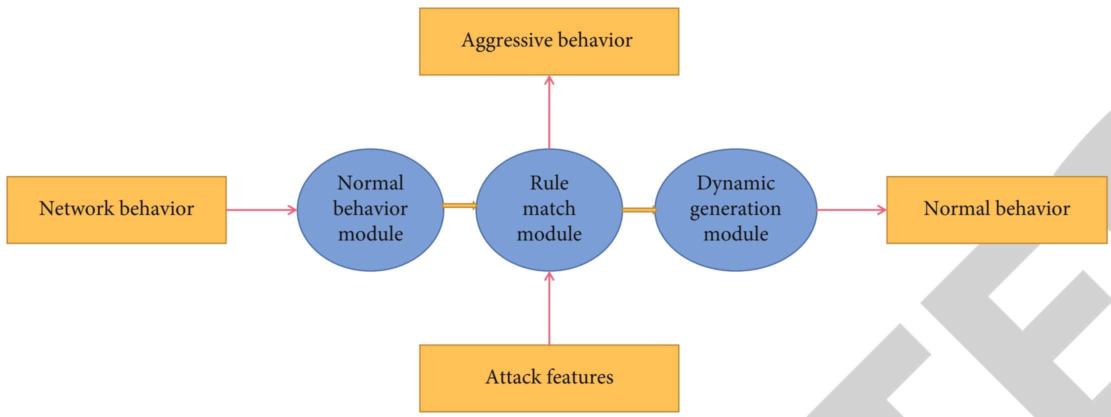

Figure 5: Improved Snort system model.

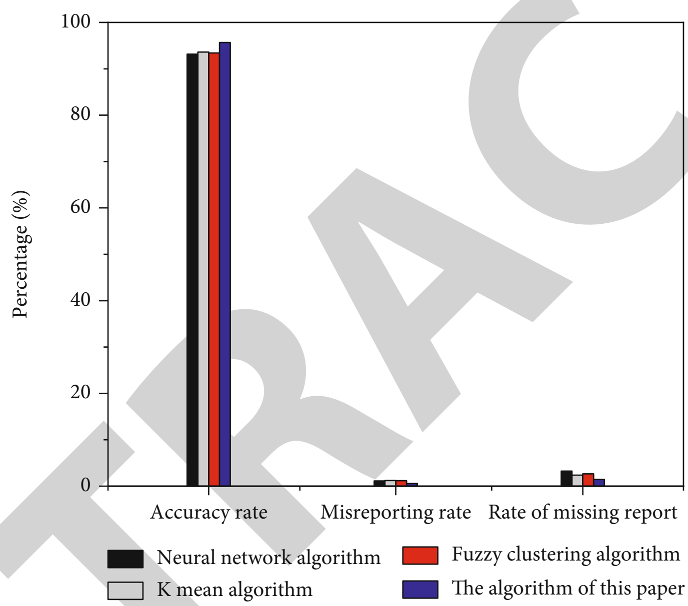

Figure 6: Comparison of detection performance of different algorithms.

(3) Experience each target data to be tested, and obtain the support frequency of the decision tree item set of the target data

(4) By calculating the support frequency of the network data packet and the normal option set of the decision tree, in order to determine whether it is abnormal data or normal data and then realize the network software intrusion detection

4. Results Discussion

Experimental verification first needs to build a software and hardware environment; the host server used by the author is Inteli7 processor, 32G memory, and 1 T hard disk; the software environment is VC++6.0 as the development language; the experimental data set is KDDCUP99; the database adopts MySQL8.0.11 version; and the operating system is Windows 7; by verifying the false-positive rate, false-negative rate, and detection time of different network software intrusion detection systems, in order to evaluate the

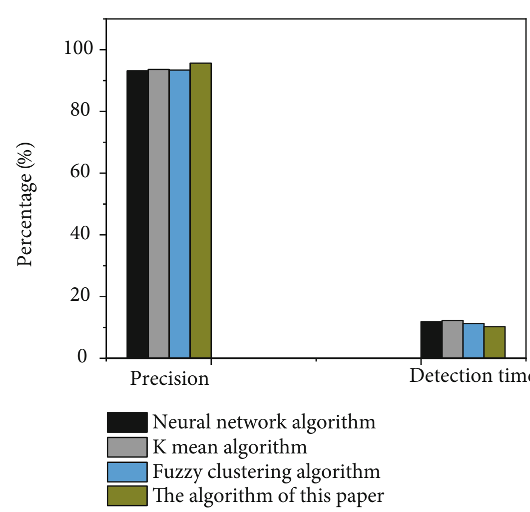

Figure 7: Comparison of different system performance.

effectiveness of the system, the comparison results of the detection performance of different algorithms are shown in Figure 6.

It can be seen from Figure 6 that the detection system model designed by the author is under the same test sample, and the accuracy rate is 95.67%, which is higher than the other three detection systems; at the same time, the rate of false positives and false negatives is also lower than other systems and has certain advantages. At the same time, in order to verify the timeliness of the algorithm, it is necessary to compare the detection time of different algorithms.In order to verify the detection efficiency of the system, all test sets were used to verify the universality of the system. The specific effect is shown in Figure 7.

It can be seen from Figure 7 that while the algorithm guarantees the detection accuracy, compared with other systems, the detection time also has certain advantages and has certain theoretical and application value.

5. Conclusion

Applying data mining technology to software intrusion detection system can quickly and efficiently perform feature selection, establish a suitable detection model, better improve the software intrusion detection capability of the software intrusion detection system, and reduce its false-positive rate and false-negative rate. The host agent designs the software intrusion detection system. Security software intrusion detection can serve the network server well and avoid losses caused by intrusion and destruction of network servers by unsafe behaviors. Design of the software intrusion detection system management decision center can effectively improve the safety factor of the database and strengthen the security of data information. Research is only one part of data security protection design, and the related technical methods need to be improved. In the computer software intrusion detection system, the application of data mining technology can effectively filter and integrate information, thereby enhancing the role and function of computer software intrusion detection.

Data Availability

The data used to support the findings of this study are available from the corresponding author upon request.

Conflicts of Interest

The author declares that they have no conflicts of interest.

Acknowledgments

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