Mobile Information Systems

Intelligent Spectrum Access Technologies for Passive Communication and Computing

Lead Guest Editor: Liming Chen
Guest Editors: Arumugam Nallanathan and Venki Balasubramanian

Intelligent Spectrum Access Technologies for Passive Communication and Computing

Mobile Information Systems

Intelligent Spectrum Access Technologies for Passive Communication and Computing

Lead Guest Editor: Liming Chen
Guest Editors: Arumugam Nallanathan and Venki Balasubramanian

Contents

Contents

Hindawi
Mobile Information Systems
Volume 2023, Article ID 9805762, 1 page
https://doi.org/10.1155/2023/9805762

Retraction

Retracted: Cross-Border E-Commerce Platform Logistics and Supply Chain Network Optimization Based on Deep Learning

Mobile Information Systems

Received 19 September 2023; Accepted 19 September 2023; Published 20 September 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This article has been retracted by Hindawi following an investigation undertaken by the publisher [1].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] H. Guo and T. Zou, "Cross-Border E-Commerce Platform Logistics and Supply Chain Network Optimization Based on Deep Learning," *Mobile Information Systems*, vol. 2022, Article ID 2203322, 10 pages, 2022.

Hindawi
Mobile Information Systems
Volume 2023, Article ID 9754151, 1 page
https://doi.org/10.1155/2023/9754151

Retraction

Retracted: Application of Cloud Computing and GIS Based on Internet of Things in Oil and Gas Storage and Transportation Production Management and Safety Monitoring and Early Warning System

Mobile Information Systems

Received 19 September 2023; Accepted 19 September 2023; Published 20 September 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] K. Wang, "Application of Cloud Computing and GIS Based on Internet of Things in Oil and Gas Storage and Transportation Production Management and Safety Monitoring and Early Warning System," *Mobile Information Systems*, vol. 2022, Article ID 1875479, 11 pages, 2022.

Hindawi
Mobile Information Systems
Volume 2023, Article ID 9891234, 1 page
https://doi.org/10.1155/2023/9891234

Retraction

Retracted: Data Collection and Management of Digital Process of Painting and Calligraphy Based on Internet of Things

Mobile Information Systems

Received 1 August 2023; Accepted 1 August 2023; Published 2 August 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] C. Sun, "Data Collection and Management of Digital Process of Painting and Calligraphy Based on Internet of Things," *Mobile Information Systems*, vol. 2022, Article ID 6060115, 6 pages, 2022.

Hindawi
Mobile Information Systems
Volume 2023, Article ID 9834172, 1 page
https://doi.org/10.1155/2023/9834172

Retraction

Retracted: Dynamic Analysis of Deep Integration of Artificial Intelligence Based on High-Performance Computing for Ideological and Political Teaching Evaluation

Mobile Information Systems

Received 1 August 2023; Accepted 1 August 2023; Published 2 August 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. Li and D. Yao, "Dynamic Analysis of Deep Integration of Artificial Intelligence Based on High-Performance Computing for Ideological and Political Teaching Evaluation," *Mobile Information Systems*, vol. 2022, Article ID 4748544, 15 pages, 2022.

Hindawi
Mobile Information Systems
Volume 2023, Article ID 9830407, 1 page
https://doi.org/10.1155/2023/9830407

Retraction

Retracted: Walking Position Data in Football Training Based on Embedded Action Recognition System

Mobile Information Systems

Received 1 August 2023; Accepted 1 August 2023; Published 2 August 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. Li, "Walking Position Data in Football Training Based on Embedded Action Recognition System," *Mobile Information Systems*, vol. 2022, Article ID 4094025, 13 pages, 2022.

Hindawi
Mobile Information Systems
Volume 2023, Article ID 9814346, 1 page
https://doi.org/10.1155/2023/9814346

Retraction

Retracted: Influence of Embedded Microprocessor Wireless Communication in the Ankle Joint Proprioception Training on the Prevention of Football Sports Injuries

Mobile Information Systems

Received 1 August 2023; Accepted 1 August 2023; Published 2 August 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] S. Li, "Influence of Embedded Microprocessor Wireless Communication in the Ankle Joint Proprioception Training on the Prevention of Football Sports Injuries," *Mobile Information Systems*, vol. 2022, Article ID 8996453, 13 pages, 2022.

Hindawi
Mobile Information Systems
Volume 2023, Article ID 9784310, 1 page
https://doi.org/10.1155/2023/9784310

Retraction

Retracted: Environmental Quality Optimization of Sustainable Rural Revitalization Strategy Based on Improved Genetic Algorithm

Mobile Information Systems

Received 1 August 2023; Accepted 1 August 2023; Published 2 August 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] G. Zhang and Z. Zeng, "Environmental Quality Optimization of Sustainable Rural Revitalization Strategy Based on Improved Genetic Algorithm," *Mobile Information Systems*, vol. 2022, Article ID 3775515, 15 pages, 2022.

Hindawi
Mobile Information Systems
Volume 2023, Article ID 9769768, 1 page
https://doi.org/10.1155/2023/9769768

Retraction

Retracted: Multimedia Technology Based on Cloud Computing in Aerobics Teaching

Mobile Information Systems

Received 1 August 2023; Accepted 1 August 2023; Published 2 August 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] X. Guo, "Multimedia Technology Based on Cloud Computing in Aerobics Teaching," *Mobile Information Systems*, vol. 2022, Article ID 4157042, 7 pages, 2022.

Hindawi
Mobile Information Systems
Volume 2023, Article ID 9764723, 1 page
https://doi.org/10.1155/2023/9764723

Retraction

Retracted: Construction Scheme of Quantitative Assessment of College Teachers' Performance Based on Big Data Analysis

Mobile Information Systems

Received 1 August 2023; Accepted 1 August 2023; Published 2 August 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. Zheng and C. Sun, "Construction Scheme of Quantitative Assessment of College Teachers' Performance Based on Big Data Analysis," *Mobile Information Systems*, vol. 2022, Article ID 8373164, 10 pages, 2022.

Hindawi
Mobile Information Systems
Volume 2023, Article ID 9891234, 1 page
https://doi.org/10.1155/2023/9891234

Retraction

Retracted: Data Collection and Management of Digital Process of Painting and Calligraphy Based on Internet of Things

Mobile Information Systems

Received 1 August 2023; Accepted 1 August 2023; Published 2 August 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] C. Sun, "Data Collection and Management of Digital Process of Painting and Calligraphy Based on Internet of Things," *Mobile Information Systems*, vol. 2022, Article ID 6060115, 6 pages, 2022.

Hindawi
Mobile Information Systems
Volume 2022, Article ID 6060115, 6 pages
https://doi.org/10.1155/2022/6060115

Research Article

Data Collection and Management of Digital Process of Painting and Calligraphy Based on Internet of Things

Chengwu Sun

Arts College, Sichuan University, Chengdu 640062, Sichuan, China

Correspondence should be addressed to Chengwu Sun; 2017321050009@stu.scu.edu.cn

Received 3 May 2022; Revised 29 June 2022; Accepted 30 July 2022; Published 19 August 2022

Academic Editor: Liming Chen

With the advent of the information age, the research on the digitization of calligraphy and painting information is particularly important. In order to improve the efficiency of data management after the digitization of printed information, this paper designs a digital information flow management system and data retrieval model based on the Internet of Things. According to the mismatch between the selected unit and the actual spatial data distribution and the influence of data dispersion, an algorithm for building an r-tree of a digital information flow control system using computer graphics is proposed through efficient data retrieval based on the *r*-tree index. The experimental results show that the algorithm has good practicability.

1. Introduction

Chinese traditional painting and calligraphy artworks have undergone thousands of years of integration and development, forming a unique national style with distinctive features compared with European and American countries, and forming an independent cultural phenomenon in the world [1]. When digitizing Chinese painting and calligraphy artworks, it is far from enough to only capture their macroscopic appearance, and it is crucial to fully identify and capture their artistic characteristics, which requires the optical resolution, color depth, and grayscale value of the digitizing equipment to fully meet the needs, so that the artistic characteristics represented by ink color and layers of painting and calligraphy artworks can be presented in the digitizing display equipment in a clear and precise manner, which provides the opportunity for the file storage format of the digitized collection results is an important factor affecting the security of its digital document storage [2].

Whether for interest, appreciation, or decoration, people's attention to painting and calligraphy has been rising, and their taste for painting and calligraphy artworks has been greatly improved [3]. On this premise, in order to meet the people's demand for public culture, many art galleries or museums regularly launch various exhibitions, allowing people to appreciate the works of famous Chinese calligraphers and painters in the past or some modern artists, and calligraphy and painting artworks have gradually transformed from the original collection of a few people to the cultural consumption of the general public.

However, because of its scarcity and uniqueness, the value of painting and calligraphy artworks is necessarily expensive, and the high price often stops most people from appreciating them. In addition, we will digitize the paintings and calligraphy in paper and set up online museums or galleries, so that more art lovers can enjoy the masterpieces in high definition on the Internet without leaving home [4]. In addition, the digital collection of painting and calligraphy artwork after image processing to produce a high degree of reproduction is also a widely used form of promotion. People will buy a replica to decorate their home or office after enjoying the original. From the second point of view, the precious works in the museum need to be regularly exhibited or transported off-site for cultural exchange, and in the process, there is a high risk of collision damage or even loss, which poses a great risk to the safety of the artwork. In this case, the exhibition unit will use various ways to produce replicas that are almost indistinguishable from the originals for exhibition instead of the originals, so that the general public can enjoy the beauty and art on the basis of protecting

the originals. In addition, for students who are engaged in the study of art, they often enjoy the original works of art in museums or galleries for a short time and from a distance or study the works of master painters in albums, and the size is usually much smaller than the size of the original work, which largely limits the accurate grasp of the artist's artistic standard. In this case, many art schools will give students high-quality reproductions of original works for study and copying, so that students can learn in detail the artist's brushwork, use of ink and detailed changes in creation, and deeply understand the artistic essence of the original work. Under this demand, how to accurately restore Chinese painting and calligraphy artworks into a fine reproduction after digital acquisition and to innovate in certain directions becomes a worthy research topic [5, 6].

The technologies in the IoT are applied to the entire digital process of calligraphy and painting data collection [9, 10]. In this paper, we hope that through the discussion of digital acquisition and image processing of calligraphy and painting artworks, through theoretical argumentation and example analysis, it can be said that the innovative image processing based on the objective reproduction of the artistic characteristics of calligraphy and painting is suitable for people's aesthetic interests in the new era.

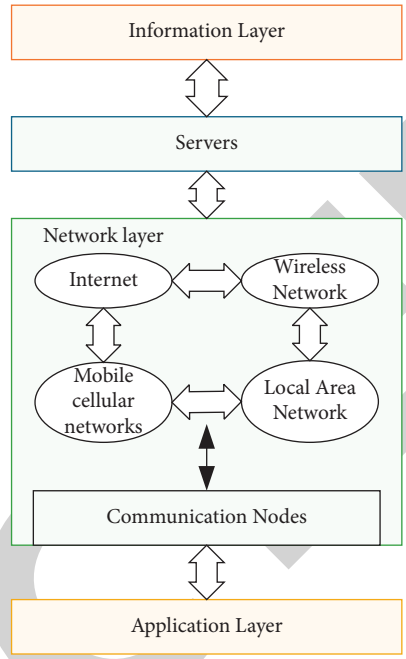


Figure 1: Intelligent digital information management system for painting and calligraphy.

2. Related Work

Digital acquisition and image processing of painting and calligraphy artworks have been emerging in the last two decades, and it has become a major form of promotion of painting and calligraphy artworks. Digital acquisition and image processing of calligraphy and painting artworks are not only for reproduction but also to disseminate them to the public in a more convenient and faster form [10].

The earliest reproduction of calligraphy and painting artworks was by hand copying, as in the case of the aforementioned "Women's History" and "Lanting Preface," using the hook copying method to get a copy of the original was the most important way of reproduction before modern times [11]. Hand copying requires a high level of painting skills and a deep understanding of the original work, as well as familiarity with the artist's characteristics and techniques. Such a copy also has high artistic value, especially if it is from the same era as the original author or not too long ago, and has completely taken the place of the original work when it has not been handed down. Handprint reproductions take longer and are small in number but are of high value, such reproductions have high collectible value but are difficult to get into the homes of the general public [12].

The second type is woodblock watermarking, which uses woodblock engraving to make multiple engraving plates on rice paper according to the color separation characteristics of the original painting to obtain a copy that is basically the same as the original. This method requires that the color separation and engraving staff must have a high level of artistic training and a high foundation in painting, so as to get a copy that matches the charm of the original. This belongs to the category of batch printing, but the production cycle is long, low production, there is a high degree of hand skills and artistry, using traditional painting materials such as pigments and rice paper, it has a certain collection value, and Beijing Rongbaozhai is a typical representative of the more successful woodblock watermarking done.

The third is the color plate printing and offset printing, which belongs to the category of printed matter, high efficiency, large print volume, and low cost and belongs to the propaganda and popular products, and the propaganda and promotion of Chinese calligraphy and painting have made a great contribution, but there are still some gaps between the printed matter and high-quality reproductions.

After the emergence of digital capture and image processing technology, in addition to using digital media such as the Internet to disseminate, making physical reproductions is a common form of promotion. For the digital capture and image processing after the electronic version of the painting and calligraphy artwork, using a digital microjet on the surface treatment of rice paper or silk reproduction of the original is a very desirable form, the level of fine, natural transition, in the presentation of details and the original highly similar. This requires high-resolution digital capture of the original work and the use of design software to adjust the color and level of the electronic image to a level that allows for digital microblowing. Digital microjet works are different from conventional prints. The biggest difference between conventional prints and manual copying and woodblock printing lies in the emotional, intellectual, and human input, which gives the impression that the prints are cold and single, lacking in dynamism, and are mass-produced industrial products [13]. Digital microjet works are not only more accurate than conventional prints, have an independent color correction system for each piece of work, and cannot achieve mass production, which is currently a more desirable path for painting and calligraphy artwork reproduction.

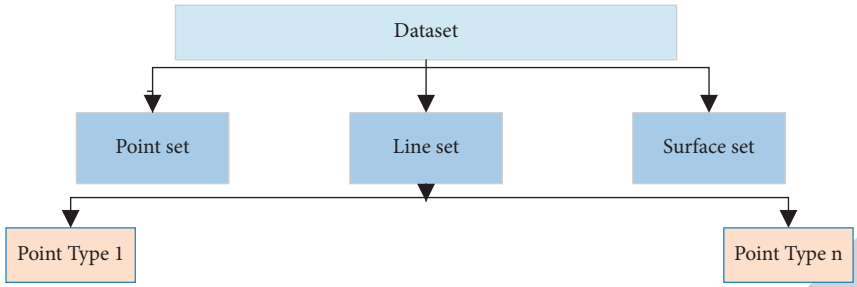


Figure 2: Hierarchical partitioning model.

There are many types of digital capture and image processing for painting and calligraphy artworks, and different methods and image processing processes are used depending on the digital capture equipment used. The objective state of the original painting and calligraphy also determines the way of digital acquisition [14].

The use of high-definition digital cameras for stitching after shooting is also the way used by some researchers, and this form is suitable for the type of not easy to scan, such as too large an area and not convenient to move.

The use of high-precision large-format photographic equipment for one-time digital acquisition is a form of collection quality is relatively high, and most companies engaged in this direction have their own set of complete programs [16, 17]. It is difficult to analyze the artistic characteristics of each work in this form, but only to achieve the resemblance. Regardless of which digital capture and image processing methods need to solve the problem is to carefully study the original art style before the digital microjetting of electronic images and design a set of independent color correction programs for the work, so as to achieve a high degree of "form and spirit with" the original work [18].

Although the digital acquisition and image processing of calligraphy and painting artworks are developing relatively rapidly, they are only at the stage of enterprise application and have not yet formed a mature theoretical system, lacking a unified theoretical guidance [19].

3. Data Acquisition and Management System of Calligraphy and Painting Digitalization Project Based on IoT

Using the network calligraphy and painting readout computer system does not meet the expectations and needs continuous optimization. Index database has many methods such as fixed grid and quadtree.

After 20 years of development, more and more p tree varieties have gradually formed the R-tree family of leaf space index. Based on geohash tree, they proposed a GRISTT method including spatiotemporal index. This method supports time and time-oriented queries. They proposed a dynamic tree (R-tree) construction method based on K-means + spatial topics to enhance the topic relevance of spatial data and improve the clustering multipath method and the segmentation algorithm of the overall efficiency of the R-tree. However, this method has the problem of abnormal interference of spatial data. In addition, the algorithm has defects in processing a large amount of data.

Input $S_l = \{r_{l1}, r_{l2}, L, r_{ln}\}$
  Initialization $C_l = \{C_l^1, L, C_l^k, L, C_l^d\}$
  For $i = 1$ to m do
  Calculation $d(r_i, c_i)$
  If $d(r_i, c_i) r_i \in M, M = \{r_b | d(r_b, C_l)\}$
  End for
  Calculation C_l'
  Calculation $r_c = \arg\min(d(C_l', S_l)), r_i \in S$
  Output r_c
Output Clustering centroids r_c.

Algorithm 1: DCC algorithm implementation process.

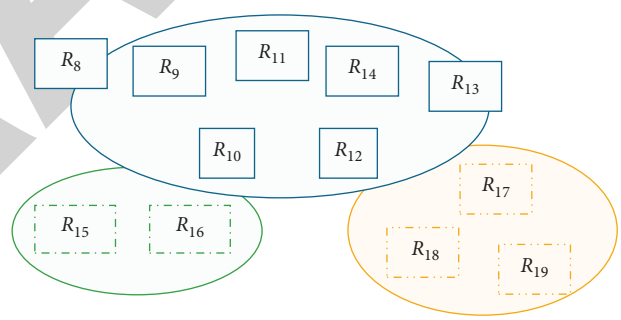


Figure 3: Minimum enclosing rectangle.

Therefore, to address the problems of mismatch between the selected clusters and the actual spatial data distribution, which are easily affected by outlier data, this paper constructs an R-tree in the intelligent painting and calligraphy digital information management system based on the dynamical clustering center (DCC) algorithm, so as to improve the data retrieval efficiency.

3.1. Intelligent Digital Information Management System for Painting and Calligraphy

3.1.1. System Structure. Figure 1 shows the intelligent digital information management system of calligraphy and painting built based on IoT technology.

This layer can define and install various processes, programs, and applications, such as an intelligent medical document management system.

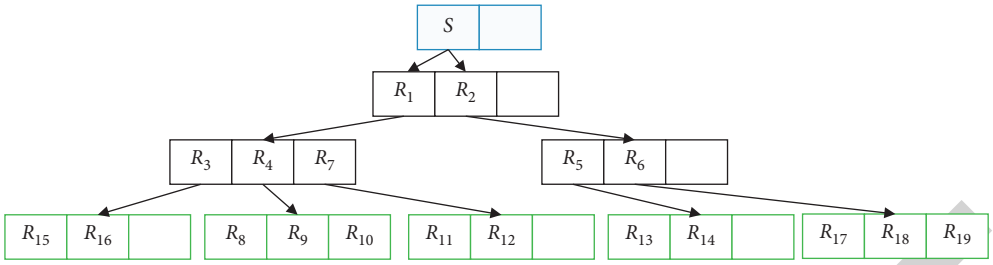


Figure 4: R-tree construction process.

```
Input: R-number type N, request data node W.
  If Nlevel = 0 do
  Back Null
  Else
  For i = 1, 2, L, n do
  If N.P_i ∈ WW′ = R.search(N.P_i, W)
  End if
  End for
  End if
  Output W′
Output: Retrieval result.
```

Algorithm 2: R-number retrieval process.

Table 1: Simulation-related parameters.

Parameters	Values
Total network bandwidth	100 MB
Medical records (T_1)	0.52 MB
Health monitoring information (T_2)	4.58 MB
Polling complexity (Q_1)	10
Number of polling tasks N_1	12088

3.1.2. System Core. The R-tree index method is used to realize the rapid access to data. Data storage is a kind of physical spatial data storage, which provides fast access to different spatial object index structures. The database of intelligent calligraphy and painting digital information management system based on tree R is based on a relational database. First, space objects are divided into three simple entities according to geometric types: point, line, and surface. The required subtopics (as shown in Figure 2) are defined according to the properties and needs of physical space objects.

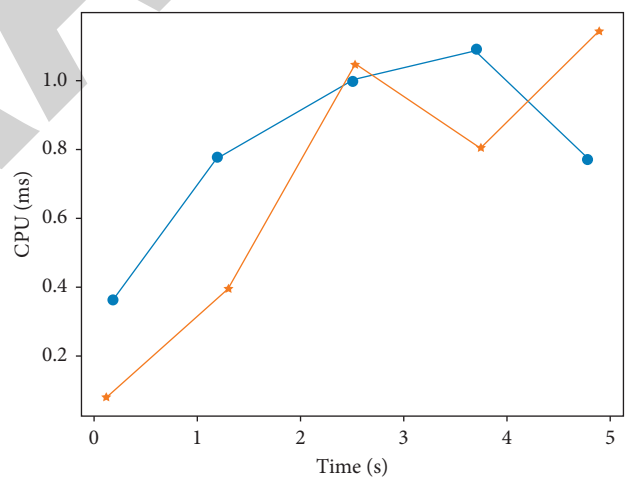


Figure 5: Comparison of CPU execution efficiency of different methods.

3.2. R-Tree Based Information Retrieval Model

3.2.1. DCC Algorithm. In order to ensure the effective access to large-scale data, the improved R-tree data index technology is introduced into the system. The calculation process is as follows:

$$R = \frac{1}{\sqrt{m/D}}. \tag{1}$$

Let d_i be the distance from the data to i. If $d_i \le R$, mark i as a neighboring object of the data; if $d_i > R$, record it as a nonneighboring object of the data. Let r_1, r_2, L, r_m be the m members of the spatial data cluster R_d. Assuming that c_i is the center of cluster i, the distance between r_i and c_i is calculated as follows:

$$d(r_i, c_i) = \sqrt{\left(r_i^1 - r_i^1\right)^2 + \left(r_i^2 - r_i^2\right)^2 + L + \left(r_i^d - r_i^d\right)^2}. \tag{2}$$

Suppose the set of samples in l is denoted as $S_l = \{r_{l1}, r_{l2}, L, r_{ln}\}$; that is, S_l contains n data. Furthermore, the average point of S_l can be described as $C_l = \{C_l^1, L, C_l^k, L, C_l^d\}, m$, where C_l^k denotes the k th attribute of C_l; then, we have

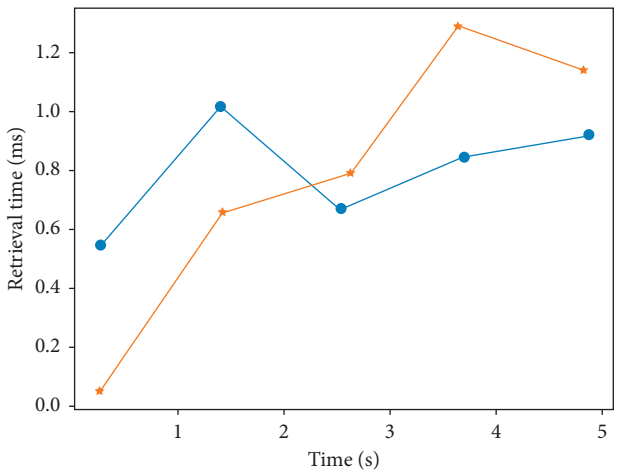


Figure 6: Comparison of retrieval efficiency of different methods.

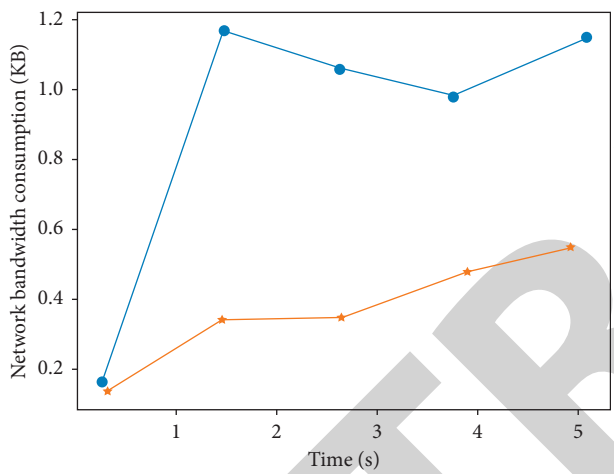


Figure 7: Comparison of bandwidth requirements for different methods.

$$nC_l^k = \frac{\left(r_{l1}^k + r_{l2}^k + L + r_{\ln}^k\right)}{n}. \tag{3}$$

In selecting the clustering centers, the average points of the data on the C_l class are first obtained. Then, the distances from C_l to other data are calculated. The neighboring objects of C_l are obtained according to the distance index R. Using the closest spatial data as the cluster center point r_c and calculating the average point C_l' of the neighboring objects, we have

$$N.P_i \in W' = R.\text{search}\left(N.P_i, W\right)_{13}, R_{14}, L, n_{11}, R_8 R_9, R_{14}, R_{17}, R_{18}. \tag{4}$$

Among them, $S_l = \{r_{l1}, r_{l2}, L, r_{\ln}\}$. In summary, the process of DCC algorithm implementation can be described as shown in the following algorithm:

3.2.2. R-Tree Index Construction. This section details the indexing process used to create a dynamic R-tree.

Next, the R-tree index structure matching any spatial object set is introduced. The basic creation process is as follows: first, create a minimum closed rectangle for all space objects, as shown in Figure 3. Then, the condensation center (DCC) algorithm of outer rectangular series clustering is determined according to the dynamics. As shown in Figure 4, R_{12} selects the point closest to the midpoint as the source center of the cluster, with a value of $k = 1$. R_{19}, which is farthest from the cluster center R_{12}, and R_8, which is farthest from R_{19}, are selected as the cluster centers to start clustering. $R_{13}, R_{14}, R_{17}, R_{18}$ are grouped as R_{19}, and R_9, R_{10}, R_{11}, R_{12}, R_{15} and R_{16} are grouped as R_8, and finally form two groups. The largest cluster with radius and center is selected from the two clusters, and then, R_{15} (farthest from R_{12}), R_{11} (farthest from R_{15}), and R_{18} is grouped as the center of the cluster R_{12} and then evenly distributed, and the measurement function of the cluster is calculated.

3.2.3. R-Tree Based Retrieval Process. The R index of a tree has a complete set of indexes (inserts), queries, and deletes nodes. The following only introduces a query algorithm, which is executed according to the tree index R of the database geometric table. Creating an R-tree index in the database will greatly improve the data retrieval efficiency of many users. The following algorithm describes the indexing process of the R-tree:

4. Experiments and Analysis

This section conducts experimental analysis through the digital information data set of paintings and calligraphy (the basic experimental data mainly come from the painting and calligraphy data of a city museum). About 5 MB of painting and calligraphy data were collected in advance, and a multigroup server was used to simulate an intelligent painting and calligraphy digital information management system. In the experiment, about 5 MB of painting and calligraphy data were collected in advance, and multiple servers were used to simulate the intelligent painting and calligraphy digital information management system. The parameters of the simulation are shown in Table 1, and the specific idea is to verify the query efficiency of the proposed method through two query tasks under different network bandwidths. The simulation environment is as follows: CPU is i5 slightly Lenovo workstation, memory is 8 GB, the operating system is windows 10×64, and programming language is Python.

The performance of the system is analyzed multidimensionally during the simulation and compared with the HBase indexing algorithm. The results of the CPU execution efficiency comparison are shown in Figure 5, where both the HBase method and the proposed method show the trend of CPU execution time increasing with time.

Figure 6 shows the retrieval efficiency comparison results, the maximum retrieval time of the HBase method is about 3.21×105 ms, and the proposed method is about 3.19×105 ms.

Hindawi
Mobile Information Systems
Volume 2023, Article ID 9754151, 1 page
https://doi.org/10.1155/2023/9754151

Retraction

Retracted: Application of Cloud Computing and GIS Based on Internet of Things in Oil and Gas Storage and Transportation Production Management and Safety Monitoring and Early Warning System

Mobile Information Systems

Received 19 September 2023; Accepted 19 September 2023; Published 20 September 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] K. Wang, "Application of Cloud Computing and GIS Based on Internet of Things in Oil and Gas Storage and Transportation Production Management and Safety Monitoring and Early Warning System," *Mobile Information Systems*, vol. 2022, Article ID 1875479, 11 pages, 2022.

Hindawi
Mobile Information Systems
Volume 2022, Article ID 1875479, 11 pages
https://doi.org/10.1155/2022/1875479

Research Article

Application of Cloud Computing and GIS Based on Internet of Things in Oil and Gas Storage and Transportation Production Management and Safety Monitoring and Early Warning System

Kai Wang

School of Transportation and Logistics Engineering, Wuhan University of Technology, Wuhan 430063, Hubei, China

Correspondence should be addressed to Kai Wang; kaileader@whut.edu.cn

Received 27 April 2022; Revised 21 June 2022; Accepted 15 July 2022; Published 8 August 2022

Academic Editor: Liming Chen

The purpose of this study is to design an information management system, which can be used for oil and gas pipeline path planning, oil and gas production scheduling, oil and gas data statistical analysis, and other functions. In this study, a production management information system for oil and gas storage and transportation based on the Internet of Things and GIS technology is proposed. Through the integration of Internet and GIS technology, it can accurately analyze the path planning of oil and gas pipelines. The experiment proves the reliability of the system, and in the aspect of path planning, the simulated path of the system will be 20–30 km shorter than the original laying path, especially for long-distance pipeline laying, which can be reduced by about 30 km.

1. Introduction

The efficient use of energy has always been our pursuit, especially now that the resources are depleted day by day. Oil and gas resources are the most widely used and longest used resources in the world, and people have been working on their efficient storage and transportation. As a product of modern high-tech, the oil and gas storage and transportation production information system has provided tremendous help for oil and gas storage, transportation and safety management. The Internet of Things and GIS technology are also new technologies that should be developed and used in various industries. In developed countries, the research on the Internet of Things and GIS has been relatively long, and the research on oil and gas storage and transportation is relatively in-depth. As an energy source, China is in urgent need of high-efficiency technologies for oil and gas storage and transportation. Therefore, it is now managing oil and gas storage and transportation production. Research on information systems is very necessary.

In the 21st century, people have realized that energy is slowly depleting, and the awareness of the energy crisis is gradually becoming stronger. Therefore, there are many research studies on oil and gas storage and transportation and GIS technology. Al-Rojaie discussed the opinions of Qassimi Arabic speakers on the linguistic variation of their own dialects, and the socio-cultural evaluations related to their opinions. Using geographic information system (GIS) mapping software for analysis, their research shows that it is necessary to further explore the potential ideologies and social values of Arabic speakers of their own dialects and other dialects in the Arabic community [1]. Xia et al. used D-InSAR new mining subsidence monitoring to accurately obtain surface deformation and established a temporal and spatial relationship model between surface deformation and underground mining characterized by subsidence. A fast, efficient, and accurate method for identifying illegal underground mining areas has been developed [2]. Orimoloye and Ololade and others used GIS technology to study a series of ecological and environmental impacts of gold mining operations. Research results show that areas with low index values are easily affected by mining and other human activities, while areas with high index values mean little or no impact [3]. Liu et al. believe that with the rapid development

of computer technology, GIS technology can be combined with database programming. However, the progress of science and technology is contrary to the principle of harmonious development between man and nature. Global warming caused by excessive carbon dioxide pollution may be the most serious environmental problem [4]. Although there are many related studies, there are still many aspects that can be strengthened for the research on oil and gas storage, transportation, and production information management systems.

This article proposes the following innovations for the Internet of Things technology: (1) Propose an information management system for oil and gas storage, transportation, and production based on the Internet of Things GIS technology. Before this, most of them were based on artificial intelligence systems or sensor networks. (2) For the information system, pay more attention to the research of tubing laying path, fully analyze its algorithm and modeling, and design a systematic geographic information database in the system.

2. Technology Internet of Things Cloud Computing and GIS Technology

2.1. Internet of Things Technology and Cloud Computing. As shown in Figure 1, the perception layer is at the foundation, and is at the bottom of the three-layer architecture. Its main function is to identify objects, perceive the environment, and collect information. With the support of the National Natural Science Foundation of China and major special funds for science and technology, the research on the sensing layer technology of the Internet of Things industry in China, such as network communication technology and sensor network, has made continuous progress. The main equipment includes two-dimensional code and readers, tags and readers, video capture equipment, wireless sensor nodes, etc. [5, 6]. The demand for big data transmission and processing platforms is a problem that the Internet of Things industry must face in the transmission network. The main technologies include embedded technology, sensor technology, item identification technology, control technology, etc. The transport layer, also called the network layer, is responsible for efficiently, reliably, and safely sending the data collected by the perception layer through a variety of networks. It solves the problem of data transmission, especially the problem of long-distance transmission [7, 8]. The Internet of Things is characterized by comprehensive perception, reliable transmission, and intelligent processing, and it is a network that can connect the physical world. The network here is not a brand-new network but is based on the mobile communication network and the Internet. The integration and expansion of various existing networks is the combination of wired and wireless, broadband and narrowband, sensing networks, and communication networks. The combination of networks can provide all kinds of users with an intelligent selection of the mode of access to the network. Commonly used network forms are Internet, wireless broadband network, wireless low-speed network, and mobile communication network [9, 10].

Cloud computing technology is not an innovation, but an integration of past technologies and the future of the software industry model. Although academics have not given a unified explanation to cloud computing, there is a saying that is widely accepted by the public. It is the development result of cloud computing, distributed computing, parallel computing, practical computing, network storage technology, virtualization, load balancing, and other traditional computer technologies. Cloud computing aims to provide users with cloud architecture nodes, and integrate a large number of relatively low-cost computer entities through the Internet or LAN to form a computer system with strong computing power. Under the SOA framework, with the help of three service providers of cloud computing: Infrastructure as a Service (IaaS), Platform as a Service (PaaS), Software as a Service (SaaS), and other advanced software models, this distributed cloud computing system with super performance has reached the hands of users.

With the continuous advancement of technical means, the popularization and application of various advanced sensing technologies and equipment, the application prospects of the Internet of Things are very broad, and more and more sensors are deployed in a wide range of production and life fields, from national security, public health, Facilitate transportation and other government public management, to smart homes, health checks, convenient payment and other daily life of the people, and are connected by the Internet and communication technology. The physical world is free from the constraints of time and space through the digital world and can present us more accurately. The application of the Internet of Things is to connect items through sensing devices and networks to realize automatic and real-time identification, positioning, and other supervision and management activities of objects, so as to achieve the corresponding demand goals of managers and consumers for items [11, 12]. The most common application in oil and gas storage and transportation is the Internet of Things (IoT) network for oil field exploitation and transportation, which links various devices through the network for unified deployment.

2.2. GGIS Technology. Geographic Information System (GIS) is an emerging modern edge science. It is involved in many research fields such as information science, computer science, and space science. The data of its geographic database includes graphic data, attribute data, positioning data, remote sensing data, etc. These data are obtained through surveys and collection. GIS was first put forward by geographers in Canada, so all geographic databases are foreign data, and domestic users need to input their own data. The geographical information system is based on a geographic database, analyzes and processes the operation process related to these data, and provides the researcher with decision-making and planning services [13].

As shown in Figure 2, the geographic system mainly includes four major components. One is the hardware system, including hardware devices such as computers, servers, and geographic detectors that make up the GIS. The

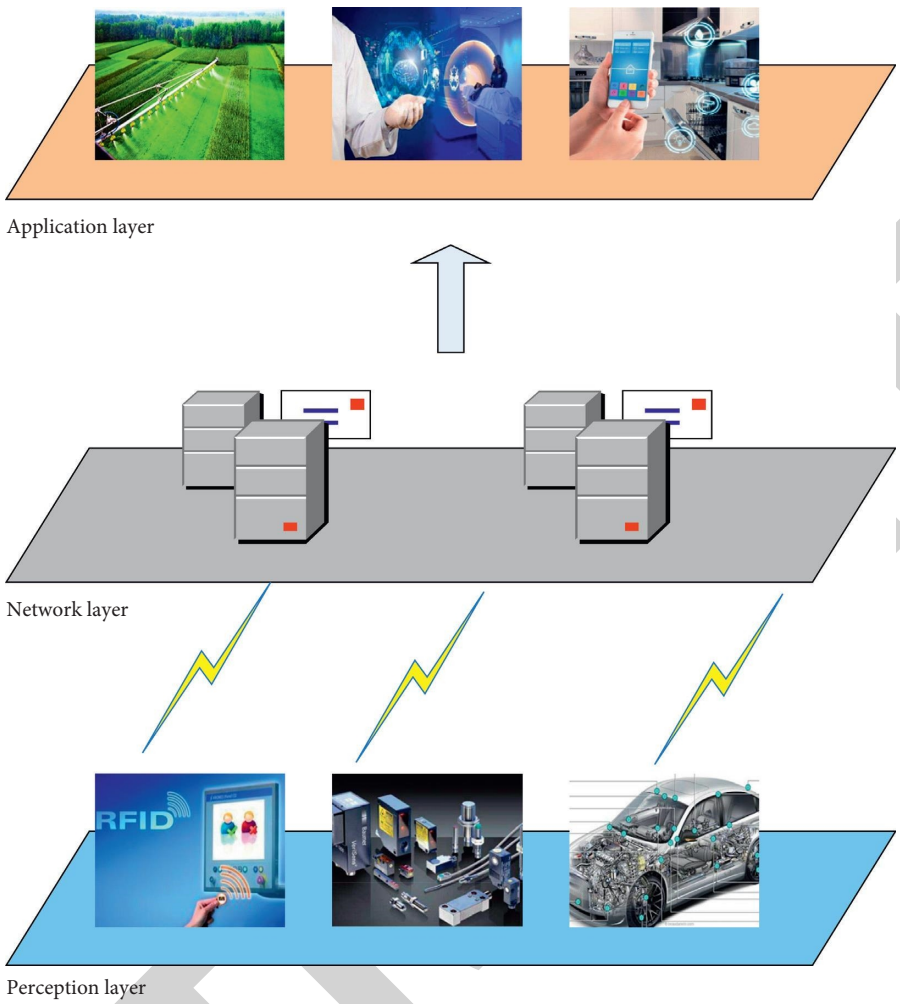


Figure 1: Basic architecture diagram of the Internet of Things.

second is a software system, which is a geographic information system developed based on GIS, which can complete certain operational tasks. The third is geographic data. The basic principle of GIS is based on geographic data, so it must be correct for geographic data. The fourth is users. As users of the system, users are divided into ordinary users and professional users. For ordinary users, it is more to use the original functions, while professional users can further develop functions based on the system and enjoy higher authority. GIS is mainly used to process geographic-related information data. Geographical information data has its own particularities. First of all, its spatial and geographic features, such as spatial location data LBS (location-based services) common longitude and latitude coordinate data, and finally, the intersection and separation of data between objects. Then there are its attribute characteristic data, such as the length, width, directionality, start point, and end point of the road data. Then there is its time-domain characteristic data, such as the time of data collection. The application of GIS technology is very extensive, involving many industries. In logistics management, it allocates resources according to the corresponding road access and material flow. It also allocates materials efficiently and reasonably in the military and urban management. In large-scale urban construction, the planning of roads, sports venues, parking lots, green spaces, etc., enables the rational distribution of facilities and the efficient use of resources [14, 15].

2.3. Application of GIS in Oil and Gas Storage and Transportation Production Management. The application of GIS technology to energy conservation master planning and sustainable development research technology in the energy conservation master plan and sustainable development research process is mainly reflected in the direct ratio of total resource savings, effective energy utilization, and energy distribution. Or indirectly analyze the powerful data processing and analysis capabilities that can be used to simulate the energy-saving dynamic change process and expected planning results. This can analyze the expected results as soon as possible, and propose feasible measures and remedial plans for some predictive results in the future. And put forward good energy-saving policies and measures to achieve a more reasonable energy-saving plan [16]. The formulation of energy-saving plans applied to different industries and projects in order to strengthen energy-saving

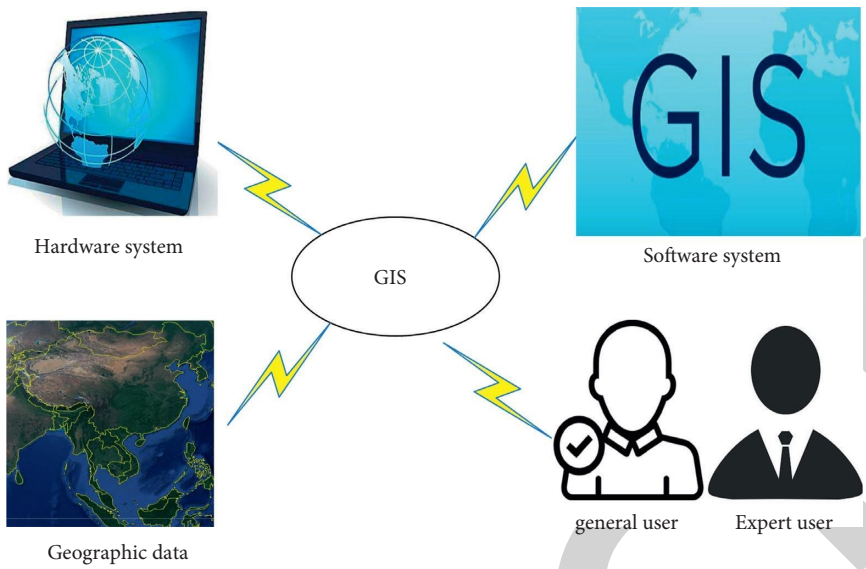


Figure 2: Composition of geographic information system.

and emission-reduction management, improve energy utilization efficiency, and achieve the sustainable development goals of energy-saving emission reduction, environmental protection, cost reduction and efficiency enhancemen. It is formulated under different industries and different economic systems. Classification of energy-saving planning is necessary. In the existing development model, as long as there are sufficient macro data and information support technology, a more reasonable professional energy-saving and emission-reduction spatial information system can be constructed, and more specific and targeted energy-saving planning can be established. For example, the energy-saving and emission-reduction development plan of natural gas enterprises, the energy-saving and emission-reduction development plan of thermal engineering, etc. can be specific to a certain industry or a large-scale implementation project, and provide different reference perspectives for the future energy-saving and emission-reduction overall planning [17, 18].

The oil and gas storage and transportation production management system should focus on improving the service quality and efficiency of the enterprise, and take the structural reform of the supply side of the enterprise as the main line. Using modern information technologies, such as GIS, Internet of Things, cloud computing, GPS, AI, to develop enterprise information resources in depth, accelerate information circulation and sharing, and build to meet the needs of enterprise decision-making, management, and executive levels for coordinated operation, efficient management and scientific decision-making The required information management system promotes the overall improvement and optimization of the production, operation, management and decision-making methods of enterprises, leads demonstrations and sets benchmarks for the informatization construction of the gas industry, and contributes to the improvement of the work quality, management efficiency and service level of oil and gas enterprises [19].

2.4. Data Acquisition and Monitoring System. The data acquisition and monitoring system (ScADA) is a computer-based automation system that can monitor and control field equipment, apply to process control and scheduling, and realize a series of automation functions from data acquisition to equipment control and even signal alarms., That is, to realize "perception" in a certain application field.

As shown in Figure 3, it is a traditional data acquisition and monitoring system, and its composition is generally divided into three levels. The bottom layer is the data collection layer, that is, the data source facing the field environment, in this layer, responsible for data collection. The middle layer is the interactive network layer. The collected data is stored and preprocessed in the network interactive layer, including data classification, data grouping, and data cleaning. The top layer is the monitoring center. After the data is collected, the data is processed in the data center and presented in the monitoring center in a visual manner [20].

3. Design of Management Information System for Oil and Gas Storage and Transportation

Oil and gas storage and transportation companies generally have multiple pipelines, multiple crude oil station depots, and multiple gas stations. The business is the "receiving, storage, transportation, and sales of crude oil and natural gas," the unified command of the production dispatching room, and the coordination of various stations and other related departments according to the requirements of the higher-level departments. Ensure the normal operation of production during this business process.

According to the production and management needs of storage and transportation companies, we should focus on the characteristics of the oil and gas field enterprises in the development, and combine the characteristics of the industry management of the oil and gas field enterprises when

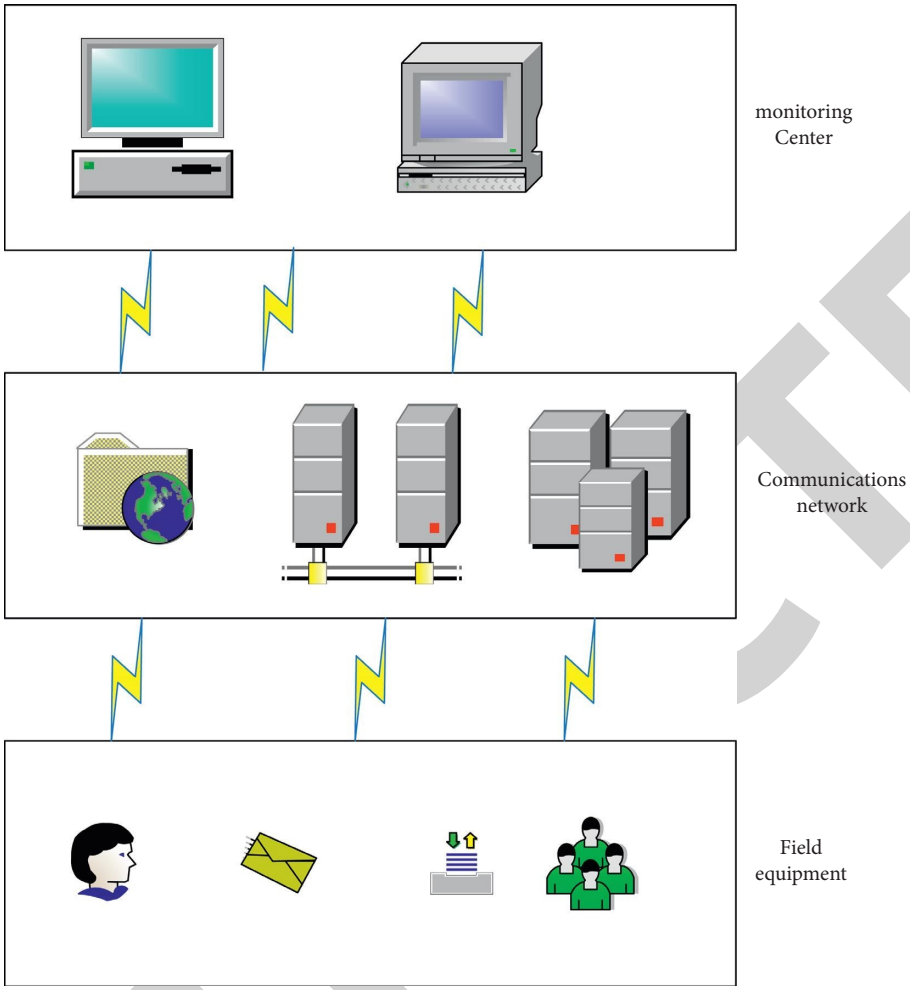


Figure 3: Traditional SCADA system.

focusing on versatility, and use information sharing and network dynamics in response to the defects of the existing systems. The technical route of management, in accordance with comprehensive management requirements, formulate a reasonable information management process, only in this way can it cater to the current development trend of storage and transportation, and in a practical sense, it can satisfy the effective control, management, and analysis of storage and transportation production [21, 22].

In the oil and gas storage, and transportation production management information system of this article, it is a visual auxiliary decision-making system for production management. The overall goal of the system is based on the basic functions of GIS, integrating the mathematical modeling methods of the main problems of oil and gas storage and transportation production management with the GIS software platform, expanding the spatial analysis functions of GIS, and making the system not only the basics of general GIS software functions, and can integrate expert knowledge in the field of oil and gas storage and transportation, conduct special research on oil and gas storage and transportation production management, and realize the integration of data input, processing, management, analysis, visual expression and decision-making in oil and gas storage and transportation production management. In particular, the following special analysis functions of oil and gas storage and transportation production management should be realized. Oil and gas pipeline structure analysis. Oil and gas pipeline safety and reliability analysis [23].

3.1. Database Design. The database design establishes a table space and an index table space for the database, which is of great benefit to the management and expansion of the database, and also helps to improve the data efficiency, so as to minimize the possibility of data damage and enhance the manageability of the database. The establishment of a database is the basis and prerequisite for the development of a management information system. Then, before the development of the oil and gas storage and transportation production management information system, a unified format of the oil and gas storage and transportation production database is first required. The entire database includes geographic data, pipeline data, and safety and reliability. Analyzing attribute data and production scheduling attribute data, the quality of the database design is very important, enough to determine the success or failure of the system.

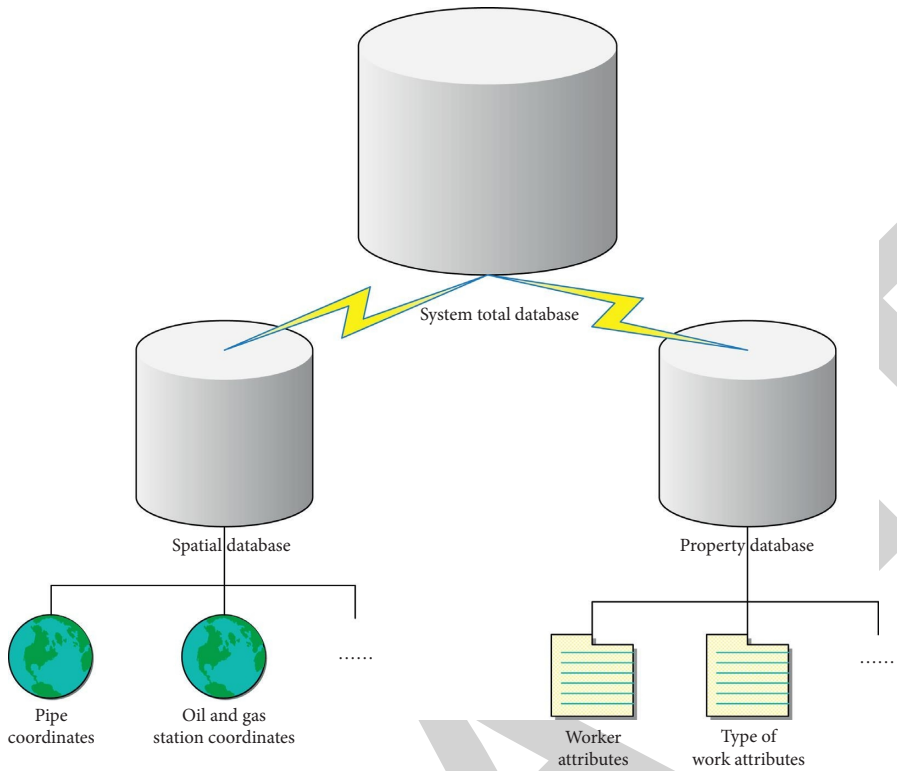


Figure 4: Schematic diagram of database composition.

As shown in Figure 4, the databases in this article mainly include spatial databases and attribute databases. Both databases will eventually be integrated into the main service system to break the barriers between data and achieve unified scheduling. For the spatial database, it mainly collects important geographic location information such as gas stations, pipeline routes, and oil stations. On the GIS system, two-dimensional geographic information data is established with north, south, east, and west as x, y. For pipeline laying simulation, three-dimensional geographic data will be established with the buried depth as z. In the attribute database, it is mainly to define the company's business, worker scheduling and other attributes, and compile attribute data into the database to achieve the purpose of data analysis, modeling, and scheduling.

3.2. Functional Framework. This system is a comprehensive information system that integrates data collection, sorting, transmission, reporting, and publishing. The system uses B/S mode to access the database for data collection and processing. The physical model of this system is designed based on the data processing center of the oil and gas storage and transportation company as the main database. The oilfield network of each grassroots station and the team is connected to the server. The client of the grassroots station and team connects to the central database through the application server. The grassroots station team can only access the data of the unit, and cannot access the data of the main database of the oil and gas storage and transportation company, which logically ensures the safety of the data, and at the same time enables the centralized management of the data to improve the utilization rate of the data. According to the requirement analysis of the system, combined with the characteristics of the GIS system and the Internet of Things, we divide the functions of the software system into three blocks: (1) pipeline construction; (2) production scheduling simulation; and (3) data analysis and processing, as shown in the Figure 5:

As shown in Figure 5, the main functions of the system are divided into three parts. The first is the pipeline laying system, which can simulate the pipeline laying between two points based on GIS technology and provide suggestions for actual pipeline laying. The second block is the production scheduling system, which can schedule workers in the system company and intelligently control oil and gas transportation by pipelines. The third block is the data analysis system, which is based on intelligent learning algorithms, records the data actually generated, performs prediction simulations, and provides data support for the company.

3.3. Pipeline Modeling

3.3.1. Mathematical Model of Oil and Gas Pipeline Simulation. In the study of oil and gas, the transportation of oil and gas is one of the most critical steps. The simulation of the pipeline model is the basis of the system's path planning. This article uses an artificial intelligence algorithm to simulate the pipeline, some of the key parameters are shown in Figure 6:

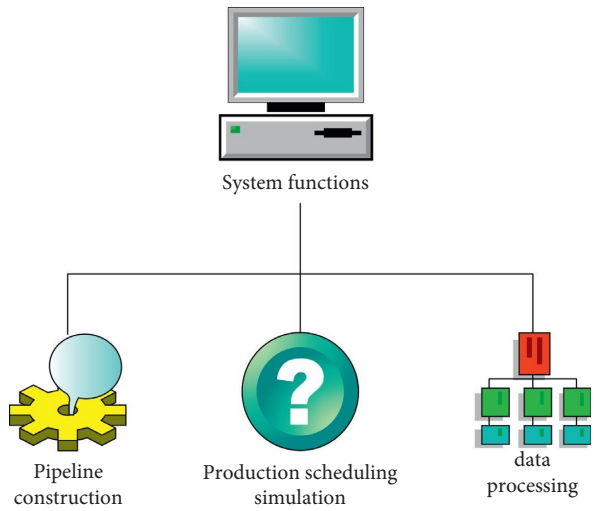


Figure 5: System function decomposition diagram.

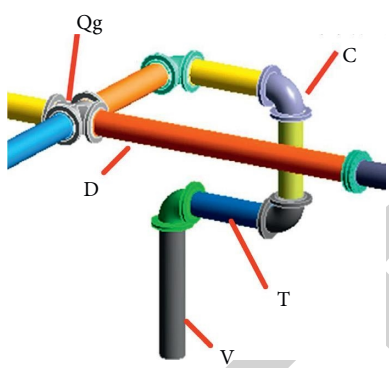


Figure 6: Schematic diagram of some parameters of pipeline modeling.

Through network configuration, optimization calculation, display and analysis of optimization results, etc., the operation conditions of the oil and gas network are simulated, and the optimized operation scheme of the oil and gas network is provided, so that the production management of oil and gas network can be rule-based and evidence-based. Equations (1)–(3) are obtained from the continuity equation, motion equation, and energy equation of the steady-state flow of gas in the pipeline.

$$\frac{v}{\rho}\left(\frac{\partial \rho}{\partial T}\right)_P \frac{\mathrm{d}T}{\mathrm{d}x} + \frac{v}{\rho}\left(\frac{\partial \rho}{\partial T}\right)_T \frac{\mathrm{d}p}{\mathrm{d}x} + \frac{\mathrm{d}v}{\mathrm{d}x} = 0, \tag{1}$$

$$\frac{1}{\rho}\frac{\mathrm{d}P}{\mathrm{d}x} + v\frac{\mathrm{d}v}{\mathrm{d}x} = -\frac{\lambda}{D}\frac{v^2}{2} - g\sin\theta, \tag{2}$$

$$\left(\frac{\partial h}{\partial T}\right)_P \frac{\mathrm{d}T}{\mathrm{d}x} + \left(\frac{\partial h}{\partial P}\right)_T \frac{\mathrm{d}P}{\mathrm{d}x} + \frac{\mathrm{d}v}{\mathrm{d}x} = -\frac{4K(T-T_0)}{\rho v D} - g\sin\theta, \tag{3}$$

where ρ is the density of the gas, v is the flow rate of the gas, T is the temperature of the gas, h is the enthalpy of the gas, λ is the friction coefficient of the pipe, D is the inner diameter of the pipe, T0 is the soil temperature at the depth of the pipe, K is the total heat transfer coefficient of the pipe, and θ is the pipe, the inclination angle with the horizontal plane, g is the acceleration of gravity, and x is the tube length coordinate. Selecting the pressure regulating valve is based on the required pressure regulating valve's flow capacity. The pressure regulating valve flow capacity formula is formulas (4) and (5):

$$C = \frac{Q_g}{580\varepsilon\sqrt{\Delta \mathrm{p} \cdot p_1/\rho_g T}}, \; L < 0.55, \tag{4}$$

$$C = \frac{Q_g}{322 p_1\sqrt{1/\rho_g T}}, \; L \geq 0.55. \tag{5}$$

In formulas (4) and (5), the flow capacity coefficient of the C pressure regulating valve in formula (5), Q_g is the gas flow rate, where:

$$L = \frac{p1 - p2}{p1}. \tag{6}$$

In (6), the gas pressure before the valve p1 and the gas pressure after the valve P2. Solve the model using known equations. Simplify the formula first, the simplified formula is as formulas (7)–(9),

$$a_{11} = \frac{v}{\rho}\left(\frac{\partial \rho}{\partial T}\right)_P, a_{12} = \frac{v}{\rho}\left(\frac{\partial \rho}{\partial T}\right)_T, a_{13} = 1, b_1 = 0, \tag{7}$$

$$a_{21} = 0, a_{22} = \frac{1}{\rho}, a_{23} = v, b_2 = -\frac{\lambda}{D}\frac{v^2}{2} - g\sin\theta, \tag{8}$$

$$\begin{aligned} a_{31} &= \left(\frac{\partial h}{\partial T}\right)_P, a_{32} = \left(\frac{\partial h}{\partial P}\right)_T, a_{32} = 1, \\ b_3 &= -\frac{4K(T-T_0)}{\rho v D} - g\sin\theta. \end{aligned} \tag{9}$$

From the simplified formula, the formulas (1)–(3) can be expressed as formulas (10)–(12):

$$a_{11}\frac{\mathrm{d}T}{\mathrm{d}x} + a_{12}\frac{\mathrm{d}p}{\mathrm{d}x} + a_{13}\frac{\mathrm{d}v}{\mathrm{d}x} = b_1, \tag{10}$$

$$a_{21}\frac{\mathrm{d}T}{\mathrm{d}x} + a_{22}\frac{\mathrm{d}p}{\mathrm{d}x} + a_{23}\frac{\mathrm{d}v}{\mathrm{d}x} = b_2, \tag{11}$$

$$a_{31}\frac{\mathrm{d}T}{\mathrm{d}x} + a_{32}\frac{\mathrm{d}p}{\mathrm{d}x} + a_{33}\frac{\mathrm{d}v}{\mathrm{d}x} = b_3. \tag{12}$$

Or expressed in ordinary differential equations as formulas (13)–(15):

$$\frac{\mathrm{d}T}{\mathrm{d}x} = f_T(x, T, P, v), \tag{13}$$

$$\frac{\mathrm{d}P}{\mathrm{d}x} = f_P(x, T, P, v), \tag{14}$$

$$\frac{\mathrm{d}v}{\mathrm{d}x} = f_v(x, T, P, v). \tag{15}$$

If $y1$, $y2$, and $y3$ are used to represent T, P, and v, then formulas (13)–(15) can be abbreviated as formula:

$$\frac{\mathrm{d}y}{\mathrm{d}x} = f(x, y). \tag{16}$$

In order to calculate the pressure, flow rate, and temperature in the pipeline according to (16), the pipeline grid is first drawn, and then the gas flow parameters on the grid points are calculated from the beginning to the end of the pipeline. The calculation method adopts Adam's prediction-correction calculation formula:

The prediction formula is formulas (17) and (18):

$$\overline{y}_{n+1} = y_n + \frac{h}{24}\left(55f_n - 59f_{n-1} + 37f_{n-2} - 9f_{n-3}\right), \tag{17}$$

$$\overline{f}_{n+1} = f\left(x_{n+1}, \overline{y}_{n+1}\right). \tag{18}$$

The correction formula is formulas (19) and (20):

$$y_{n+1} = y_n + \frac{h}{24}\left(9\overline{f}_{n+1} + 19f_n - 5f_{n-1} + f_{n-2}\right), \tag{19}$$

$$f_{n+1} = f\left(x_{n+1}, y_{n+1}\right). \tag{20}$$

This completes the description of the mathematical simulation of oil and gas pipelines.

4. System Effect Analysis

4.1. Oil and Gas Storage and Transportation Production Effect Inspection. First, calculate the distance of oil and gas transportation. We randomly selected two oil and gas stations on the GIS system and let the system simulate pipeline construction. In order to test the effect of the system, we selected 10 groups of oil and gas stations with a straight line distance of 50 km on the map, and 10 groups of oil and gas stations with a straight line distance of 100 km on the map. Select 10 groups of oil and gas stations with a straight line distance of 200 km on the map, and select 10 groups of oil and gas stations with a straight line distance of 400 km on the map to test the algorithm respectively. The selected distance is divided by referring to the distance between most oil and gas stations on the map. The test results are shown in Table 1:

It can be found from Figure 7 that in the simulation of different distances, the system has the effect of reducing the laying path and optimizing the path. In the short-distance pipeline laying of 50 km, the simulation effect of 9 out of 10 times is better. The effect reached 90%; in the 100 km pipeline laying, the optimization effect reached 100%, and the results of 10 simulations were shorter than the original laying path. In the pipeline laying of 200 km, the optimization effect is 60%, six simulation results are shorter than the original path, two simulation results are equivalent to the original path, and two simulation results are longer than the original algorithm. In the 400 km pipeline laying simulation, the optimization effect was also 90%, and once again it was similar to the original path. Therefore, the system has a relatively good effect on path optimization, but the effect is not particularly good in the simulation of 200 km mid-distance pipeline transportation.

Friction analysis is drag reduction analysis. For oil pipelines, too much resistance will result in a great decrease in oil delivery. There are also many studies on friction analysis-related literature. Generally, it is believed that the relationship between oil delivery and resistance is shown in the figure:

In Figure 8, H represents the resistance and Q represents the maximum oil delivery. It can be found that when the pressure of the oil transfer pump is constant, the smaller the resistance, the greater the maximum oil transfer volume. Because the resistance is impossible to eliminate, at H1, the maximum oil delivery and the resistance value reach a balanced state. At this time, the resistance is also more difficult to drop, and the drop in resistance has a small impact on the oil delivery. Therefore, we hope that the simulated frictional resistance of the pipeline can be closer to H1. In actual operation, the resistance of oil pipelines is generally fixed, and we can reduce the resistance by drag reducer.

4.2. System Risk Assessment. As shown in Figure 9, in the risk assessment of the system, we need to focus on analyzing the security of the system network.

4.3. LoadRunner Test. Carry out a LoadRunner test on the system, and test the performance of the system under high intensity by simulating multiple users online at the same time through LoadRunner. The test results are as follows:

As shown in Figure 10, LoadRunner is used to simulate 50 people online at the same time, and the response time of each person in the system is recorded separately. It can be seen that the response time of 50 people is between 4 s and 5 s, which conforms to a stable time series. The response time of the system is considered to be relatively stable, the lowest response time is 4 s, the highest is 5 s, and the difference is 1 s. In the actual situation, the average user's stay time will not exceed 5 s. If it exceeds 5 s, most users will choose to leave. It can be found that the system in this article is in line with actual usage requirements. Then analyze the performance of the system.

In order to test the maximum performance of the system, LoadRunner is used to simulate the number of people online from 1 to 100 at the same time. Each simulation is performed 10 times and the average value is the response time of the number of people online at the same time. As shown in Figure 11, with the increase in the number of people, the response time is also at the right price, and the overall rise is stepped up. What can be found is that when the number of people at the same time reaches more than 80 people, the response time exceeds 5 s. At this time, the user experience is very bad. When the

Table 1: Comparison table of test results.

50 km		100 km		200 km		400 km	
Original path	Algorithm simulation path	Original path	Algorithm simulation path	Original path	Algorithm simulation path	Original path	Algorithm simulation path
80	65	151	126	263	260	476	434
81	60	142	128	262	221	488	447
79	60	136	110	246	258	461	463
84	59	157	136	268	250	490	444
74	70	140	138	254	253	485	447
62	65	158	123	240	221	491	432
89	55	146	118	242	255	479	447
79	65	154	119	249	223	499	441
68	56	155	130	255	254	475	447
82	55	156	132	267	232	482	442

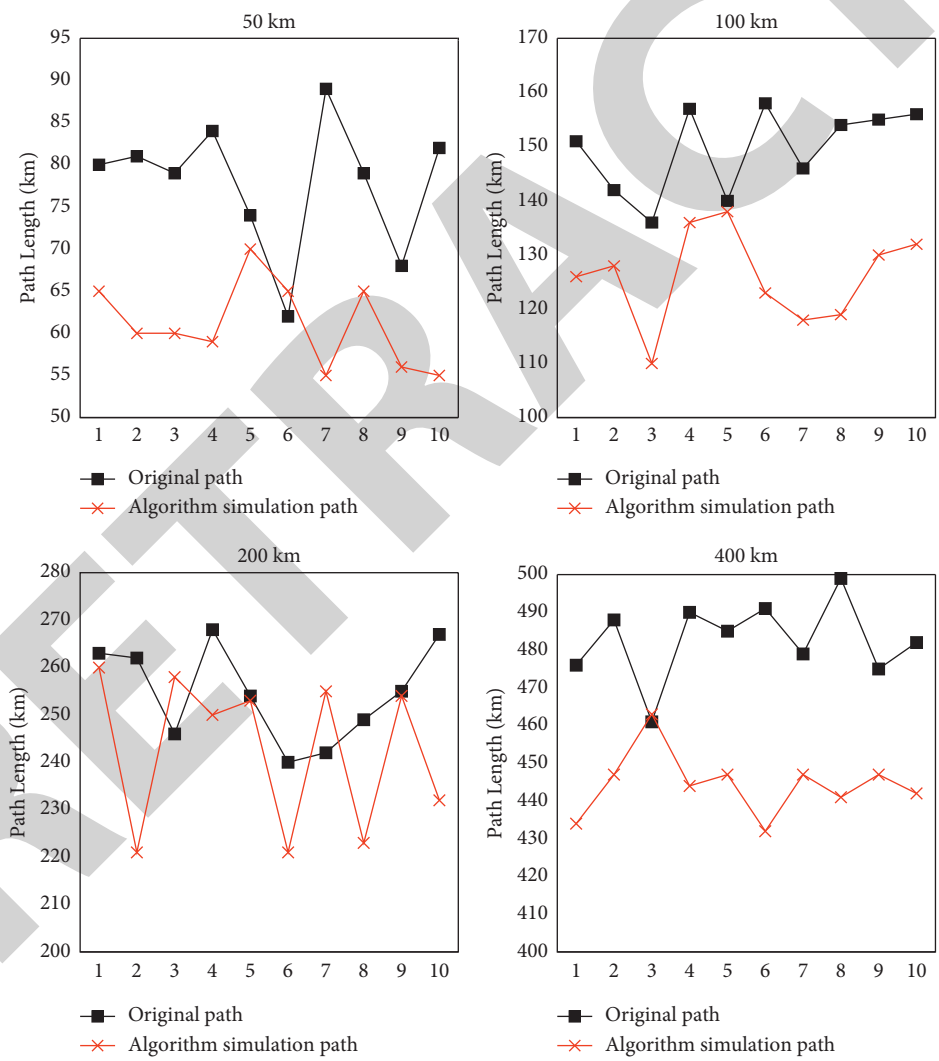


Figure 7: Simulation of different distance systems.

number of people online at the same time reaches 95 people, the response time soars to more than 9 s, and the user experience for the level card is now almost unusable. Therefore, the maximum number of simultaneous online users of the system is best controlled within 80 people, and the system is still acceptable when there are less than 95 people. The performance is stuck and the maximum number cannot exceed 95 people.

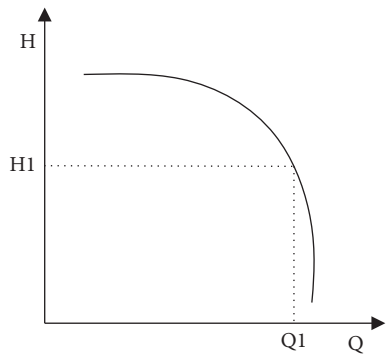


Figure 8: The relationship between resistance and maximum oil delivery.

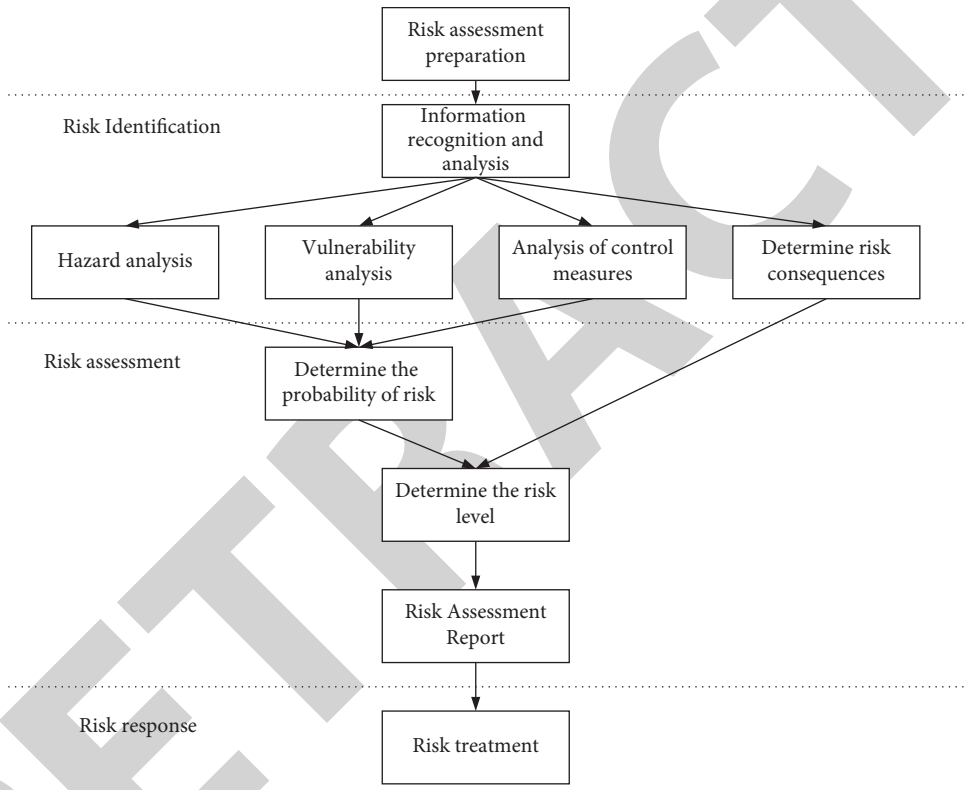


Figure 9: Risk assessment flowchart.

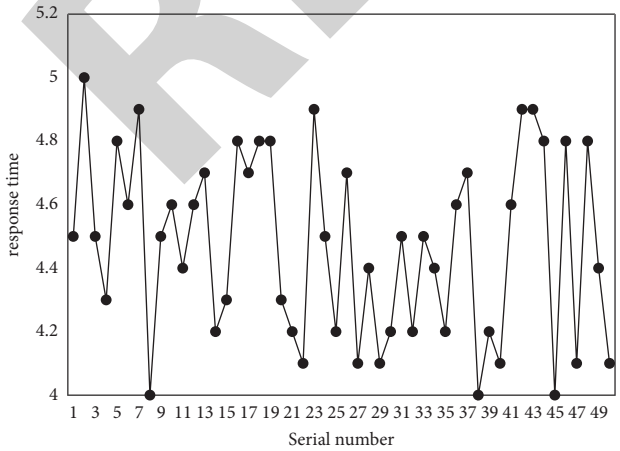


Figure 10: The response time of each person when 50 people are online at the same time.

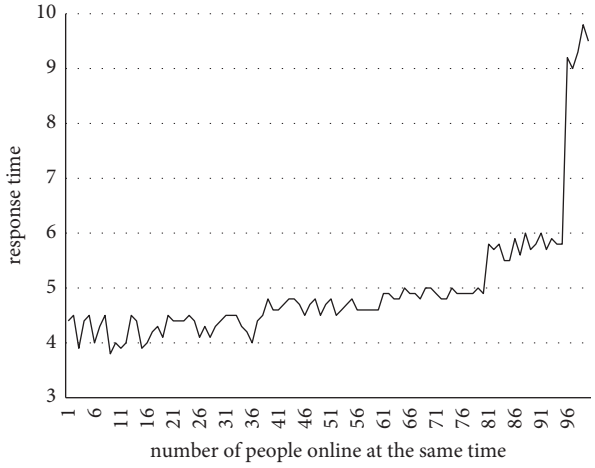


Figure 11: System performance analysis.

Hindawi
Mobile Information Systems
Volume 2022, Article ID 8582862, 11 pages
https://doi.org/10.1155/2022/8582862

Research Article

Construction of Perceptual Classroom Based on Internet of Things Technology

Tongtong Yu

School of Business and Trade, Nanjing Vocational University of Industry Technology, Nanjing 210023, Jiangsu, China

Correspondence should be addressed to Tongtong Yu; hn487@wfd.edu.ug

Received 22 March 2022; Revised 23 April 2022; Accepted 2 June 2022; Published 31 July 2022

Academic Editor: Liming Chen

At present, in the traditional classroom teaching process, there are still problems such as differences in students' original knowledge, low student participation, and single teaching methods. For students, the mobile phone carrying rate is high, but the learning utilization rate is low and has self-control, poor ability, and low classroom participation. To solve the above problems, the research on the construction of perception classrooms based on the Internet of Things technology is particularly important. Perceived classroom refers to the use of existing technology to closely connect students and teachers, fully mobilize students' enthusiasm, and make the classroom atmosphere. This article aims to study the construction of perceptual classrooms based on the Internet of Things technology to increase students' interest. Through the investigation of the current situation of the digital campus, relying on the Internet of Things technology, the feasibility of the perception classroom is analyzed, and the perception classroom is constructed through the design of image processing and fuzzy control rules, which provides a perfect hardware environment for the digital campus. The experimental results show that based on the Internet of Things technology, through the perception of classroom interaction and practical activities, learning is no longer a process of mechanical memory of book knowledge, but a process of students constantly discovering and exploring problems and then solving problems in the process of practice. Among 84 classroom teaching behaviors, classroom interaction accounted for 69.05% of the total classroom teaching activities. In the "computer + projection" classroom environment, the proportion of teacher-student interaction in classroom teaching activities is 40.47%. Teachers can focus on the design of teacher-student interaction according to the characteristics of students and learners, avoid long-term theoretical explanations, and intersperse interactive links such as question and answer and request answers.

1. Introduction

1.1. Background. Since the 1990s, information technology and the Internet have rapidly developed and become popular. The traditional campus is based on the network, from environment, resources, activities to digitalization, to realize network office, network management, and network services, which has an important influence on the construction of digital campus, education and teaching mode, learning, and lifestyle of teachers and students. With the development of perception technology, artificial intelligence and automation technology have promoted the formation and development of a new generation of network technology Internet of Things. This will promote the research and construction of a new generation of smart digital campuses. China is one of the pioneers of IoT technology. Localities have also increased their investment in the Internet of Things industry, and the concept of "Smart Earth" and "perceived China" has become popular. The development and deployment of smart campuses have had a positive impact on the school's informatization construction and promoted the improvement of the school's core competitiveness. Therefore, this article attempts to build a perceptual classroom based on the perceptual classroom, using the Internet of Things as the carrier to provide ubiquitous online learning, integrating new network research, transparent and efficient student management, colorful classroom culture, and a convenient and thoughtful campus.

1.2. Significance. Constructivist theory believes that individuals actively construct knowledge and acquire knowledge of the world in a certain social situation, in interaction with others and the environment. An important concept of constructivist theory is the schema. Schema refers to the way in which individuals perceive and think about the world. It can also be regarded as the framework or organizational structure of mental activities. Perceptual classroom is a teaching model based on constructivism theory. With the help of the Internet of Things, technology, we focus on real-time interaction and convenient dialogue between people and things, better improve the classroom ecology, allow students to actively participate in activities and problem exploration and self-construction in their own practice and real experience, and form a positive cognitive psychology and unique cognitive personality. According to the individual needs of students, teachers should prepare rich learning resources, diverse homework forms and different levels of problems, build appropriate teaching scaffolding, and guide different students to individualized learning.

1.3. Related Work. The construction of perceptual classrooms will jointly promote the development of Internet of Things technology in teaching and increase students' interest in classroom learning. Saban pointed out that the purpose of this study was to investigate the views of teacher candidates on the physical aspects of classroom management. Instruct 120 third-grade students from the elementary education department of the state university to visit an elementary school, and observe the physical dimensions of the classroom. Guide students to tell the actual classroom they have observed, and tell the classroom they dream of. Therefore, this research aims to discover students' understanding of actual classrooms and the construction of dream classrooms from the physical characteristics. Research findings show that most teacher candidates mentioned their dream classrooms based on actual classrooms, and only one-third of them designed classrooms based on the characteristics of their dream classrooms. However, the teacher candidates did not mention the emotional impact of physical layout and environment on individuals [1]. Brown and Hughes pointed out that the purpose of this article is to examine three middle school teachers' beliefs about how their understanding of history affects their teaching. The authors of design/methods/methods conducted qualitative multicase studies based on semistructured interviews and artifact analysis. Survey results analysis described teachers' understanding of history, involving the choice of historical viewpoints, the use of textbooks, the integration of major resources in the classroom, and the tension between teaching content and teaching techniques. The study concluded that although exposure to history may be useful for undergraduates and can help history teachers manage the complexity of the major, it is still a long-term process to fully understand history to understand historical narratives in the classroom challenge [2]. Zhou and Zhang believe that with the rapid development of information technology and mobile Internet technology, the learning methods of learners have also undergone tremendous changes. In this new era, learners face two main problems: information overload and knowledge fragmentation. In this case, university teaching is no longer limited to the traditional classroom teaching mode. Instead, integrating MOOC, SPOC, and flipped classroom models is a new trend. By combining mobile Internet technology with classroom teaching and course materials, this paper constructs a flipped English teaching classroom model to solve the disconnection between teaching software and textbooks in the teaching process, to improve language learning in terms of time. And space truly realizes border learning [3].

1.4. Main Content. This article proposes to create a perceptual classroom, creating a resonance classroom of knowledge, life, and emotion. Students are the main body and the real protagonists on the stage. They are also the builders and creators of knowledge. Combining things with people based on the Internet of Things technology, the classroom is not boring, but becomes lively and interesting. This article introduced the methods of perception classroom energy saving and emission reduction, realizing classroom energy saving, and realizing and establishing the perception classroom through the construction experiment of "perception classroom." The teachers here are more to guide the students to explore and create together. The teaching process is a process of collision of ideas. This process must reflect respect for student life. There is no standard answer here. Students can speak up, think independently, explore together, and actively use existing equipment to realize their ideas.

2. Perceive Classroom Energy Saving and Emission Reduction Methods

2.1. Research Methods

2.1.1. Survey Method. Select representative schools and students, conduct questionnaire surveys and interviews on the status quo of teacher-student interaction in classroom teaching, analyze existing problems, and seek a realistic basis for this research.

2.1.2. Observation Method. In a natural situation, personally go deep into the classroom teaching, directly use your own eyes, ears, and other senses to perceive the authenticity of teacher-student interaction, and provide first-hand information for the research of this topic. For the collected data, qualitative and quantitative research methods are used to analyze the interaction between teachers and students in the classroom.

2.1.3. Experimental Method. The classroom teaching design based on teacher-student interaction is applied to classroom teaching practice, and the homogeneous contrast experiment method is used to compare and analyze the experimental results and draw the scientific conclusion of teacher-student interaction.

2.2. Key Technologies of the Internet of Things. With the rapid development of the Internet of computers and the continuous improvement of technology, through the use of radio frequency identification technology [4], sensor technology, nanotechnology, intelligent embedded technology, and other technologies, the Internet of Things will be able to realize the integration of all things in the world. In this world, the connection between things can be realized through RFID tags, as long as they use wireless sensor network technology to collect the main information of the goods to the central information center, identify them, and complete the communication. Finally, it is shared and exchanged around the world through the use of the Internet.

Radio frequency identification technology (RFID) is a major communication technology. The main step uses radio signals to directly identify and interpret the locked target, and does not require mechanical or optical linking of the identified system with the target in the process of recognition and interpretation. At present, the use of RFID technology should be very mature and complete, and the cost of the technology is extremely low. However, there are also shortcomings. In the data collection technology, RFID technology [5] is not enough, and it can only identify the type and characteristic attributes of the items. This technology is collected in the Internet of Things.

In information technology, sensor technology, computer technology, and communication technology are the most important main technologies, and they play a major role in information technology. Sensing technology is using various types of sensors to sense, to obtain corresponding information in nature, classify and process it, and finally obtain key information. The quantity and quality of information obtained from nature are mainly determined by the quality and type of the sensor. In the process of information processing, it needs to go through many procedures, the main steps of which are preprocessing, postprocessing, extraction of its main features, and selection of main information. For the identification of information, as long as the information is classified, it will be very convenient to use in the future. Wireless sensing technology plays an essential role in the perception of information in the Internet of Things.

The application principle of wireless sensors is to connect the functions of some scattered space nodes [6] (application sensors) to each other and then play the role of collecting network information, so that the information can be transmitted to each other and the content of the information can be transferred. A series of processing is forming useful information for humans. The WSN that traverses the entire network connects computing, communication, and sensor technologies, which promotes the development of the Internet of Things network. Cloud computing is a networked application program that divides a large-scale computing processing system into small pieces and then hands them to multiple servers to solve each subroutine together. After the solution is solved, they are assembled to form a whole for users.

Embedded technology is a technology that uses a computer to process information and then uses it in an application system. It is a system that integrates computers, apps, and operating systems. It is an intelligent network of embedded systems that realizes perception capabilities. In many cases, embedded systems will exist, and the development of the Internet of Things is also created on the basis of embedded systems. It is also said that the emergence of the Internet of Things symbolizes the rapid development of embedded systems.

Therefore, the Internet of Things will cause a technological revolution in the future. If the development of wireless sensors with nanotechnology can achieve significant development, then the Internet of Things will also develop rapidly.

2.3. Classroom Lighting Control Strategy. To achieve the goal of energy saving and emission reduction, a new lighting control strategy is proposed. When students enter the classroom, they turn on part of the lights in the classroom to provide light sources. The surveillance camera starts to take photos and analyzes the location of the students through image processing. The light controller turns on the lights around the students and turns off other lights. The lighting controller monitors the intensity of the lights around the students in real time and adjusts the brightness of the lights through PWM to keep the best light intensity around the students and provide a good learning environment for the students.

2.3.1. Image Processing. The first step to realize the intelligent control of classroom lighting is to analyze the position of students in the classroom, analyze the position of students in the classroom through the photos taken by the monitoring camera, and capture a monitoring picture every minute. In the figure, the contour of the human body is extracted by the steps of foreground image extraction and binarization to obtain the coordinates of the midpoint of the human body [7].

The idea of binarization is to find a threshold and compare the gray value of the image with it. If it is greater than the threshold, it is 1, and if it is less, it is 0. The Bernsen binarization algorithm that we used in this design is a local threshold algorithm that can solve the problem of uneven illumination of the image. The central idea is to calculate the threshold $T(x, y)$ of the pixel (x, y) in the area of $(2w+1) * (2w+1)$ centered on the pixel (x, y), and the expression is as follows:

$$T(x,y) = 0.5 \times \left[\max_{-w \le k,l \le w} f(x+k, y+l) + \min_{-w \le k \le w} f(x+k, y+l) \right]. \tag{1}$$

After that, $f(x, y)$ is binarized, and the relationship between its gray value and $T(x, y)$ is compared. If it is greater, then the current value is 1;

otherwise, it is 0, and the binarized image is $B(x, y)$ as follows:

$$B(x, y) = \begin{cases} 0 & f(x, y) < T(x, y) \\ 1 & f(x, y) \geq T(x, y). \end{cases} \quad (2)$$

For general images, there is usually a certain amount of noise. To reduce the problem of missing image details after binarization, the paper improved the traditional Bernsen algorithm, adding Gaussian filtering before binarization to remove excess noise. The model of the Gaussian filter is as follows:

$$G(x, y) = \frac{1}{2\prod \sigma^2 e^{-\frac{x^2 + y^2}{2\sigma^2}}}. \quad (3)$$

Let $f(x, y)$ be the gray value at the point (x, y), take the point (x, y) as the center, and select a region S with a size of $(2w + 1) * (2w + 1)$. $f(x, y)$ is the gray value after Gaussian filtering at the point (x, y), which is the smoothing scale, k and l are the position parameters, and $B(x, y)$ is the result of binarization. The improved Bernsen binarization algorithm can be written as the following expression.

The $f(x, y)$ threshold $T_1(x, y)$ of the unfiltered wave is expressed as

$$T_1(x, y) = 0.5 \times \left[\max_{-w \leq k, l \leq w} f(x+k, y+l) + \min_{-w \leq k, l \leq w} f(x+k, y+l) \right]. \quad (4)$$

The gray value $f(x, y)$ after filtering at point (x, y) is

$$f(x, y) = \frac{1}{(2w + 1)^2} \sum_{i,j \leq s} f(x, y) e^{-\frac{x^2 + y^2}{2\sigma^2}}. \quad (5)$$

The threshold $T_2(x, y)$ of f (x, y) after filtering is

$$T_1(x, y) = 0.5 \times \left[\max_{-w \leq k, l \leq w} f(x+k, y+l) + \min_{-w \leq k, l \leq w} f(x+k, y+l) \right]. \quad (6)$$

Set parameter $a \in (0, 1)$, to binarize $f(x, y)$ point by point

$$f(x, y) = \begin{cases} 0 & f(x, y) < (1 - a)T_1(x, y) + aT_2(x, y) \\ 1 & f(x, y) \geq (1 - a)T_1(x, y) + aT_2(x, y) \end{cases}, \quad (7)$$

where a is the adjustment coefficient. The degree of Gaussian filtering [8] can be changed by adjusting the size of a. When $a = 0$, the system does not add Gaussian filtering. The value of a is not as large as possible. If it is too large, the image will be partially distorted, as shown in Figure 1.

2.3.2. Fuzzy Control Algorithm. The indoor light intensity y of the system is different from the target light intensity $y1$, and e is obtained; that is, $e = y - y1$, the error rate of change is $de = e_{i+1} - e_i$, e_{de} and u are fuzzified, and the language variables are E, DE, and U, respectively. The state stipulates that the light intensity in the classroom is between 300 and 500 lux, and the system determines that e does not exceed 80 lux; that is, the domain of science is [80, 80], the domain of E is $X = \{-4, -3, \ldots, 0, \ldots, 3, 4\}$, the quantization factor of e is $ke = 4/80 = 0.05$, and the language variable E is $\{NB, NS, O, PS, PB\}$, so that the membership function of the error e can be determined. Establish the assignment table of E, as shown in Table 1.

The light intensities measured by the sensors in the classroom are all accurate values, which can be calculated by converting them into the membership function of the fuzzy set. For example, if the detected light intensity in the classroom is $y = 415$ Lux, and the target light intensity is $y1 = 450$ Lux, then $e = -35$ can be calculated. After transformation $[e'] = -2$, you can see -2 level from the table. The upper membership degree is only 1.0, and the maximum value is 1.0. According to the ZAD method, it can be expressed as

$$NS = \frac{0.5}{-3} + \frac{1.0}{-2} + \frac{0.5}{-1}. \quad (8)$$

The fuzzy set NS is the fuzzy result of the exact error e. The fuzzification principle of error rate de is the same as e. Select the domain $Y = \{-4, -3, \ldots, 0, \ldots, 3, 4\}$ of DE, the transformation factor $K_{de} = 1$ from de to DE, and the language variables of DE are $\{NB, NS, O, PS, PB\}$, according to the membership function to establish the assignment table of the language variable DE shown in Table 2.

Finally, determine the domain of the output variable u, divide the LED light from the brightest to the extinguished into 100, evenly, select the domain of U, $Z = \{-4, -3, \ldots, 0, \ldots, 3, 4\}$, the transformation factor from u to U is $K_u = 1$, and the language value of U is $\{NB, NS, O, PS, PB\}$. According to the membership function, the assignment table of the language variable DE shown in Table 3 is established.

2.3.3. Design of Fuzzy Control Rules. The design of fuzzy control rule [9] depends on experience. On the basis of fuzzy set theory and operation experience, the control quantity of equipment operation is obtained by reasoning. The fuzzy control rule base is induced and established by if-then statement. This design adopts a fuzzy controller with dual input and single output. The expression of the sentence is as follows:

If there are E and DE, then there will be U.

For example, if $E = PB$ and $DE = PB$, then $U = NB$; this sentence indicates that if the light intensity in the classroom is much larger than the target light intensity, and the brightening trend is great, the control light dimming should be taken to the maximum state at this time. In the design, E and DE both have 7 language values, and the control state U should have 25 situations. These 25 situations are summarized into a control rule table, as shown in Table 4.

Figure 1: Binarized image when $a = 0.2$.

Table 1: Language variable E control table.

$E\ u(x)\ X$	−4	−3	−2	−1	0	1	2	3	4
NB	1.0	0.5	0	0	0	0	0	0	0
NS	0	0.5	1.0	1.0	0	0	0	0	0
O	0	0	0	0	1.0	0.5	0	0	0
PS	0	0	0	0	0	0.5	1.0	0.5	0
PB	0	0	0	0	0	0	0	0.5	1.0

Table 2: Language variable DE control table.

$DE\ u(x)\ Y$	−4	−3	−2	−1	0	1	2	3	4
NB	1.0	0.5	0	0	0	0	0	0	0
NS	0	0.5	1.0	0.5	0	0	0	0	0
O	0	0	0	0.5	1.0	0.5	0	0	0
PS	0	0	0	0	0	0.5	1.0	0.5	0
PB	0	0	0	0	0	0	0	0.5	1.0

Table 3: Language variable U control table.

$Uu\ (x)\ Z$	−4	−3	−2	−1	0	1	2	3	4
NB	1.0	0.5	0	0	0	0	0	0	0
NS	0	0.5	1.0	0.5	0	0	0	0	0
O	0	0	0	0.5	1.0	0.5	0	0	0
PS	0	0	0	0	0	0.5	1.0	0.5	0
PB	0	0	0	0	0	0	0	0.5	1.0

Table 4: Fuzzy control status table.

E U DE	*NB*	*NS*	*O*	*PS*	*PB*
NB	*PB*	*PB*	*PB*	*PB*	*PB*
NS	*PB*	*PS*	*PS*	*O*	*NS*
O	*PB*	*PS*	*O*	*NS*	*NB*
PS	*PS*	*O*	*NS*	*NS*	*NB*
PB	*NB*	*NB*	*NB*	*NB*	*NB*

The 25 fuzzy sentences are described by connecting them through the "or" relationship. The fuzzy relationship R ($i = 1, 2, \ldots, 25$) of each fuzzy conditional sentence is calculated as follows:

$$\widetilde{R}_i = \left(E_i \times DE_i\right) \times U_i. \tag{9}$$

After calculating each fuzzy relationship R ($i = 1, 2, \ldots, 25$), we start to calculate the total fuzzy relationship of the entire control system:

$$\widetilde{R} = R_1 \vee R_2 \vee \ldots R_{25} = \bigcup_{i=1}^{25} R_i. \tag{10}$$

According to the fuzzy subsets E_i and D_{Ej} on the input language variable universe, calculate the fuzzy subset U_{ij} on the output language variable universe:

$$U_{ij} = \left(E_i \times DE_j\right) \circ \widetilde{R}. \tag{11}$$

2.3.4. Precision. According to the previous introduction, the fuzzy set of the output has been obtained. If the fuzzy number is executed, defuzzification needs to be performed, and it is converted into a precise quantity and applied to the actuator. This process is also called precision. The commonly used center of gravity method is used to achieve precision. The center of gravity method takes the center of gravity of the area enclosed by the fuzzy membership function curve and the abscissa as the output value of fuzzy inference. For a discrete domain with n output quantization series [10], there are

$$v_0 = \frac{\sum_{k=1}^{n} v_k \mu_v\left(v_k\right)}{\sum_{k=1}^{n} \mu_v\left(v_k\right)}. \tag{12}$$

If the calculation result is not an integer, the result is rounded. The control output obtained by precision is a quantization level, and then multiply it with the quantization factor mentioned in the previous article; that is, $u = k_u * V_0$, and the executable control quantity u of the system can be obtained.

As shown in Table 5, the fuzzy control table is a two-dimensional array. When writing a single-chip microcomputer program, you must first declare a two-dimensional array [9]. When the single-chip microcomputer is running, the error collected will be e and the error rate of change de is multiplied by its quantization factors k_e and K_{de} to obtain their respective domain representation elements x and y, and then query from the two-dimensional array fuzz [9] to find the corresponding control variable u, and then multiply. With its scale factor k_u, the actual control amount can be obtained, and the brightness of the light can be adjusted.

Table 5: Fuzzy control table.

e u de	−4	−3	−2	−1	0	1	2	3	4
−4	4	3	3	3	3	3	0	0	0
−3	3	3	3	2	2	2	0	0	0
−2	3	3	2	2	1	1	0	−1	−2
−1	2	2	2	1	1	0	−1	−2	−2
0	2	2	1	1	0	−1	−2	−2	−3
1	2	1	0	−1	−1	−2	−2	−3	−3
2	2	1	0	−1	−1	−2	−2	−3	−3
3	0	0	0	−2	−2	−2	−3	−3	−3
4	0	0	0	−3	−3	−3	−3	−3	−4

3. "Perception Classroom" Construction Experiment

Through questionnaire surveys and interviews, we have learned about the current situation of the classroom. Teachers rarely use information technology in the classroom, and many equipment is idle and cannot really play its role. Because many teachers are experienced, they have difficulties in accepting new ideas and new technologies. However, the role of information technology in education is unquestionable and cannot be ignored. Therefore, under the support of the existing information technology environment and existing platforms, we must jointly create our own "perceived classroom," inject new vitality into teaching, maximize the use of equipment, optimize classroom teaching effects, and optimize students' learning experience.

The teaching goal of the perceptual classrooms is that teachers organize teaching reasonably, and information technology really plays a role. Teachers choose different teaching strategies according to the different teaching contents of different students, use their own words and deeds to influence students' words and deeds, and help students develop good thinking habits.

Students can enjoy the learning process and use related equipment to learn and create independently. They can study independently and think independently. It can also be created by teamwork. Finally, the profound resonance of knowledge, social life, and the lives of teachers and students is reached.

3.1. Provide Hardware Environment. The hardware environment is the foundation of a modern classroom and a necessary condition for a good class. The author's ideal classroom is not for a certain class, but for the general needs of junior high school mathematics.

3.1.1. Sound Recording and Broadcasting System. As shown in Figure 2, it is a standard classroom for information education. Area *A* in the front is the classroom, and Area *B* in the back is the listening room. The advantage of separating the classroom from the listening room is that the attendees can listen to the lesson at any time without interrupting the classroom. Because the front and rear are separated by mirror glass, the attendees can clearly see the picture in the classroom during the class, but the people in the classroom

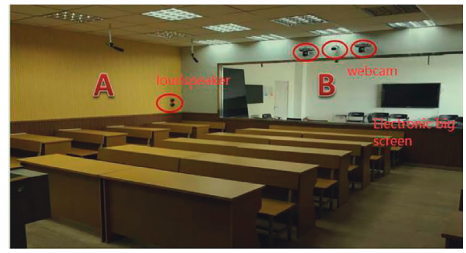


Figure 2: Classroom with recording and broadcasting system.

Figure 3: Recording system host.

cannot see the lesson in this way; even if the classroom is full of leaders and classrooms, it will not bring any psychological pressure to the classroom and students, and the audience will hear a normal class that represents the real situation of the teacher. The circle marked [11] in the classroom of Area *A* is the automatic tracking camera throughout the whole process. In the classroom, no matter if the teacher and the student have a large floating movement, such as the teacher's gesture, the student raises their hand and speaks, and the camera can track it. At this time, the expression of the speaker can also be clearly presented and recorded. The TV on the side wall of Area *B* is used to present the teacher's courseware, and the wall on the back is a hanging all-in-one machine, which is convenient for the lecturers and instructors to comment on the lectures. There is also a device in area *B* as shown in Figure 3, the host of the recording and broadcasting system. Its function is to complete the recording and postproduction of classroom videos. In the past, to facilitate after-class research and realize classroom reobservation, at least two sets should be installed on the classroom shelf. The above video recorder and two professionals are used to track the operation, and the required pictures must be organized according to the audio track later. With such equipment, we can also realize the live and broadcast of classroom videos [12], so that experts and scholars from other places can participate in the lectures. These authors believe that they are also part of the integration of information technology and courses.

3.1.2. 3D Printer. With the development of technology, 3D printing in the classroom is no longer out of reach. The teacher concluded that the integration of 3D printing and mathematics has the following advantages: 3D printing technology realizes the concept that mathematics comes to life, allowing students to see the real object of spatial

imagination; with the help of modeling software such as the 3D one, it can restore students who lack a sense of space. A real picture helps to learn the knowledge of three-dimensional graphics, through the printer to verify whether your modeling ideas are correct.

3.1.3. Pad. Pad entered the classroom and set off a wave of times. Recalling that in the mathematics classes, the teachers left students with analytical tasks for proof questions. Students quickly wrote different proof processes on their own scratch paper, just for who can be the first. After finishing the writing, let the teacher present it to the class through the physical booth. Now, how can we save paper and pen through the pad [13] and write directly in the homework mode. After finishing the one-click submission, it can be presented on the big screen. When the results are presented on the big screen at the same time, students can start a discussion and vote for the simplest process with pad.

Another function of the pad is to realize the instant feedback of objective questions. In the practice class, teachers can send practice question banks to students. The question types can be multiple-choice questions and fill-in-the-blank questions. Students can choose the difficulty level of the question according to their actual situation. Each question will have instant feedback after the students answer, and all questions will have a total score. The teacher has a real-time monitoring function for students' answers. As shown in Figure 3, you can know what percentage of students has chosen different levels. Judge and understand the completion of teachers' teaching objectives by researching and analyzing students' responses to questions. At this time, the pad realizes teaching students in accordance with their aptitude and realizes that teachers can check the quantity and quality of students' homework at any time, and can quickly solve the problems in the homework in the classroom.

At the same time, pad can realize the sharing and mutual evaluation of subjective questions [14]. What people care most about is the evaluation of others. This is especially true for students in junior high school. In view of the psychological characteristics of their age group, a student's point of view is in class, and it was proposed that other students gave an agreeable point of view. This student naturally accepted it. How to give an opposing point of view might be rebutted out of the face and without thinking. If this form is moved to pad, the student will express his own opinion. Opinions are established in a forum. The authors will not have much emotional fluctuations when receiving different opinions. They think this is a very private discussion. The opinions that the students give me are for their own good, so they will think and accept humbly and modify them objectively. Improve your point of view.

3.1.4. Combination of Blackboard and Whiteboard. No matter how good the whiteboard is, the author believes that it cannot replace the role of the blackboard in a class. The blackboard writing is a high-level summary of the key and difficult content of a lesson. Students can always pay attention to the content on the blackboard and recognize their own mathematics. The structure of knowledge has an impact, and a new cognitive model is constructed through various forms of content on the whiteboard [15, 16] as shown in Figure 4.

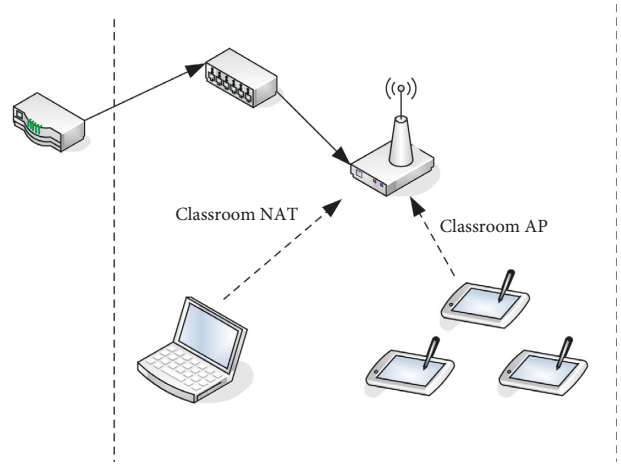


Figure 4: Hi-teach classroom internal network.

3.2. "Teacher-Class" Interactive Activity Design Based on Interactive Whiteboard. The interactive whiteboard combines the advantages of "blackboard" + "computer projection." The whiteboard screen is both a "whiteboard" and a computer screen. The teacher breaks away from the shackles of the computer console [17], walks into the middle of the students from the high platform, and looks. It is also not necessary to alternate back and forth between the computer screen and the student, which is more in line with the teacher's habit of talking and writing while walking. It not only plays the role of teachers in guiding and assisting learning, but also highlights the dominant position of students, and the interaction between teachers and students is more equal and naturally accessible. Use interactive whiteboards to create a reasonable teaching situation, naturally carry out teachers' classroom interactive activities, and create a relaxed teaching environment. Display multimedia materials such as pictures, music, and animation related to the main body of teaching content, present them intuitively and easily, strengthen the connection between students' original knowledge and new knowledge, and enhance students' confidence in participating in learning. For the teaching content that students cannot see and operate, using the characteristics of multimedia to reproduce and simulate, students can more truly feel the shape of things and the process of development and change, which makes up for the deficiency of traditional teaching in the presentation of teaching content.

It can be intuitively observed from Figure 5 that in teacher Z's classroom teaching, teacher-class interaction and teacher-person interaction are the main types of classrooms. In classroom teaching, teachers spend most of their time in classroom narration and teacher-student questions. By recording the number of teacher-class interactions and the

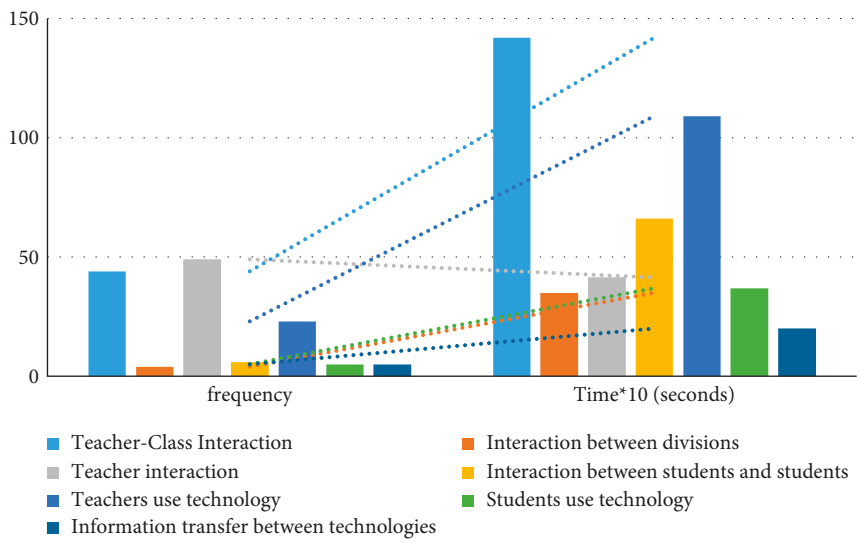


Figure 5: Analysis of observation results.

number of teacher-teacher interactions, the frequency of teacher interaction is very high, but the proportion of teacher-teacher interaction time makes the teacher-class interaction average. It can be seen from the data that the teacher has a high frequency of interaction with student, the time is short, and the classroom rhythm is fast. Combined with video observations, it is found that questions and answers in teacher-person interaction are the most important way of interaction, and teachers and students have almost no time to think. The time for questioning and answering does not exceed a minute or even a few seconds, which reflects the problems existing in teachers and students in classroom teaching.

3.2.1. Whiteboard Interactive Function Design Example 1. The course introduction link can bring students into the problem situation by setting up questions and placing suspense, fully arouse students' curiosity, and gradually solve the problems to lead the teaching content in depth, so that we can firmly grasp the attention of all students and allow students to consciously and wholeheartedly devote themselves to the interaction to achieve the expected teaching effect or even exceed the expected teaching effect. For example, using the "screen curtain" function of the interactive whiteboard [18] to raise questions, pull the opening cloth from up, down, left, and right, and gradually carry out the teaching process to create the feeling of uncovering the mystery and improve students' attention.

3.3. "Teacher-Group" Interactive Activity Design Based on Interactive Whiteboard. Different students have a different breadth and depth of knowledge, problem-solving methods, and values. Group activities are organized under the organization of teachers. Students can diverge thinking and have unlimited creativity. They can work together to complete tasks in an active atmosphere, which is conducive to students' communication and feelings, and it is conducive to the cultivation of students' expression abilities and organizational abilities, turning a limited classroom into an infinite space for everyone to participate in [19] and think individually.

Teachers use interactive whiteboards to present group discussion questions during the teaching process. The members of the group first use their brains to think independently and speak their own ideas. After the discussion and analysis of the group members, the group members are comprehensively satisfied with the proposal. The selected group representatives present the conclusion on the whiteboard, and the whiteboard camera screenshot [20] function can save the conclusion in the form of pictures. In the teacher comment session, select screenshots of each group from the resource library, display the discussion results side by side, compare similarities and differences to find problems, and at the same time, increase the group mutual evaluation link, which is more conducive to the communication and learning between the groups. Teachers need to control the rhythm of classroom activities, and listen to and give appropriate guidance during group discussions, to ensure that each student participates in group activities and appreciates the fun and meaning of group activities. In addition to designing collaborative teaching activities within the group, mutual assistance or competition activities between groups can also be appropriately carried out to increase the classroom learning atmosphere and cultivate students' sense of responsibility, teamwork, and competition.

3.3.1. Whiteboard Interactive Function Design Example 3. In this example, the "magnifying glass" function and "texture brush" of the interactive whiteboard are mainly used. Oral English practice is one of the English classroom teaching links. Teachers use the interactive whiteboard multimedia presentation function [21] to show several sets of pictures, allowing students to understand the meaning of the pictures, set the character of the characters, design the content of the dialogue, or select relevant to the teaching

Table 6: Observation record of classroom interaction behavior in "computer + projection" environment.

	Time	Teaching process	Types of interaction	Refine	Specific interaction behavior
1	0 : 00–0 : 18	The teacher reminded the students to start the class	Teachers and students	Division class	Organization management
2	0 : 19–0 : 40	The teacher talks about the course arrangement of this section	Teacher's individual behavior		
3	0 : 55–1 : 48	The teacher plays the video, and the students watch it	Teacher-media + living medium		Division operation media, media The body acts on life
		.....			
37	20 : 17–20 : 29	The teacher explained the exercises	Teachers act alone		
38	20 : 40–20 : 52	The teacher asked the students to discuss the exercises in groups	Teachers and students	Teacher-class	Request response
39	21 : 59–24 : 13	Teachers and students + continuous questioning and discussion results, broadcast by projection Put preprepared answers	Teacher-media	Teacher	Questions and answers, the teacher operates the media
		.....			
62	35 : 47–37 : 18	The teacher invites students to participate in the game and sends digital cards to each student who participates in the game	Teachers and students	Teacher-class	Request response
67	39 : 50–40 : 12	Teacher summary	Teacher alone		
68	49 : 13–40 : 35	Review key points	Teachers and students	Teacher-class	Question and answer

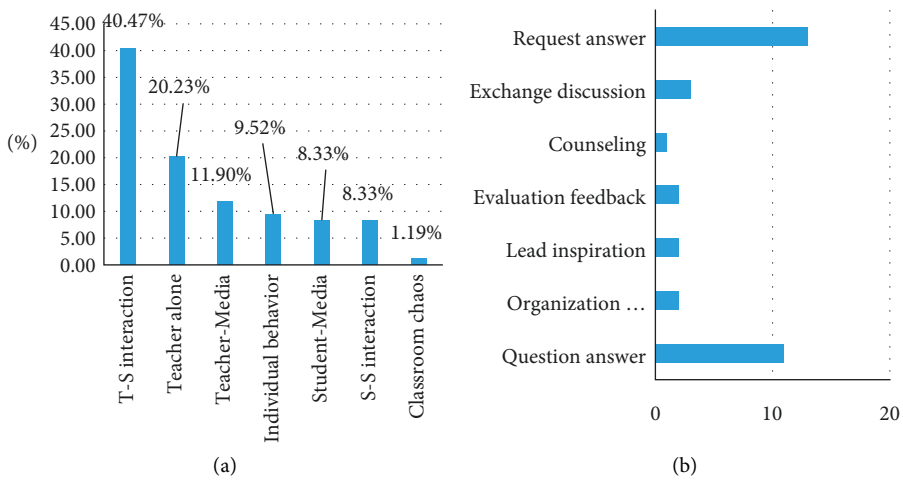


Figure 6: Classroom interactive activity allocation and specific behavior based on frequency. (a) Classroom interactive activity allocation. (b) Specific behavior based on frequency.

flash or English movie fragments provided for students to provide students with English lines. After discussion and practice, the dialogue or dubbing will be displayed in a group.

4. Teacher-Student Interaction Activities

Classroom observation records of teaching videos in a certain "computer + projection" environment, a total of 69 records, including 84 classroom interaction behaviors, are summarized in Table 6.

As shown in Table 6, in 84 classroom teaching behaviors, classroom interactive activities accounted for 69.05% of the entire classroom teaching activities. In the classroom environment of "computer + projection," the teacher-student interaction accounted for 40.47% of classroom teaching activities. Teachers can focus on the design of teacher-student interaction according to the characteristics of students and learners, avoiding long-term theoretical explanations, and interspersed with questions. Interactive links are answering and request response. Teachers' individual behavior and students' individual behavior without interaction accounted for 20.23% and 9.52% of the entire classroom activities, respectively. Teachers' individual behaviors are mainly written on the blackboard, hands-on props, hands-on postpictures, explanation of principles, summary evaluation, etc., for students. The proportion of teachers' explanations is relatively high. Although some textures and tools are prepared to attract students' attention [22], the time spent on operating teaching tools is too long. The proportion

of student activities is 8.33%, and the enthusiasm of student group activities is high. Perhaps, the content of the group exploration is relatively simple, and there is no longer-term student-student interaction activity, but the student-student discussion, student-student mutual evaluation, and other links are still designed. There were too many students participating in the last game, and students were required to go to the podium. There was a period of class confusion during the process of returning to their seats.

As shown in Figure 6, teachers use the media to inspire teaching content and create situations. The behavior of counseling and answering questions is a demonstration of the teacher walking among the students during the group discussion, answering questions, and so on.

As shown in Figure 6(a), the main interactive activities are mainly reflected in requests for responses and questions and answers. The frequency of occurrence is 13 and 11, respectively. To keep students' attention during the teaching process, teachers often use question and answer and request response methods. When comparing the size of the exercises of 10, the interaction of questions and answers is adopted, and the composition of exercises of 10 is also the interaction of questions and answers. The emphasis and difficulty of teaching are not prominent, the interaction method is single, and the teaching process [23] is relatively monotonous. The behavior of counseling and answering appeared once, when the teacher walked among the students during the group discussion and answered the students' questions. It can be seen that the teacher did not pay attention to the design of the interactive activities for counseling and answering.

As shown in Figure 6(b), teacher-media interaction and student-media interaction accounted for 11.9% and 8.33%, respectively. Multimedia is mainly used as a presentation tool for teaching content in the teaching process. The operation of the media by the teacher is independent of the teaching activity. Due to the poor visibility of the multimedia console, the teacher lowered his head at least twice to adjust the mouse and select links [24]. The teacher's individual behavior, such as teaching the principle and summarizing the teaching content, is accompanied by some gestures to emphasize the teaching content during the teaching process. The interaction between students and the media is almost all passive interaction; that is, the media acts on students. Students receive multimedia information by watching pictures, videos, etc. There is only one time when the teacher asks a student to come on the stage to operate the computer. Digital connection is an active interaction between students and the media.

5. Conclusions

Traditional learning is a way of passive acceptance. In contrast, research-based learning has strong initiative and practicality. Only by personally experiencing learning and gaining a wealth of experience can students truly stimulate their enthusiasm for learning, mobilize existing cognitive experiences, and promote the further construction of knowledge. The process of meaning construction is essentially a process of solving practical problems. Teachers should guide students to learn that students use problems as learning carriers and problem-centered to organize their own learning activities. Based on the Internet of Things technology, through perceptual classroom interactions and practical activities, learning is no longer a process of memorizing book knowledge mechanically, but a process in which students continuously discover and explore problems in the process of practice, and then solve problems. Perceived classrooms need to provide students with relevant emotions, but also need to generate various questions and problems in student emotions, guide students to explore problems, and actively construct relevant knowledge. Based on the cognitive theory of constructivist teaching, the classroom is no longer a preset activity, but an effective and equal dialogue between teacher and students. Perceptual classroom is formed through the behavior and interaction of participants, and it encourages teachers and students to generate lessons in interaction and dialogue. Teaching has become a common exploration activity for teachers and students in the process of meaning creation. In the classroom, teachers can timely grasp and flexibly deal with situations with generating value, making teaching full of flexibility, wisdom, and vitality. At the same time, this kind of expansion and deepening of the classroom promotes students' autonomous, individualized, and creative learning.

Data Availability

No data were used to support this study.

Conflicts of Interest

The author declares that there are no conflicts of interest regarding the publication of this article.

Acknowledgments

This study was supported by Research on Blended Learning Teaching Mode in Higher Vocational Colleges from the Perspective of International Comparison (No. gj19-02z) and Exploration of Flipped Classroom Teaching Mode in Higher Vocational Colleges Based on the 20 Items of Vocational Education (No. 2019skyj05).

References

[1] A. I. Saban, "An investigation of teacher Candidates'-Perceptions about physical dimension of classroom management," *European Journal of Educational Research*, vol. 6, no. 2, pp. 199–212, 2017.

[2] S. D. Brown and R. L. Hughes, "It's not something we thought aboutTeachers'Perception of historiography and narratives," *Social Studies Research and Practice*, vol. 13, no. 2, p. 00, 2018.

[3] S. Zhou and T. Zhang, "Research on the construction of flipped classroom model for English teaching based on SPOC," *Revista de la Facultad de Ingenieria*, vol. 32, no. 14, pp. 267–273, 2017.

[4] A. Cs and B. Ly, "Design and implementation of security system for smart home based on IOT technology," *Procedia Computer Science*, vol. 183, no. 2, pp. 4–13, 2021.

[5] N. A. M. Pauzi, S. M. Mustaza, and I. Yahya, "Low-cost environmental monitoring mini rover based on IoT technology," *International Journal of Advanced Technology and Engineering Exploration*, vol. 8, no. 74, pp. 64–72, 2021.

[6] Y. Quionez, C. Lizarraga, and R. Aguayo, "Communication architecture based on IoT technology to control and monitor pets feeding," *Journal of Universal Computer Science*, vol. 27, no. 2, pp. 190–207, 2021.

[7] L. Tian and L. A. Clifton, "Examining collaborative knowledge construction in microblogging-based learning environments [J]," *Journal of Information Technology Education: Research*, vol. 16, no. 16, pp. 365–390, 2016.

[8] J. K. Boateng, S. L. Boateng, and R. B. Awuah, "Videos in learning in higher education:assessing perceptions and attitudes of students at the University of Ghana," *Journal of Education and e-Learning Research*, vol. 3, no. 4, pp. 124–129, 2016.

[9] Z. Zhu, X. Chen, Y. Tu, and X. Zhang, "Palmprint image acquisition and analysis system based on IoT technology," *OALib*, vol. 07, no. 11, pp. 1–8, 2020.

[10] M. Yi, X. Xu, and L. Xu, "An intelligent communication warning vulnerability detection algorithm based on IoT technology," *IEEE Access*, vol. 7, no. 99, pp. 164803–164814, 2019.

[11] E. Sun, "Solar photovoltaic power generation wireless monitoring system based on IOT technology," *Volume 26, Number 4, 2018*, vol. 26, no. 04-2018, pp. 130–136, 2018.

[12] H. W. Kim, "Delivery agent service system using drone based on IoT technology," *International Journal of Applied Engineering Research*, vol. 12, no. 20, pp. 9752–9756, 2017.

[13] S. Qiao, Q. Zhang, Q. Zhang, F. Guo, and W. Li, "Hybrid seismic-electrical data acquisition station based on cloud technology and green IoT," *IEEE Access*, no. 99, p. 1, 2020.

[14] B. Yang, T. Yu, X. Zhang, L. Huang, H. Shu, and L. Jiang, "Interactive teaching–learning optimiser for parameter tuning of VSC-HVDC systems with offshore wind farm integration," *IET Generation, Transmission & Distribution*, vol. 12, no. 3, pp. 678–687, 2017.

[15] C. Hundt, M. Schlarb, and B. Schmidt, "SAUCE: a web application for interactive teaching and learning of parallel programming," *Journal of Parallel and Distributed Computing*, vol. 105, no. jul, pp. 163–173, 2017.

[16] I. Wanpen and C. Somjinda, "Effects of an interactive teaching method on perceived disaster nursing competencies of undergraduate nursing students[J]," *Health Emergency and Disaster Nursing*, vol. 5, no. 1, pp. 25–31, 2017.

[17] L. I. Jiashan and L. I. Zhonghua, "Dynamic gesture recognition algorithm combining global gesture motion and local finger motion for interactive teaching," *IEEE Access*, no. 99, p. 1, 2021.

[18] D. Rizzo and A. Mano, "The perceptions of graduate students regarding diversity and culture in the construction of teacher identities[J]," *International Journal for Innovation Education and Research*, vol. 8, no. 11, pp. 555–566, 2020.

[19] J. M. Díaz, S. Dormido, and R. Costa-Castelló, "An interactive teaching/learning approach to the design of robust linear control systems using the closed-loop shaping methodology," *IFAC-PapersOnLine*, vol. 53, no. 2, pp. 17174–17178, 2020.

[20] M. Gallardo, J. J. Jenkins, and P. J. Dillon, "Exploring identity construction:considerations of student identity expression in online modalities," *International Journal of Information Communication Technologies and Human Development*, vol. 8, no. 4, pp. 32–37, 2017.

[21] X. Liang, H. Lv, J. Liu, and L. Lin, "Reform of English interactive teaching mode based on cloud computing artificial intelligence–a practice analysis," *Journal of Intelligent and Fuzzy Systems*, vol. 40, no. 5, pp. 1–13, 2020.

[22] P. Wu, D. Yang, and H. Chen, "Interactive teaching mode activates entrepreneurship classes in universities," *OALib*, vol. 07, no. 11, pp. 1–9, 2020.

[23] L. Jiang, "Virtual reality action interactive teaching artificial intelligence education system," *Complexity*, vol. 2021, no. 3, pp. 1–11, 2021.

[24] P. Yan, X. Cao, H. Huang, C. Zhan, Y. Zhou, and Y. Lei, "Exploring the multi-dimensional interactive teaching mode in teaching of colligative properties of dilute solutions," *University Chemistry*, vol. 34, no. 7, pp. 23–30, 2019.

Hindawi
Mobile Information Systems
Volume 2022, Article ID 7872741, 13 pages
https://doi.org/10.1155/2022/7872741

Research Article

Construction of International Education Talents Training Mechanism Based on Data Fusion Algorithm

Ying Hong

Center of International Education & Exchange, Jiangsu College of Engineering and Technology, Nantong 226007, Jiangsu, China

Correspondence should be addressed to Ying Hong; hongying@jcet.edu.cn

Received 28 April 2022; Revised 6 June 2022; Accepted 24 June 2022; Published 11 July 2022

Academic Editor: Liming Chen

With the increasing trend of economic globalization and the continuous evolution of economic forms, the role of science and technology in promoting the development of human civilization has become more and more obvious. With the improvement of comprehensive national strength, the knowledge economy has brought new opportunities and challenges. With the increasing internationalization of higher education, it has not only driven the economic exchanges between countries but also led to the exchange of educational resources among transnational countries. However, China's international education talent cultivation started late, with poor teaching awareness, imperfect discipline construction, and low quality of international education talents. A series of problems have seriously hindered the establishment of the talent training mechanism. In order to establish a reasonable and perfect talent training mechanism, optimize the international education talent training mechanism, make the international education talent training mechanism keep up with the development trend of science, technology, and education in the contemporary world, promote the internationalization of international education talent training, and strengthen the exchange of educational resources among countries. This paper uses various algorithms of fusion algorithms to accurately calculate the talent data. The algorithm results show that the optimized grouped quadratic combined Kalman filter has a shorter running time than the traditional Kalman filter, which decreased about 20%. The S-LEACH algorithm outperforms the traditional algorithm in the simulation results of the number of surviving nodes, relative energy consumption, and data transmission. In response to the national strategy of rejuvenating the country through science and education, cultivating international talents and building a modern talent training mechanism are particularly important.

1. Introduction

Since the 1980s, the number of multinational companies in the world has been increasing year by year at an average annual growth rate of 29%. With the continuous expansion of these multinational organizations, the demand for international education talents has also increased. However, in terms of international talent education, China's training mechanism started relatively late, with little emphasis in the early stage, resulting in mixed data and information in the later stage of international talent education. The quality of teaching could not keep up, and the shortcomings of discipline construction appeared, which seriously hindered the cultivation progress and effects of international talents in China. Data fusion algorithm is an information processing algorithm that mainly collects and stores data information through computer and finally distributes and transmits data through sensors. In the process of building a talent training mechanism, it can not only improve the speed of data calculation, but also improve the calculation accuracy, as well as provide technical support for the construction of an international education talent training mechanism. Build the international education talent training mechanism under the data fusion algorithm, use science and technology to improve China's international talent training and education level, break the traditional rigid mode and institutional constraints, open the door to the world, integrate with the world education, and enhance the strength of China's international education talents in the international competition.

Based on the data fusion method, this paper cites the basic algorithms of data fusion algorithms such as Bayesian decision algorithm, Kalman filter algorithm, grouped quadratic joint Kalman filter information fusion algorithm, LEACH routing algorithm, and S-LEACH routing algorithm. Both the aspects of data calculation and network life have been improved, which is conducive to improving system performance and allowing the international education talent training mechanism in order to form a clear hierarchical positioning system under the fusion algorithm. In the process of building a talent training mechanism, the improvement of these algorithms can effectively improve the measurement accuracy of data and shorten the measurement cycle and data analysis capabilities. Through data analysis, a clearer training plan will be formulated. The training objectives will also be clarified, and the school-running model will be diversified and open.

As the application of data integration becomes more and more extensive, more and more research is being done on fusion data. In order to improve the network survival time, H Wang combined the optimal BP network, the genetic algorithm, and the particle swarm algorithm and proposed the GAPSOBP data improvement algorithm. In GAPSOBP, wireless sensors are like neurons in a neural network. The data collected by the sensor is output through the BP network and then combined with the cluster path to mix additional data, thus reducing the amount of data sent to the base station or sink. The simulation results show that the GAPSOBP algorithm is higher than the LEACH and PSOBP algorithms in terms of power consumption and grid life [1]. In order to solve the experimental problem that the model on which the assimilation system was based was discretized on a spatial grid with a horizontal dimension of tens of kilometers and there might be tens or hundreds of measurements in the future, N Zoppetti developed a new data fusion method, namely, a full data fusion algorithm for combining a set of retrieved products in a single product. In this paper, they use the full data integration method for ozone profile measurements to simulate thermal infrared and ultraviolet groups in real-world scenarios. The combined product is then compared to the input area. The comparison shows that the output of the data mix has the lowest total error and the highest data content [2]. Through in-depth research and analysis of dance motion enhancement algorithms in wearable sensor networks, Li Y selected the advanced Kalman filter algorithm and the quaternary method. A sensor measurement system based on manual measurement was proposed. The algorithm is a legendary optimization algorithm, which divides each iteration into one step of optimal and maximum probability and finds the best value completion. The values of each gesture and practice are introduced in the training algorithm model for the detection and differentiation of control data, the monitoring of its recognition accuracy, and the continuous improvement of the model to achieve accurate recognition of controls and human behaviors, thus evaluating its training of the model [3]. In order to improve the reliability of wireless sensor network (WSN) monitoring system and prolong the service life of monitoring system, an adaptive prediction weighted data fusion (AFWDF) algorithm based on clustering is proposed by Yu X. AFWDF establishes a prediction model based on the time correlation of data. The source node extracts feature values and eliminates outliers by comparing predicted values with measured values. The cluster head recovers the monitoring value and calculates the reliability and weight of the monitoring value to fuse it. Through performance analysis and simulation, it is concluded that AFWDF algorithm has high reliability. In the simulation environment, the network life cycle is about 15% higher than SAEMDA and BPNDA [4].

The development of China's international talent education mechanism started relatively late. Rakhmonov pointed out through the report that it was necessary to strengthen the connection between higher education institutions and the labor market by improving the quality of higher education institutions and cultivating high-quality talents. The report also noted that the relationship between the higher education system and production and labor markets has not been fully developed. During the independence period, the dynamics of higher education institutions and student numbers were analyzed. He studied the strategy of action and the implementation of the tasks set forth in the Decree of the President of the Republic of Uzbekistan and the resolution of higher education institutions on improving the quality of education, as well as the principles of the Bolon model on improving the quality of education [5]. Zhang surveyed Chinese HR managers' perceptions of the value of different talent development practices, with a particular focus on MBAs. This qualitative study involved 16 interviews with Chinese human resource managers. A five-dimensional human capital model was employed to guide the assessment of perception. The findings suggested that MBAs were believed to increase the value of all five human capital dimensions of the human capital model used in the study. Both national and institutional culture were believed to influence the implementation of talent development and the perceived value of an MBA by HR managers [6]. Zheng outlined "embedded" international talent training, a practice in Hebei province's two-way opening of higher education to cultivate talents with understanding of international law, mastery of economic management expertise in a globalized context, cross-cultural competence, and strong innovative international management. They could be familiar with international business activities and rules and could work in enterprises and institutions. While building cultural self-confidence, it was a practice to introduce high-quality educational resources from abroad [7]. The above literature is mainly about the knowledge of data fusion and international talent education, which is instructive for the following research.

This paper mainly uses data fusion algorithm to build a perfect international education talent training mechanism with technical support. This article analyzes and compares four basic data fusion algorithms including Kalman filter algorithm, grouped quadratic joint Kalman filter information fusion algorithm, LEACH routing algorithm, and S-LEACH routing algorithm. It is found that the running time of the grouped quadratic joint Kalman filter

information fusion algorithm is increased by 20% compared with the traditional Kalman filter algorithm, and the S-LEACH algorithm is superior over traditional algorithms in terms of the number of surviving nodes, relative energy consumption, and data transmission.

2. Construction of International Education Talents Training Mechanism Based on Data Fusion Algorithm

2.1. Data Fusion Concept. The basic idea of data fusion is to collect and store target information in a certain order by means of computer technology, electronic communication technology, etc. Then the data information is analyzed, parsed, and comprehensively processed from multiple levels or angles through relevant criteria, and then the information such as the state and characteristics of the target can be grasped and the decision-making related to the target can be made.

According to the different levels of fusion, in data fusion, there are generally three levels of fusion, which are data layer fusion, feature layer fusion, and decision layer fusion [8]. These three levels of fusion are represented from low level to high level. As shown in Figure 1, it is a hierarchical model diagram of data fusion.

2.1.1. Data Layer Fusion. Data fusion firstly obtains the fusion for the information channels in the sensor. According to the data information obtained after fusion, the system extracts the feature vector, and then the system performs the process of data identification and transmission [4]. There is no problem of data loss in data fusion, and such results are the most accurate. Sensors must meet the conditions of the same type. If multiple sensors are heterogeneous, data can only be fused at a higher layer. If the data traffic is large, the bandwidth and processing capacity of the system are very high.

2.1.2. Feature Layer Fusion. Feature layer fusion, as the name implies, is to classify according to the feature model of the data and extract the features to form different types of feature data vectors. Then it uses pattern recognition to process, which requires less bandwidth of the system than data layer fusion. However, due to the inaccurate problem of extracting features, in extreme cases, the opposite fusion results will be produced.

2.1.3. Decision Level Fusion. After the feature layer is completed, the decision layer fusion is to integrate the features of multiple sensors. The main advantage of feature fusion is that it combines a variety of features for calculation with high accuracy.

2.2. Multisensor. As the most basic facility of information fusion, multisensor can use different dimensions of sensor information data combined with computer technology to measure and analyze, and it can also collect data information according to time sequence [9]. Through the optimization of various information and feature extraction, more valuable information can be extracted. According to the level of data flow, it can be divided into data layer, feature layer, and decision layer. Each layer has its own function, and finally they will form a complete system that depends on each other and cooperates with each other. After each sensor identifies the target, the results of multiple sensors are integrated. According to the synergistic and complementary relationship between the comparative data, the expected data fusion result is finally achieved. The main purpose of using information fusion technology to establish a talent training mechanism is to obtain more effective information and to integrate and analyze the information received by multiple sensors, which can effectively solve the unilateral problem of information collection from a single sensor. The establishment of a multisensor information fusion model for the talent training mechanism is of great significance for improving the talent training mechanism.

2.3. Bayesian Decision Algorithm. Bayesian decision algorithm is a frequently used data fusion algorithm for parameter estimation [10]. Using the knowledge of probability and statistics for classification, a value is given. Then a measurement evidence fusion is added to the algorithm to estimate and update the data, which is a kind of data fusion algorithm.

Using R1, R2, R3, etc. to represent n assumptions that do not contain enumerables, the Bayesian formula is in the form as the following formula:

$$T(R_i|H) = \frac{T(H|R)T(R_i)}{\sum_{j=1}^{n} T(H|R_j)T(R_j)}, \tag{1}$$

$$\sum_{i}^{n} T(R_i) = \sum_{i}^{n} T(H \mid R_i)T(R_i) = \sum_{i}^{n} T(H, R_i) = T(H). \tag{2}$$

The Bayesian inference method was first used to determine inference, and its important advantage is that it is based on axioms and has a strong theoretical data foundation that can be intuitively understood [11]. Bayesian decision-making provides a feasible method for data fusion, which is used for multisensor high-level information fusion in a static environment. According to the probability principle of sensor information combined with Bayesian decision-making, the conditional probability is used to represent the uncertainty of different measurements. When the target of the sensor tends to be consistent, it can be directly used for data fusion. But in most cases, multisensor data is constantly changing, and even the range of changes will be very large. Therefore, it is not optimal in most cases.

Its main disadvantages include the following:

(1) The probability distributions required for Bayesian decision-making must be independent, which becomes particularly difficult in systems that contain

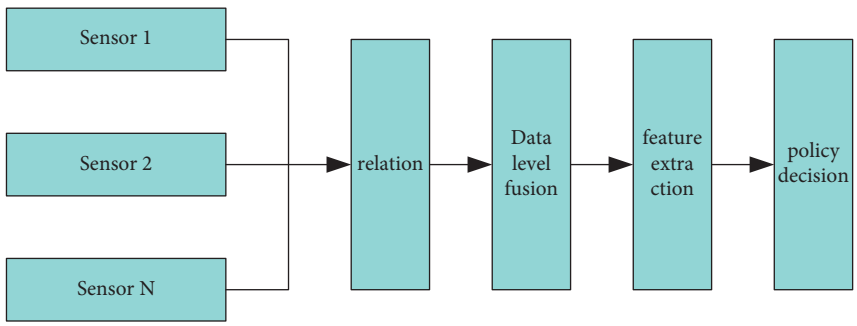


Figure 1: Hierarchical model of data fusion.

multiple sources of linked information. Sometimes it may be even impossible.

(2) The acquisition of the conditional probability of prior knowledge and the acquisition of prior probability are difficult. The results of the obtained probability are inconsistent, resulting in large workload and low efficiency, which is not desirable for large-scale system calculation.

(3) Updating the rule base is computationally expensive, because when the system needs to increase or decrease a rule, all the probabilities must be recalculated to ensure the correlation and consistency of the system, which is not desirable for large systems.

(4) The Bayesian method must be used on the same level of recognition framework. If in the data fusion, it is impossible to use the Bayesian method to fuse the data collected at different levels. Because the prior probability is known in advance, and the prior probability of high-level evidence cannot be assigned in advance, it will lead to fusion errors of different layers [12].

2.4. Kalman Filter Algorithm. It is a powerful tool for solving state space model estimation and prediction. It does not need to rely on huge historical data and is implemented by recursive method based on the minimum mean square error. This algorithm is mainly a multidimensional and nonstationary processing process. It is often used in the establishment of various mechanisms [13]. Kalman filter algorithm is a data fusion algorithm for dealing with linear system noise. The realization method is to obtain the fusion estimated value after a series of linear combinations of the estimated values of sensor nodes in the network.

Kalman filtering is widely used in discrete control systems, so the following analysis is based on this system. The system is actually a linear stochastic differential equation as the following formula:

$$W(h) = \mathrm{RW}(h-1) + \mathrm{YU}(h) + P(k). \tag{3}$$

The measured values of the system are expressed as the following formula:

$$F(h) = \mathrm{EW}(h) + V(h). \tag{4}$$

In formula (4), the control variable $U(h)$ corresponds to time h, the others are various parameters in the system, and each parameter forms a matrix in the model. In the Kalman filter system, if the measured value is not large or the number of measurements is only one, then E is 1. If the matrix of the system is multidimensional, then this parameter represents a matrix E at that time. $W(h)$ represents the noise in the measurement process. According to the above formula, it can be known that if the process noise satisfies the Gaussian white noise, the co-square error of these white noises can be measured.

In the Kalman filter system, the measurement error estimation that satisfies white Gaussian noise can be divided into five steps. Firstly, the following formula is obtained:

$$W(h|h-1) = \mathrm{RW}(h-1|h-1) + YU(h). \tag{5}$$

In formula (5), $W(h|h-1)$ represents the result obtained by the system at the top level. $\mathrm{RW}(h-1|h-1)$ is the optimal result selected from the results obtained by the system, and $YU(h)$ represents the control amount. If there is no control amount in the system, this parameter is generally set to 0 by default.

The system forecast results are recalculated to obtain the latest system results. When the covariance of the predicted value is not updated, M is used to represent the covariance. The calculation formula of the covariance is as followsa:

$$M(h|h-1) = \mathrm{RM}(h-1|h-1)R + Q. \tag{6}$$

According to the observed results above, the measured value of the system in the current state can be calculated. Combined with the above results, the optimal estimated value $W(h|h)$ in the current state can be obtained as follows:

$$W(h|h) = W(h|h-1) + \mathrm{Kg}(h)(F(h) - \mathrm{EW}(h|h-1)). \tag{7}$$

In formula (7), Kg represents the Kalman gain, and the formula can be obtained:

$$\mathrm{Kg}(h) = P(h|h-1)E|(\mathrm{EP}(h|h-1)E + A). \tag{8}$$

Now, the optimal estimated value of h in the current state of the system is obtained. In order to keep the calculation of the system going, knowing that there is no next measurement value in the system calculation, the covariance

calculation will be used after iterative update. The calculation formula is as follows:

$$P(h|h) = (L - \mathrm{Kg}(h)E)P(h|h-1). \quad (9)$$

The above is the basic principle and basic formula of Kalman filter. Kalman filtering is well suited for solving the inertial feature problem associated with filtering. For example, the possible position of the object is predicted by detecting the current position of the object in real time at the next moment. For moving objects with changing positions, assuming that the next position is the current position, there is a deviation between the predicted value and the actual value. The Kalman filter can estimate the deviation, so it is suitable for real-time measurement of the target position for tracking. The target is constantly moving, so the data of the two states before and after the moving target have motion characteristics, and the Kalman filter is used to solve the abovementioned motion prediction problem [14]. Meanwhile, Kalman has higher requirements on the change model of the prediction object and the distribution model of noise, and the filtering results can directly reflect the quality of the model. Since the Kalman filter is very easy to diverge, it is generally used for data fusion at low levels. At the same time, the Kalman filter process is a process of continuously updating the current state for recursion, so it is no longer necessary to save all the states that have occurred in advance and then perform calculations, which does not require high system requirements and has good real-time performance [15]. When there is a lot of redundancy in the sensor combination information, the dimension of the observation matrix will become huge, and the calculation amount of the filter will soar. Adding sensors increases the complexity and probability of failure of the system, and when a system failure cannot be detected, it can quickly contaminate the entire system.

2.5. Grouped Quadratic Joint Kalman Filtering Information Fusion Algorithm. According to the optimal criterion of information fusion and the three fusion structures improved above: centralized structure, distributed structure, and hybrid structure, all have their own scope of application, advantages, and disadvantages. To address the problem that Kalman centralized data processing causes excessive computation and that erroneous data from a single sensor can rapidly contaminate the entire system, a data fusion algorithm based on joint Kalman filtering is used to improve the computational speed and scalability of the system [16]. The grouping here does not mean that there is no relationship with each other but another interpretation of distribution. It is used to specify the structure of the local filter, which indicates that the components are distributed into the local filter in groups. Figure 2 shows the basic structure of grouped quadratic fusion.

In recent years, joint Kalman filtering has been applied to various traffic and navigation information systems. It is widely praised in practical production applications. Among them, the joint filtering model has made significant improvements to the algorithm under the premise of the original distributed state fusion. The joint Kalman filter model not only requires a small amount of computation, but also has outstanding performance in terms of flexibility and reliability. Now it has become a new generation of general-purpose filtering models. Decentralized filtering is the basis of the joint filter, and the joint Kalman provides data from the local filter, so as to achieve the reliability of the data. The local filter must include an information distribution process. During this process, the dynamic information of the main filter is proportionally distributed among the local filters.

2.6. LEACH Routing Algorithm. The LEACH algorithm is a cluster-based protocol algorithm, which randomly selects the balanced nodes within the network to carry energy according to logical division and finally achieves an energy-saving routing algorithm within the system [17]. The LEACH algorithm uses multiple rounds of operation in its work. During each round, the nodes in the network complete the work of electing cluster heads in the aggregation area. After the cluster head election is successful, the message will be transmitted to other nodes, and other noncluster head nodes choose which cluster to join according to their own conditions (such as signal strength, etc.). Since the energy consumption of the cluster head is larger than that of the noncluster head nodes, the LEACH algorithm has to reelect the cluster head after each round to achieve the purpose of balancing the energy. To ensure that the collected data is accurate enough, it is required that the nodes in the network can be evenly distributed, and the energy and structure of the nodes must be consistent. The phenomena of node heterogeneity cannot exist. It is done in order to make the data compatible during aggregation and fusion without generating errors. When deploying nodes within the network, it needs to be ensured that the energy value of each node is sufficient along with other nodes for information transmission, so that the system can carry out the next operation of electing the cluster head. It also needs to be ensured that the cluster head and the noncluster head can keep in touch with each other. The protocol is simple and its implementation is easy. The protocol adopts the node random election cluster head strategy. The cluster head is adaptively generated, and the whole network load is balanced, reducing network energy consumption. The cluster-based protocol structure allows the cluster head node to fuse the information of the nodes in the cluster. The generated data packets are sent to the sink node uniformly, which avoids the energy loss caused by the large-scale transmission of multiple single nodes. Even when the node energy is exhausted due to uneven load or environmental factors, a timely response mechanism can be made. Figure 3 is the flowchart of the LEACH routing algorithm.

2.6.1. Cluster Head Election Policy and Data Transmission.

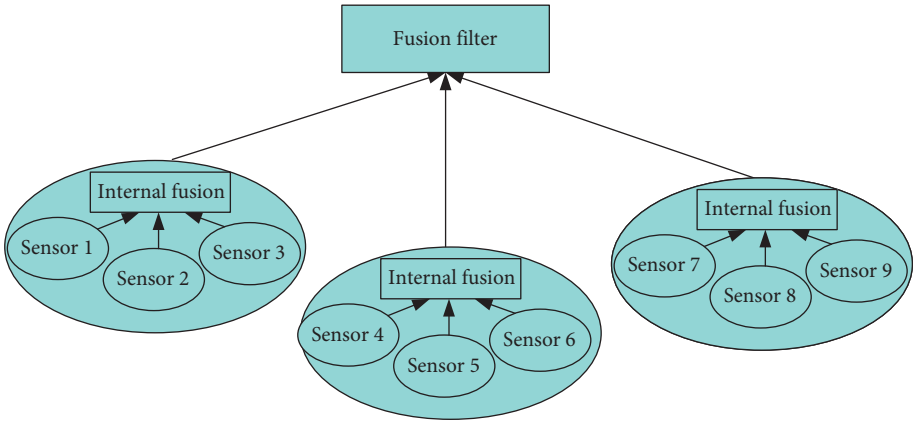


Figure 2: Basic structure of grouped secondary fusion.

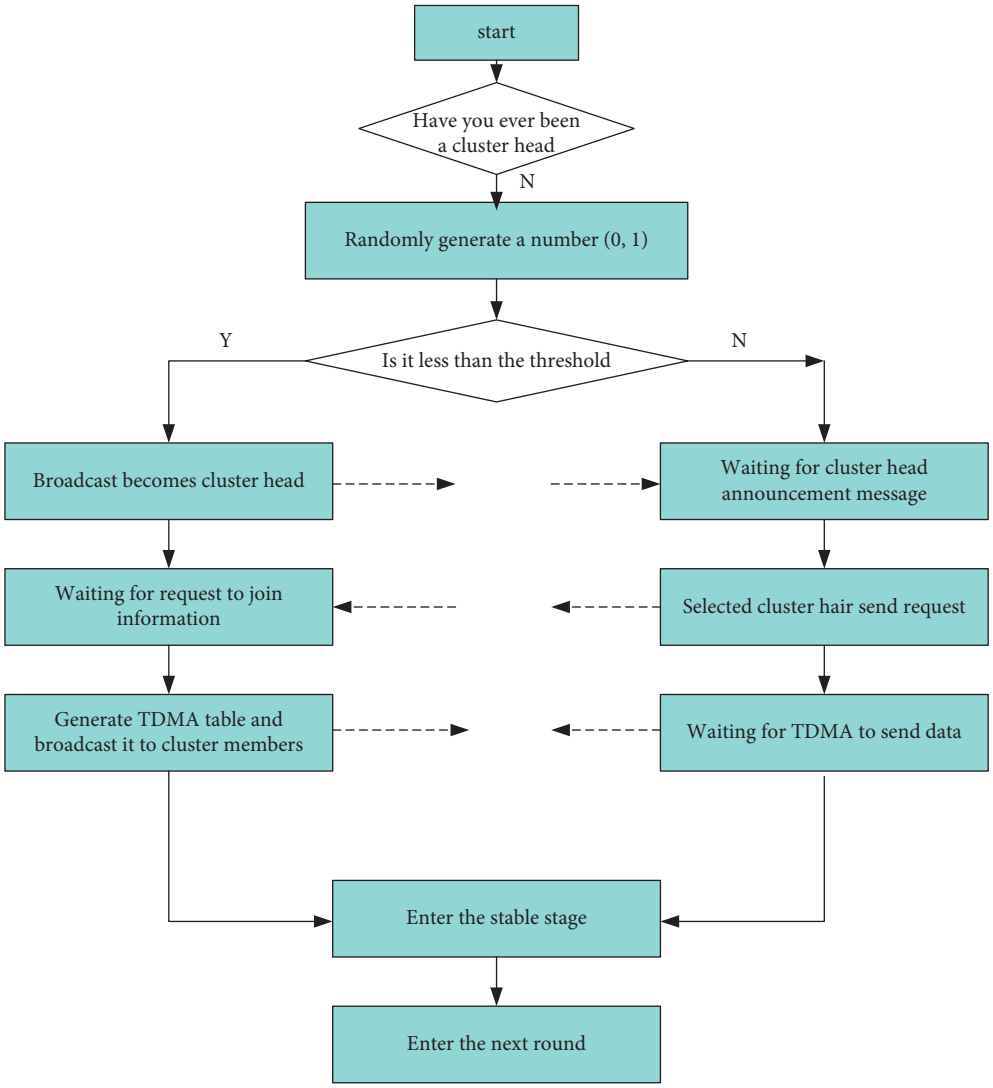


Figure 3: LEACH routing algorithm process.

The election of the clusters is conducted in a random manner. Before the election continues, a threshold is first set so that the random data generated by the node is between 0 and 1. Then, the threshold for the election is as follows:

$$U(s) = \left\{ \begin{array}{ll} \dfrac{T}{1 - T \times [r \bmod (1/T)]}, & s \in G \\ 0 & \end{array} \right\}. \quad (10)$$

In formula (10), T is the probability of being elected as the cluster head node, and G is the set of nodes that have not been elected as the cluster head; r represents the current election round number. In this link, the nodes are elected until the last unelected node becomes the cluster head, which means that this link ends. As can be seen from the structure diagram, the way that the LEACH algorithm collects the information of the cluster is mainly the TDMA mechanism. This mechanism integrates the collected information by the cluster head in the node and then transmits it to the information gathering point by the cluster head. After the transmission of the nodes in the cluster is determined by the TDMA timing message, the nodes in the cluster start to transmit data in their own transmission time slots, and the transmission adopts a simple single-hop mode. After a round of transmission, the cluster head compresses and summarizes the received node data into a new transmission signal.

2.6.2. Communication Energy Model. Since each point in the LEACH algorithm has a consistent energy value, it is assumed that all nodes in the network have the same initial energy value and limited energy. The energy consumption per unit distance is the same, and there is only one sink node in the network. Its location is fixed, and then the energy of the first part of the level in the sensor can be expressed as follows:

$$\begin{aligned} D_{\mathrm{Tn}}(l,h) &= \mathrm{lD}_{\mathrm{elec}} + l\beta h^r \\ &= \left\{ \begin{array}{l} \mathrm{lD}_{\mathrm{elec}} + l \times \beta_{\mathrm{mp}} \times h^4, h \geq h_0 \\ \mathrm{lD}_{\mathrm{elec}} + l \times \beta_{\mathrm{fs}} \times h^2, h < h_0 \end{array} \right\}. \end{aligned} \quad (11)$$

During the signal transmission process, the energy of the node will be weakened with the transmission. There are two attenuation paths: multipath attenuation and free space attenuation. The attenuation path becomes the threshold distance. The calculation formula of the threshold distance is as follows:

$$h_0 = \sqrt{\frac{\lambda_{\mathrm{fs}}}{\lambda_{\mathrm{mp}}}}. \quad (12)$$

The energy consumption of the second part level is expressed as follows:

$$D_{\mathrm{Qn}}(l,h) = \mathrm{lD}_{\mathrm{elec}}. \quad (13)$$

In summary, the energy consumed in the system is as follows:

$$D_T(l,h) = D_{\mathrm{Tn}}(l,h) + D_{\mathrm{Rn}}(l,h) = 2\,\mathrm{lD}_{\mathrm{elec}} + l\beta h^r. \quad (14)$$

Although the LEACH routing algorithm has many advantages, it also has disadvantages such as ignoring the remaining energy, repeated collection of information, etc., which lead to rapid consumption of energy consumption between nodes. In this way, internal nodes often die prematurely, and network life is also impaired [18]. Long-distance transmission is not considered. The algorithm is only suitable for small-scale networks. When the distance is short, the single-hop transmission method can still exert its advantages. But when the transmission distance is long, the single-hop transmission method will consume a lot of energy of the cluster head.

2.7. S-LEACH Routing Algorithm. Aiming at the shortcomings of LEACH routing algorithm, an improved and optimized algorithm, S-LEACH routing algorithm, is proposed in this paper. In the S-LEACH algorithm, the remaining energy of the node, the location of the node, and the density of the node are the factors that are mainly considered in the election of the cluster head. The specific election process is as follows.

(1) The remaining energy ratio of the node is recalculated as follows:

$$\frac{D_i(r)}{D_{ic}}. \quad (15)$$

D_{ic} represents the remaining energy of node i in the rth round of cluster head election and the initial energy at the beginning of the node. The ratio of the first two is proportional to the remaining energy. The larger the ratio is, the higher the probability of becoming a cluster head will be.

(2) The formula for calculating the distance between the node and the sink point is as follows:

$$h(i) = \sqrt{(m_i - m_0)^2 + (n_i - n_0)^2}. \quad (16)$$

In formula (16), $(m_i - m_0)$ represents the node coordinates of node i in the internal network, and $(n_i - n_0)$ represents the coordinates of the convergence point. In the cluster head election, the node closest to the sink is the most likely to become the cluster head.

Relative density calculation of nodes is as formula:

$$\partial(x) = \frac{\mathrm{Nei}(x)}{(1/P) - 1}. \quad (17)$$

Relative density refers to the relative density of nodes within the range of the specified radius R, which is the ratio of the number of adjacent nodes to the number of adjacent nodes in the standard cluster.

In formula (17), P represents the proportion of cluster heads in all nodes, and the number of adjacent nodes between each cluster head is represented by (1/P) − 1. The formula for calculating the radius H is as formula:

$$H = \sqrt{\frac{Q}{\pi \times F \times P}}. \quad (18)$$

In formula (18), Q represents the coverage area of the sensor, and F is the total number of nodes existing in the network range.

After the cluster head election in LEACH is optimized, a new threshold can be obtained. The calculation formula is as follows:

$$U(s) = \left\{ \begin{array}{c} \dfrac{T}{1 - T \times [r \bmod (1/t)]} \times E, s \in G \\ \\ 0 \end{array} \right\}. \quad (19)$$

In formula (19), E is the impact factor of the threshold. Its calculation formula is as follows:

$$E = e_1 \frac{E_i(r)}{E_{\text{ic}}(r)} + e_2 \frac{h_{\text{avg}}}{h(i)} + e_3 \frac{\text{Nei}(x)}{(1/p) - 1}. \quad (20)$$

According to these formulas, the optimized algorithm can achieve the optimal cluster head election. According to the new threshold formula, nodes which are with high residual energy, close to the sink node, and of relatively high density will make the threshold larger, thus making it more likely to be elected as the cluster head [19].

2.8. Talent Training Mechanism Fusion Algorithm Architecture. According to the different fusion architectures, the talent training mechanism is divided into the following three architecture modes, namely, centralized fusion, distributed fusion, and hybrid fusion structure [20].

2.8.1. Centralized Fusion Structure. The processing center of the centralized fusion structure can use all the original measurement sensor values without data loss, so the fusion result is theoretically optimal. The centralized structure is generally used in small systems. In large systems, the above two problems will cause the fusion structure to fail to meet the requirements, as shown in Figure 4.

Centralized Kalman filtering also has irreparable shortcomings. In the multisensor information system, there will be some problems, such as poor performance and real-time performance. If the number of sensors becomes large, it will lead to a very large amount of calculation, which will seriously affect the real-time performance and performance of the sensor system [21]. Its fault tolerance is poor. Since the centralized Kalman filter processes all the data uniformly, if the data of a certain sensor is polluted due to device damage or other factors such as environmental changes, it is even considered that the data is polluted. This contamination data is diffused into the observations and states of all other normal sensors. This will lead to a decrease in the correctness of the entire system data.

2.8.2. Distributed Fusion Structure. In the distributed fusion structure, each local sensor (ellipse node in the figure) has its own processor, which performs preprocessing before sending the data to the processing center, as shown in Figure 5. Since each sensor has its own processor, the corresponding filtering estimation results can be obtained. Finally, the processing center obtains the global estimation result. Compared with the centralized structure, the results obtained by distributed fusion are usually suboptimal [22]. However, this fusion method has the characteristics of low communication bandwidth requirements, strong system vitality, and relatively easy implementation.

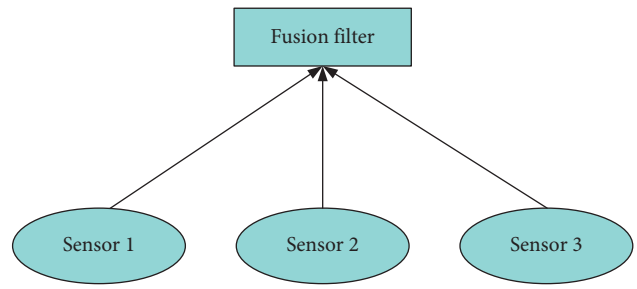


Figure 4: Centralized fusion structure.

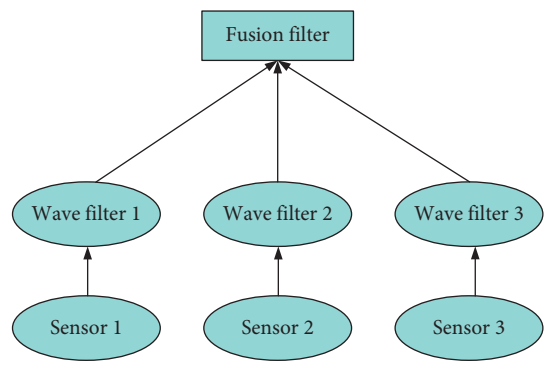


Figure 5: Distributed fusion structure.

The distributed structure also has the problem that the centralized structure can be improved due to the large amount of computation. However, after local processing, the information that may affect the final fusion result is lost because it needs to be compressed and refined and then transmitted to the fusion filter, which will eventually lead to the fusion result being suboptimal. It is unacceptable in large application systems to have a corresponding processor for each sensor. It will cause the cost to rise in a straight line, and it will also have a long-term impact on future maintenance. However, due to the improved performance, it has great application value in some simple systems that do not require high fusion accuracy and are relatively simple.

2.8.3. Hybrid Fusion Structure. The hybrid fusion structure is a hybrid of the two fusion structures described above. The part obtained by the fusion center is the original measurement value directly given by the sensor, and the remaining part is the intermediate data processed by the remaining local nodes, as shown in Figure 6. Since this structure combines the characteristics of both centralized and distributed fusion structures, the advantages and disadvantages are dealt with between the two. At the same time, this structure provides merit for the fusion of

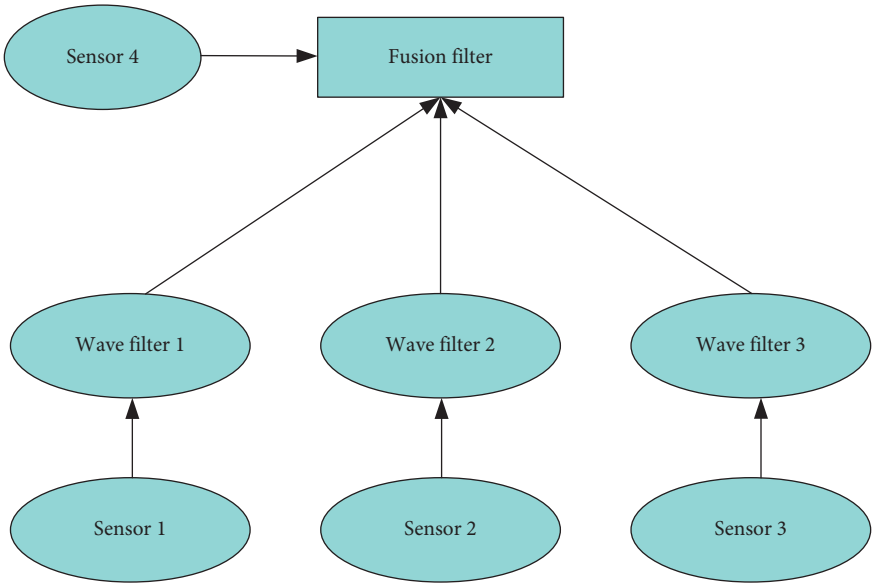


Figure 6: Hybrid fusion structure.

multiprocessing, multiplatform, and heterogeneous sensor information [23].

The hybrid structure combines the advantages of the centralized and distributed structure described above and reasonably avoids the disadvantages of the centralized structure, which has a large amount of computation. It is difficult to process in heterogeneous systems, and the distributed structure fusion structure is suboptimal. Not only can the heterogeneous system be handled calmly, but also the measurement data of the direct sensor can produce a relatively better fusion structure compared to the centralized structure. However, the hybrid structure design is more complicated. In large-scale application systems, changes to some sensors will lead to major changes in the entire fusion processing system, so its scalability and reliability are not high.

Considering the configurability and scalability, as well as the optimization and improvement of the algorithm, the processing flow of the whole system is as follows: After the system starts, it first reads the configuration file and encapsulates the data necessary for the database connection as a CProperty entity object. Then the data is handed over to the joint Kalman filter package class. Then the whole process starts. Connected to the database through CProperty, three local filters and each pre- and postprocessor are initialized. Then data can be read. If there is no data, it will exit directly. Otherwise, the data will be encapsulated into entity objects according to the weight value and handed over to the preprocessor for processing. If the processing does not pass, it will continue to read the next piece of data directly. If not, each data part of the entity object is handed over to three local filters, respectively. The local filter first obtains the local state estimate by generating the predicted state and then adds the covariance matrix of the three local filters to obtain

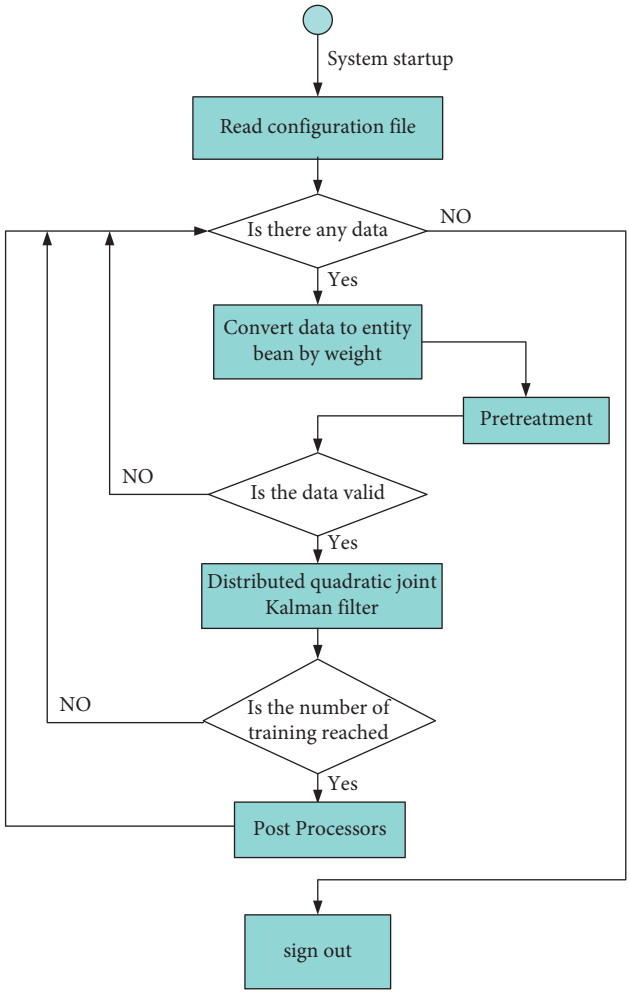


Figure 7: Overall flowchart of the fusion system.

Table 1: Performance comparison table of two fusion algorithms.

Hardware environment	Win-XP sp3+Intel Corei3 3.5 GHz + 4G memory			
Contrast scene (run 50 respectively) time (average)	Standard joint Kalman filter		Grouping quadratic joint Kalman filter	
	242 records	484 records	242 records	484 records
Overhead (MS)	1	1	1	1
Filtering overhead (MS)	164.9	310.7	129.44	265.3
After overhead (MS)	17.97	30.18	20.43	28.56
Total time cost	183.87	441.88	150.87	294.86

the global covariance. After adding the local state estimates of the three filters, the global estimate is obtained by left-multiplying the global covariance device. The global covariance is scaled down by 1/3, and the local filter is updated with the measured value of the solid object. Then whether the number of training data is reached will be determined. If the number of training records is not reached, the next record in the database will be read directly. It is responsible for handing over the results to the postprocessor for processing, generally writing to a database or file. Figure 7 shows the overall flowchart of the data fusion system.

3. Experiment on the Construction of International Education Talent Training Mechanism Based on Data Fusion Algorithm

3.1. Applicability of Kalman Filter Algorithm in International Education Talents Training Mechanism. In this paper, the construction information of the international talent education mechanism is studied, and the data sources of talent education information are combined to compare the efficiency of the grouped quadratic joint Kalman filter and the original standard joint Kalman filter. In this experiment, the time overhead of preprocessing, filtering, and postprocessing of the two algorithms was calculated at the same time to reduce the measurement error. Table 1 shows some results obtained by comparing the operation time.

It can be seen from Table 1 that the two filtering algorithms occupy a small proportion of time in preprocessing and postprocessing and have little impact on the overall performance. One of the time-consuming items is the loss of filtering. In the experiment, the filtering script was repeatedly executed 50 times. Then the average filtering time was calculated, and the time of each scene was added to obtain the final average filtering duration. The experimental results show that the total cost of the original standard Kalman filter is 341.88 in 484 records when the average is obtained after running 50 scenarios. The running time of the grouped quadratic joint Kalman filter in the same record is 294.86, which is 72.02 less than the running time of the standard Kalman filter. The running time of the grouped quadratic joint Kalman filter is reduced by about 20% compared with the standard Kalman filter, and the operational efficiency of the system is improved by about 20% after optimization and improvement. If the grouped quadratic combined Kalman filter is applied to the actual construction of the international education talent training mechanism, it can effectively not only improve the measurement accuracy of data, but also shorten the measurement period, as well as improve the system's data analysis capabilities more significantly.

3.2. Network Simulation and Performance Analysis of LEACH Algorithm and S-LEACH Algorithm. In order to verify whether the LEACH algorithm and the S-LEACH algorithm have better performance in the process of establishing the international talent education mechanism, this paper compares the S-LEACH algorithm with the traditional LEACH algorithm, using the MATLAB tool. The simulation results are calculated. Then the simulation parameter settings in s-leach algorithm can be obtained, as shown in Table 2.

It can be seen from Figure 8 that the number of surviving nodes of the LEACH algorithm is lower than that of the S-LEACH algorithm. In the experiment, the initial number of nodes of the two algorithms remained the same, and the LEACH algorithm ran out of energy when it ran to about 460 rounds. However, the nodes of the S-LEACH algorithm all died after 820 rounds. It can be seen from the experimental data that S-LEACH algorithm can effectively prolong the life cycle of the network.

From the simulation results in Figure 9, it can be seen that the energy loss curve in the traditional LEACH algorithm was more complex and extreme, indicating that the energy suddenly disappears in a short time or reached a certain time. At about 300 rounds, the energy consumption reached its peak; however, under the optimized S-LEACH algorithm, the consumption curve was relatively regular and flat. It can be seen from the figure that the curve of energy consumption changed regularly with the change of cycle, and the decline was also slow. It reached its peak value after more than 700 rounds. Therefore, S-LEACH algorithm can reduce the speed of energy consumption in the system, save cluster head energy, ensure cluster head vitality, and improve network life.

From the comparative analysis of the data transmission of the two algorithms, it can be seen in Figure 10 that the traditional LEACH algorithm was also weaker than the S-LEACH algorithm data transmission in terms of data transmission. The capacity curve of LEACH data transmission was flat. Even if the number of rounds reached 1000, the amount of transmitted data was still below 0.5 bit. The S-LEACH data transmission curve rose steadily. The maximum transmission effect was between 3 and 3.5 bit, and the transmission capacity was strong. It also can be seen that

Table 2: Setting of simulation parameters in S-LEACH algorithm.

Parameter name	Parameter	Size	Company
Network size	S	$200 * 200$	m^2
Sink node coordinates		(100,100)	
Total number of nodes	N	100	
Node initial energy	D_0	0.5	J
Communication radius	r	20	m
Wireless signal energy consumption	D_{elec}	50	$nJ\ bit$
Power amplifier	β_{amp}	10	$pJ/(bit.m^{-2})$
Power amplifier	β_{mp}	0.0013	$pJ/(bit.m^{-4})$
Reference distance	h_0	87	m
Single sample signal	k	4000	bit
The energy consumed by the fusion of the	D_l	5	$nJ/bit/signal$

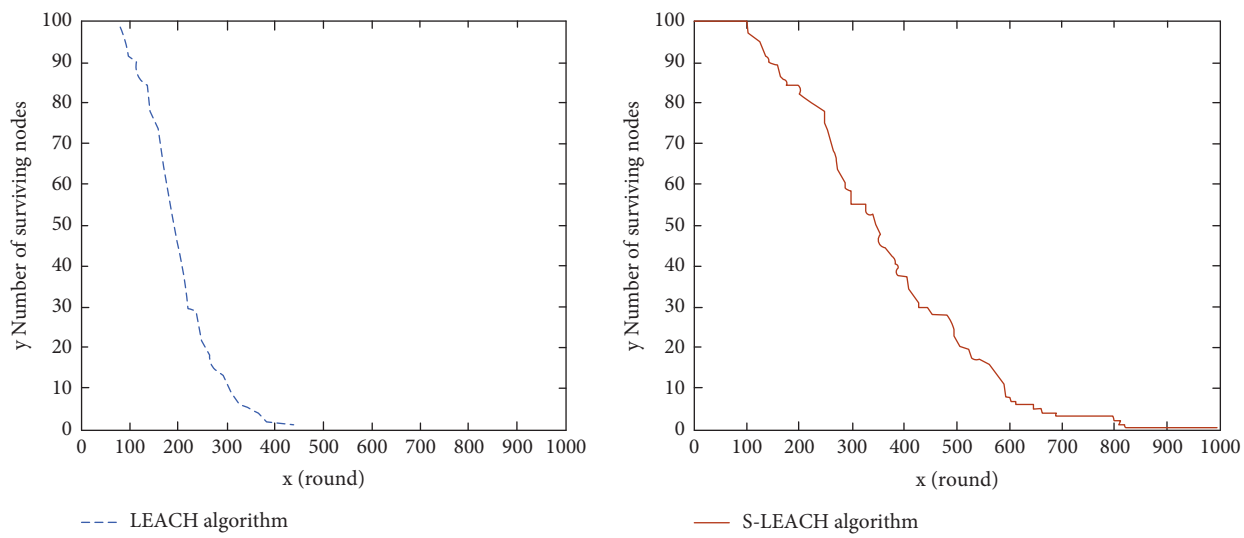


Figure 8: Comparison of the number of surviving nodes with time.

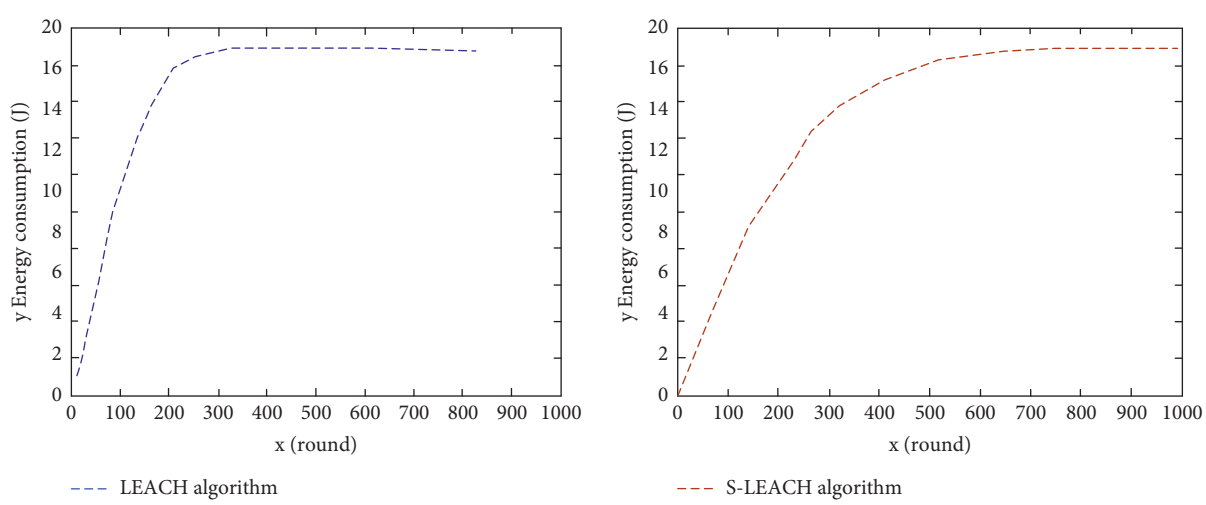


Figure 9: Comparison and analysis of network energy consumption of two algorithms.

S-LEACH has strong transmission capability. Therefore, the S-LEACH algorithm is obviously superior to the traditional LEACH algorithm in terms of the number of surviving nodes, relative energy consumption, and data transmission.

4. Discussion

This paper analyzes the data fusion algorithm to build a perfect international education talent training mechanism.

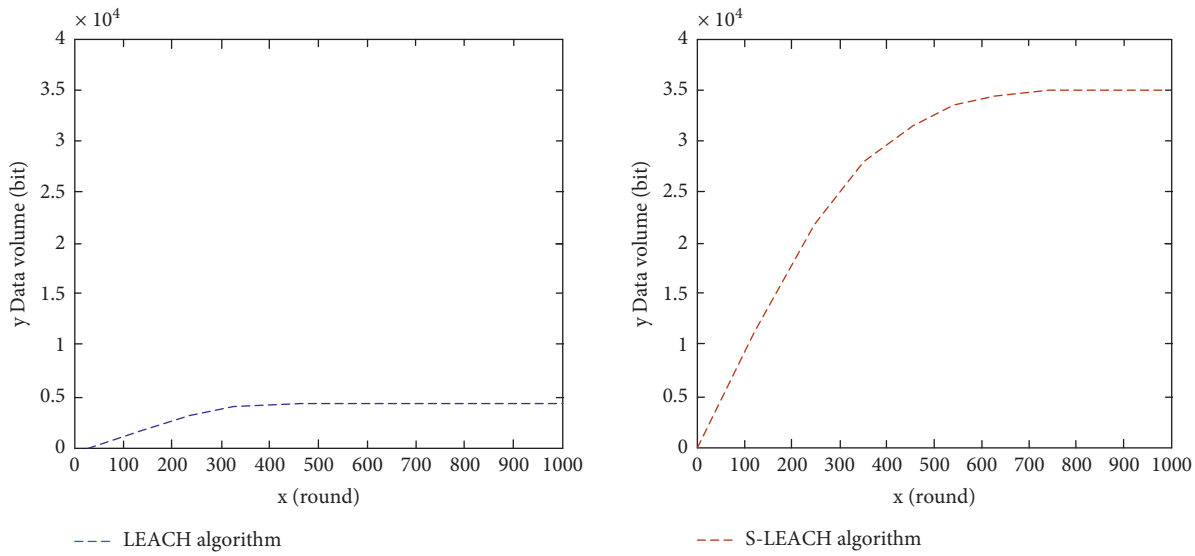


Figure 10: Comparison and analysis of data transmission between two algorithms.

According to the shortcomings found in the traditional fusion algorithm, the optimized data fusion algorithm is derived, and the Kalman filter algorithm, the grouped quadratic joint Kalman filter information fusion algorithm, the LEACH routing algorithm, and the S-LEACH routing algorithm are used to test the system performance of the international education personnel training mechanism. The comparison between the system's running time, node survival number, relative energy consumption, and data transmission speed is verified through tests. It is found that the improved algorithm is more beneficial to the overall operation of the system and improves efficiency.

5. Conclusions

This paper focuses on the role of Kalman filter algorithm, grouped quadratic joint Kalman filter information fusion algorithm, LEACH routing algorithm, and S-LEACH routing algorithm to build the international education personnel training mechanism. The article first talks about the concept and basic structure of fusion algorithm, such as sensors, so that people have a preliminary understanding of data fusion. Then, the basic algorithm of data fusion is described in detail. The benefits of these algorithms for building an international education talent training mechanism and how to build a perfect talent training mechanism are discussed. In the experiment part of the article, the applicability of data fusion algorithm in the international education talent training mechanism is explored through Kalman filter algorithm and grouping quadratic joint Kalman filter. The experiment shows that the operation efficiency of the system is improved by 20% under grouping quadratic joint Kalman filter. By comparing the network simulation and performance of LEACH algorithm and s-leach algorithm, it is found that s-leach algorithm can effectively prolong the network life cycle and improve the network life. Finally, it is found that the grouped quadratic joint Kalman filtering information fusion algorithm and the S-LEACH routing algorithm are superior to other algorithms in terms of performance and data transmission. Although the article proposes some data fusion algorithms that are beneficial to the construction of a talent training mechanism, the actual operation of data algorithms in the mechanism remains to be considered [24–26].

Data Availability

Data sharing is not applicable to this article as no new data were created or analyzed in this study.

Conflicts of Interest

The author states that this article has no conflicts of interest.

References

[1] H. Wang, L. Song, J. Liu, and T. Xiang, "An efficient intelligent data fusion algorithm for wireless sensor network," *Procedia Computer Science*, vol. 183, no. 3, pp. 418–424, 2021.

[2] N. Zoppetti, S. Ceccherini, B. Carli et al., "Application of the Complete Data Fusion algorithm to the ozone profiles measured by geostationary and low-Earth-orbit satellites: a feasibility study," *Atmospheric Measurement Techniques*, vol. 14, no. 3, pp. 2041–2053, 2021.

[3] Y. Li, "Dance motion capture based on data fusion algorithm and wearable sensor network," *Complexity*, vol. 2021, no. 1, pp. 1–11, 2021.

[4] X. Yu, F. Fan, and L. Zhou, "Adaptive forecast weighting data fusion algorithm for wireless sensor network," *Chinese Journal of Sensors and Actuators*, vol. 30, no. 5, pp. 772–776, 2017.

[5] N. Rakhmonov, "Enhance qualification and provide competiveness of higher education institutions," *International Finance and Accounting*, vol. 2019, no. 2, p. 22, 2019.

[6] Y. E. Zhang and P. L. Nesbit, "Talent development in China: human resource managers' perception of the value of the MBA," *International Journal of Management in Education*, vol. 16, no. 3, pp. 380–393, 2018.

[7] W. Zheng, Y. Wen, and L. Zheng, "An "embedded" mode of international talent training boosts the two-way opening of higher education," *Open Journal of Social Sciences*, vol. 07, no. 03, pp. 136–145, 2019.

[8] W. Zhang, J. Yang, H. Su, M. Kumar, and Y. Mao, "Medical data fusion algorithm based on Internet of things," *Personal and Ubiquitous Computing*, vol. 22, no. 5-6, pp. 895–902, 2018.

[9] N. . Pan, "A sensor data fusion algorithm based on suboptimal network powered deep learning," *Alexandria Engineering Journal*, vol. 61, no. 9, pp. 7129–7139, 2022.

[10] L. Cao, Y. Cai, and Y. Yue, "Data fusion algorithm for heterogeneous wireless sensor networks based on extreme learning machine optimized by particle swarm optimization," *Journal of Sensors*, vol. 2020, no. 5, pp. 1–17, 2020.

[11] D. N. Nan, W. W. Liu, W. X. Fu, B. Q. Li, and J. L. Kong, "Study on fast recognition of biotoxins and biological modifiers using data fusion algorithm," *Chinese Journal of Analytical Chemistry*, vol. 48, no. 10, pp. 1343–1350, 2020.

[12] G. Zhao, A. Chen, G. Lu, and W. Liu, "Data fusion algorithm based on fuzzy sets and D-S theory of evidence," *Tsinghua Science and Technology*, vol. 25, no. 1, pp. 12–19, 2020.

[13] C. Zhen, "Using big data fuzzy K-means clustering and information fusion algorithm in English teaching ability evaluation," *Complexity*, vol. 2021, no. 5, pp. 1–9, 2021.

[14] L. R. West and J Kemp, "Expanding the sport and exercise medicine online community and quality international education: join the SMA journey in 2021," *British Journal of Sports Medicine*, vol. 55, no. 8, pp. 407-408, 2021.

[15] G. Pan, P. S Seow, and G. Koh, "Journal of international education in business examining learning transformation in project-based learning process article information: for authors," *Journal of International Education in Business*, vol. 12, no. 2, pp. 167–180, 2019.

[16] Q. Qu, "Problems related to talent training in marine cultural industry," *Meteorological and Environmental Research*, vol. 2017, no. 01, pp. 24–26, 2017.

[17] H. Cao, "Study on the school-enterprise cooperative incubation mechanism of order-oriented e-commerce talent training," *Boletin Tecnico/technical Bulletin*, vol. 55, no. 20, pp. 414–418, 2017.

[18] Q. . Huang, "Research on the hybrid teaching reform of online open course three-dimensional classroom," *International Journal of Social Science and Education Research*, vol. 2, no. 9, pp. 55–61, 2019.

[19] Y Fei, C Xie, and Z Tang, "State-of-Charge estimation based on square root unscented kalman filter algorithm for Li-ion batteries," *Proceedings of the Csee*, vol. 37, no. 15, pp. 4514–4520, 2017.

[20] V Mahboub, M Saadatseresht, and A. A Ardalan, "A general weighted total Kalman filter algorithm with numerical evaluation," *Studia Geophysica et Geodaetica*, vol. 61, no. 1, pp. 19–34, 2017.

[21] P Ren, S Wang, M He, and W. Cao, "Novel strategy based on improved Kalman filter algorithm for state of health evaluation of hybrid electric vehicles Li-ion batteries during short- and longer term operating conditions," *Journal of Power Electronics*, vol. 21, no. 8, pp. 1190–1199, 2021.

[22] M. Brell, K Segl, L Guanter, and B. Bookhagen, "Hyperspectral and lidar intensity data fusion: a framework for the rigorous correction of illumination, anisotropic effects, and cross calibration," *IEEE Transactions on Geoscience and Remote Sensing*, vol. 55, no. 5, pp. 2799–2810, 2017.

[23] H. Kim, B. Liu, C. Y. Goh, S. Lee, and H. Myung, "Robust vehicle localization using entropy-weighted particle filter-based data fusion of vertical and road intensity information for a large scale urban area," *IEEE Robotics and Automation Letters*, vol. 2, no. 3, pp. 1518–1524, 2017.

[24] F. Xiao, "Multi-sensor data fusion based on the belief divergence measure of evidences and the belief entropy," *Information Fusion*, vol. 46, pp. 23–32, 2019.

[25] D. Guido, H. Song, and A. Schmeink, *Big Data Analytics for Cyber-Physical Systems: Machine Learning for the Internet of Things*, pp. 1–360, Elsevier, Amsterdam, Netherlands, 2019.

[26] O. I Khalaf and G. M. Abdulsahib, "Optimized dynamic storage of data (ODSD) in IoT based on blockchain for wireless sensor networks," *Peer-to-Peer Netw. Appl.*, 2021.

Hindawi
Mobile Information Systems
Volume 2023, Article ID 9784310, 1 page
https://doi.org/10.1155/2023/9784310

Retraction

Retracted: Environmental Quality Optimization of Sustainable Rural Revitalization Strategy Based on Improved Genetic Algorithm

Mobile Information Systems

Received 1 August 2023; Accepted 1 August 2023; Published 2 August 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] G. Zhang and Z. Zeng, "Environmental Quality Optimization of Sustainable Rural Revitalization Strategy Based on Improved Genetic Algorithm," *Mobile Information Systems*, vol. 2022, Article ID 3775515, 15 pages, 2022.

Hindawi
Mobile Information Systems
Volume 2022, Article ID 3775515, 15 pages
https://doi.org/10.1155/2022/3775515

Research Article

Environmental Quality Optimization of Sustainable Rural Revitalization Strategy Based on Improved Genetic Algorithm

Guangqing Zhang[1] and Zixuan Zeng[2]

[1]*School of Political Science and Public Administration, Shandong University, Qingdao 266000, Shandong, China*
[2]*Guangxi (ASEAN) Research Center of Finance and Economics, Guangxi University of Finance and Economics, Nanning 530000, Guangxi, China*

Correspondence should be addressed to Zixuan Zeng; zengzixuan@gxufe.edu.cn

Received 22 March 2022; Revised 23 April 2022; Accepted 24 May 2022; Published 7 July 2022

Academic Editor: Liming Chen

To address the environmental quality of sustainable rural revitalization strategies, an improved genetic algorithm-based approach is proposed, environmental quality of rural revitalization strategies. Firstly, an index system to comprehensively assess the settlement environment of rural people based on the "production-production-production" space is built and then forms the trinity theoretical guidance framework; secondly, value of information entropy used to evaluate the dispersion of an index calculates the weight of each indicator and provides the basis for a comprehensive multi-index assessment; thirdly, by analyzing the spatial differences of rural human settlement environment quality, the quality of human settlement in rural areas has a positive correlation with the level of regional economic development. It shows that based on improved genetic algorithm, the environmental quality of sustainable rural revitalization strategy has been greatly improved, the growth rate of the comprehensive score of rural living environment in most regions reached more than 14%, and the comprehensive score growth rate of some rural living environment was 4.52%.

1. Introduction

Environmental quality is one of the most basic research contents on human settlement environment, emphasizing human settlement culture as a whole, from the aspects of human settlement material culture, human settlement spiritual culture, and human settlement system culture; comprehensively studying the cultural characteristics and development rules of human settlement, it involves people's settlement space, living space, cultural space, production space, literacy space, and other aspects, and is a comprehensive strong cross-subject [1]. Some international scholars mainly discuss the human settlement environment from the perspectives of landscape morphology, settlement morphology, historical geography, comfort development theory, and livable ability, mainly focusing on the spatial evolution of rural cultural landscape, localization, and diversification of traditional village cultural landscape.

Rural living environment is an important carrier of the progress and development of rural areas, and a good rural living environment has great significance for the healthy and sustainable development of rural areas. village. In the past few decades, due to the rapid progress of industrialization and urbanization, it has in fact created division and antagonism between urban and rural areas, a large and disordered development pattern. It has brought great damage to agricultural development and farmers' lives, exacerbated the conflict between people and land, and led to the long-term deterioration of rural habitats. The national development strategy: as the development of urban-rural relations has been adjusted, as shown in Figure 1, more and more attention has been paid to the study of rural human settlements [2].

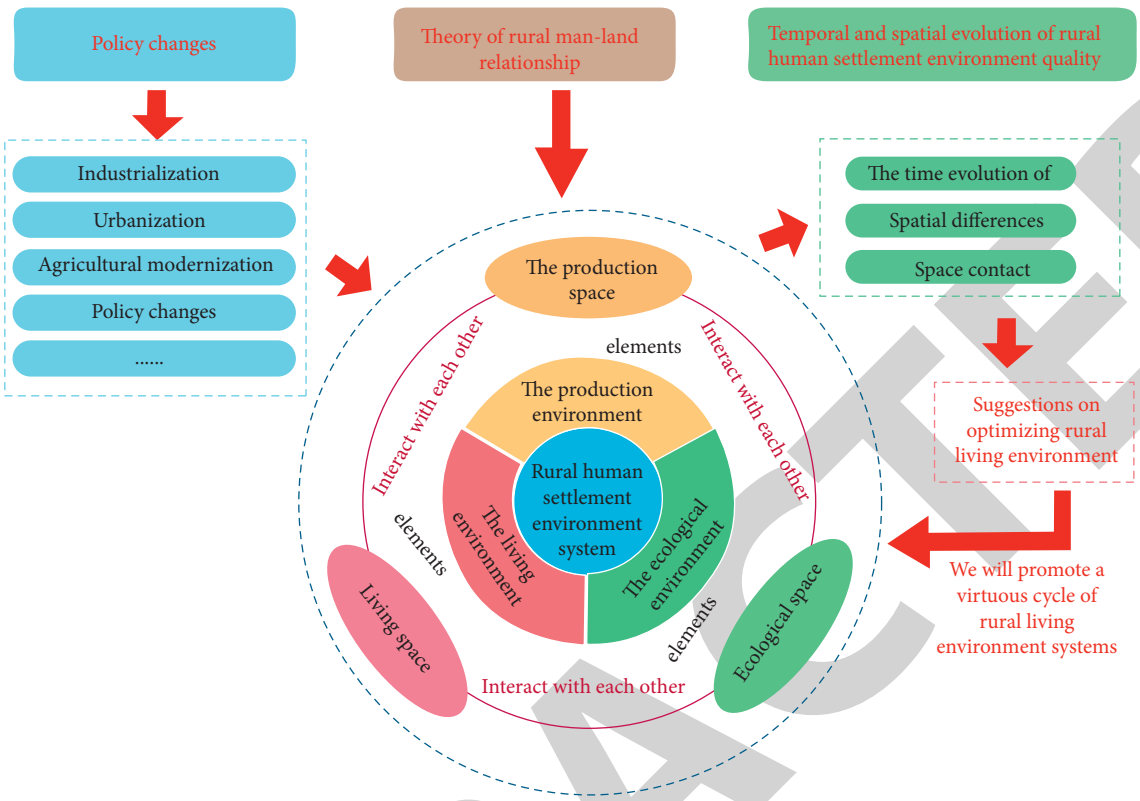


Figure 1: Theoretical framework of comprehensive evaluation of rural human settlement environment.

2. Literature Review

Rural habitat quality refers to, in rural areas, the organic combination of materials and nonmaterials that farmers need for production and life, it includes living conditions, public infrastructure and facilities, and other hard environments, it covers soft environments such as living comfort, information exchange convenience, economic development level, and social service level, and it is a dynamic complex giant system. At the same time, extensive and disorderly development model also makes agricultural and rural development still face many problems, the rural ecological environment has been destroyed, traditional rural culture is declining, public infrastructure is lacking, and the "negative effects" of rural habitats, such as the increasingly severe problem of settlement hollowness and the gradual disintegration of social structures, have become increasingly prominent and become the real epitome of the crisis in China's rural relationships. Therefore, in accordance with the National Action Plan to Improve the Quality of the Rural Environment, how to understand the evolution and patterns of rural settlements, and how to improve the landscaping and development of rural settlements are becoming more pressing issues.

Yu et al. [3] mostly reflected the research on rural living environment in the research of theoretical system, the sociological significance of rural living environment, and the construction path of rural living environment [3]. Song C. et al. [4] expressed the rural human settlement environment as the logical connection between the rural human environment, the regional space environment, and the natural ecological environment [4]. Jingke [5] believed that the quality of rural living environment is the organic combination of material and nonmaterial elements to maintain rural life [5]. Lyu [6] researched comprehensive evaluation and optimization strategies for different types of rural human settlements, the existing evaluation methods of human settlements are mostly based on field research and qualitative evaluation, and it mainly focuses on the evaluation of residents' satisfaction with the quality of living environment [6]. Zheng et al. [7] from the aspects of infrastructure, energy consumption, etc., have expanded the evaluation index system of rural living environment quality [7]. Jun et al. [8] studied people and the environment from the perspective of human ecology, and it is believed that urban planning should coordinate the ecological living environment of urban and rural areas from a regional perspective [8]. Jia et al. [9] emphasized that the living environment should be people-centered and focus on regional and natural views, advocating urban planning and human settlement construction [9]. Lu et al. [10] first put forward the concept of "human settlement environment." They creatively combined systems theory, cybernetics, information theory, ecology, and other multidisciplinary theories and applied them to the study of the human settlement environment. It is emphasized that all human settlements, including villages, towns, and cities, can be studied as a whole, which marks the formation of human settlements science with urban planning as the core [10]. Zhou et al. [11] proposed the classical agricultural location theory, he

systematically analyzed the spatial distance relationship between the production location and the consumption location, and a concentric circle-layered rural structure is obtained [11]. Wang et al. [12] systematically expounded the formation and evolution of settlements for the first time, and a comparative study of different types of settlements such as cities, market towns, and villages was conducted, getting the geographical environment and traffic routes [12]. Ying [13] established the central place theory, he proposed the central place theory about the location of the city, greatly promoted the development of geography, and helped people to understand the location formation mechanism of cities and villages, and it has made a significant contribution to the research of rural geography [13]. Yang et al. [14] inspired by Dossadias' theory of human settlement founded "Human Settlement Science," and it integrates the three basic disciplines of architecture, geography, and planning, and builds a research framework for human settlement science [14]. Wang et al. [15] considered the evaluation and optimization of human settlements in metropolises, and the human settlement environment is evaluated from three aspects: living conditions, ecological environment quality, and infrastructure and public service facilities [15]. When Ji et al. [16] studied the evaluation of urban human settlements, and the living environment is divided into close living environment, community environment, and urban environment [16].

Based on current research, improved genetic algorithm, and environmental quality optimization of sustainable rural restoration strategy, environmental quality has been greatly improved and index system comprehensive assessment of rural habitats is based on the established "three generations" space, using the value of information entropy to assess the dispersion of an index, calculating the weight of each indicators, and creating a basis for comprehensive evaluation of many indicators.

3. Optimization of Environmental Quality for Sustainable Rural Revitalization Strategy Based on Improved Genetic Algorithm

3.1. Improved Genetic Algorithm

3.1.1. Overview of Genetic Algorithms. Genetic algorithm (GA) first proposed by Professor Holland in 1975 is a global stochastic optimization algorithm that simulates natural biological evolution and genetic mechanism. Genetic algorithm is an organic combination of the ideas of evolution and computer science, and it is based on the basic principles of the theory of biological evolution and genetics, and the basic principles of genetics. Darwin simulated the evolution process of biological groups in nature from simple to complex, from low-level to high-level, similar to the process from initial solution to optimal solution [17]. As a global optimization search algorithm, the genetic algorithm is easy to use. Many optimization problems can get satisfactory results through the genetic algorithm, which has been widely developed and applied in many fields. It has also been well received in the field of engineering optimization and gradually has been widely used in the hydraulic calculation of water supply. Genetic algorithms are based on the principles of biological genetic inheritance and eugenics, by mimicking natural selection and using genetic mechanisms, starting with a randomly generated initial population [18]. That is, a certain number of parents (initial solutions) are selected through constant population iteration, and they replicate, cross, and mutate, pass on good genes to their offspring, throw away the bad genes, and ultimately solve complex problems; in other words, the optimal individual (optimal solution) was obtained. Randomly generate the initial population, and based on the fitness of individuals in the population, for calculating selection, crossover, and variation among individuals in the population, the individuals in the population (the solution of the problem) continue to evolve and gradually approach the optimal solution of the problem. The calculation flowchart is shown in Figure 2, and the specific steps are shown in the following section.

3.1.2. Advantages and Disadvantages of Traditional Genetic Algorithm

(1) Advantages of Traditional Genetic Algorithm

① The feasible solution can be widely expressed, and the application field is wide.

Genetic algorithms can encode the parameters of the problem they are dealing with, and the gene string corresponding to the genetic space is obtained. The original solution space can be set, matrix, sequence, and other one-dimensional or multidimensional structures. So, genetic algorithms are widely used in many fields, such as computing science, artificial intelligence, manufacturing, automatic control, engineering, and social sciences.

② Global parallel search feature

This feature enables genetic algorithm to have better global search performance, for the multi-peak distribution, the solution space will not fall into a local single-peak extremum point, and it also makes the genetic algorithm itself easy to parallelize [19].

③ In the course of the search, genetic algorithms are not easy to fall into local optimization, even if the fitness function defined is discontinuous, it can also quickly and reliably solve the problems that cannot be solved by the transmission spinning method, and the global optimal or suboptimal solution can be found with a high probability [20].

④ Genetic algorithms can be improved in many ways; for example, there are improved methods such as parament genetic algorithm, simulated annealing genetic algorithm, hybrid genetic algorithm, and ant colony algorithm.

⑤ Genetic algorithms are scalable and easy to mix with other technologies; for example, genetic algorithm

and generalized reduced gradient method are used together.

(2) Disadvantages of Traditional Genetic Algorithm

① Genetic algorithms code in a variety of ways, different coding methods should be adopted for different application problems, so the specific coding problem needs to be improved.

3.1.3. The Implementation Method of Improved Genetic Algorithm

(1) Coding Method. Genetic algorithms must translate the parameters of the problem space into the genes of the genetic space and form chromosomes or individuals according to certain structures, which is called encoding [21]. At present, commonly used genetic algorithm forms of encryption include binary encoding, real number encoding, and character encoding. Among them, binary encoding is the most commonly used method in coding genetic algorithms, that is, the binary character set {0, 1} produces the usual 0.1 string to represent candidate solution of the problem space, and this coding method is simple and easy to analyze with pattern theorem.

(2) Fitness Function. In evolutionary nature, fitness, also known as adaptive value, refers to the fact that under certain environmental conditions, the ability of individuals to adapt to their surroundings, it can also represent an individual's ability to reproduce, the relative ability of a person with a known genotype to transfer a gene to the gene pool of his or her offspring is a measure of an individual's ability to survive and reproduce, and the greater the fitness, the higher the survival and reproductive chances. The fitness function in genetic algorithm is used to judge the merits and demerits of an individual, and the evaluation is carried out according to the generalized objective function of the problem. In the genetic algorithm, the fitness function is positive, so to convert the objective function to a maximum or minimum problem, and to translate the constraint problem into the objective function, thus, a generalized objective function is constituted to evaluate as fitness function.

3.2. Environmental Quality of Sustainable Rural Revitalization Strategies

3.2.1. Basic Manifestations of Rural Environmental Quality Problems in Sustainable Development. In recent years, the construction of urban infrastructure has been intensified, and the discharge of urban environmental pollution has been gradually brought under control, in contrast, environmental pollution and ecological damage are becoming increasingly serious in towns and villages, and there are both primary environmental problems and more secondary ecological damage problems.

(1) Pollution from Agricultural Production. With the acceleration of agricultural modernization, traditional agriculture was gradually replaced by modern agriculture with mechanical and chemical features, large quantities of chemicals, mulch, pesticide packaging, etc., passed through the natural food chain, in a network of three-dimensional circulation among environmental elements, reduced soil fertility, enhanced the resistance of pests and diseases, and caused the surrounding water eutrophication, and negative effect is obvious.

(2) Life Pollution. Due to the backward construction of rural environmental protection infrastructure, the coverage of rural household garbage collection and transfer system is low, and a large amount of solid waste is randomly stacked and occupies large tracts of arable land, breeding and spreading of harmful bacteria, lack of supporting sewage treatment facilities, eventually contaminating soil and water, and becoming the source of nonpoint source pollution. In addition to industrial pollution, the countryside itself is also a major source of pollution. As a large grain-producing area, rural areas in northern Jiangsu use a large number of pesticides and chemical fertilizers every year. The average use intensity of chemical fertilizer in northern Jiangsu was 882.71 kg/hm^2, 26.7% higher than the average level of Jiangsu Province, pesticide use intensity is greater than 500 kg/hm^2, and some villages are even more than 2000 kg/h prong, belonging to a higher intensity. In 2015, chemical oxygen demand from agricultural sources in northern Jiangsu reached 197,200 tons, accounting for 56.2% of the province; ammonia emissions were 17,100 tons, accounting for 47.0% of the province. In addition, the discharge of sewage from the villagers is also a source of pollution in the countryside itself. In the process of rural renovation, the garbage disposal and transportation facilities have been improved in northern Jiangsu, but the sewage treatment is far from enough. In 2015, the harmless treatment rate of rural sewage in northern Jiangsu was only 25.9%, less than half of the 65.3% in the Yangtze River Delta. See Figures 3 and 4.

(3) Ecological Damage. Farmers have weak ecological consciousness, in order to satisfy their own interests, large-scale reclamation, and overuse of land, resulting in a large amount of surface organic soil loss, desertification. Lack of garbage classification system, pesticide packaging and other hazardous waste carelessly discarded, and straw burning caused a sharp deterioration of the surrounding atmosphere. On the other hand, domestic pollution and industrial wastes from surrounding cities have been transferred to rural areas, and the countryside has become the "sewage field" of the city, which aggravates the deterioration of the rural ecological environment.

3.2.2. Connotation of Rural Living Environment. Rural habitat in the narrow sense refers to rural living environment; rural habitat in a broad sense refers to rural areas, promoting production development and rural life in a complex system of physical and nonphysical human-land relations, and it is the comprehensive embodiment of

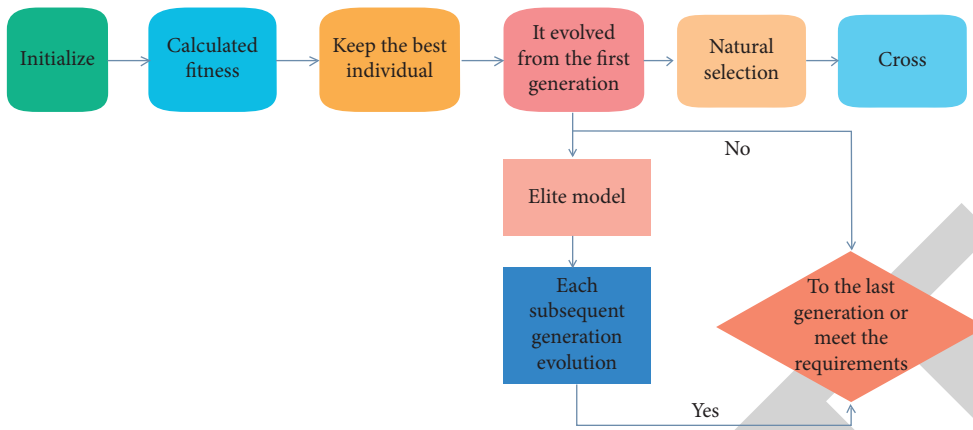


Figure 2: Flowchart of genetic algorithm.

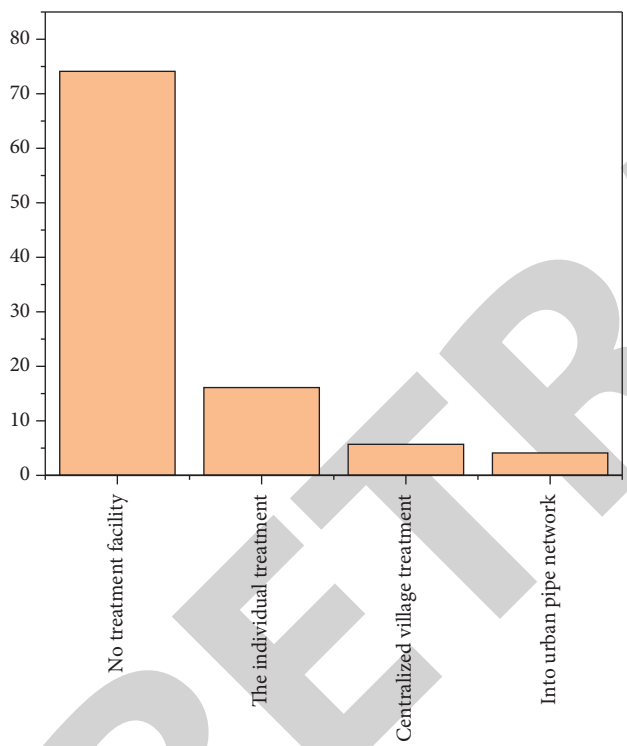


Figure 3: Structure of rural sewage treatment methods in northern Jiangsu.

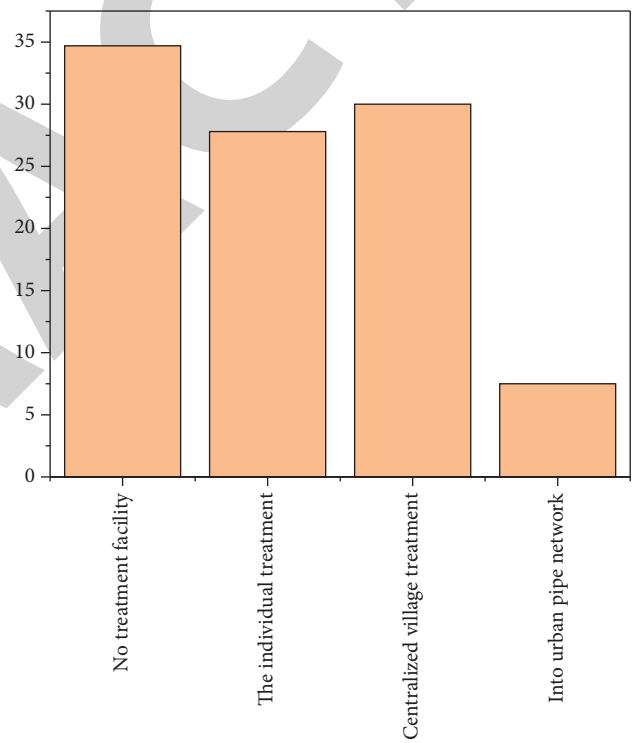


Figure 4: Composition of rural sewage treatment methods in the Yangtze river delta region.

humanistic social activities and natural ecological environment in rural area space. Its content covers the physical geography, ecological environment, industrial development, lifestyle, infrastructure, environmental health, educational and cultural atmosphere, social organization, etc. In short, rural living environment is the general term of natural, economic, social, and cultural environment in which farmers live, produce, and live. Specifically, it includes rural production environment, rural living environment, rural ecological environment, rural social environment, and rural cultural environment (Figure 5). The natural ecological environment lays the material foundation for the life of rural residents, rural production activities, and rural social culture as an important driving force and creates a social foundation for rural life, and rural living environment represents the quality of life of rural residents.

Rural production environment is the general term of rural industrial development, industrial structure, and investment in industrial development. Rural living environment refers to rural residents' income, living conditions, infrastructure construction, and public service level. Rural ecological environment refers to the quantity and quality of ecological resources that affect farmers' survival and development, the general term for pollution of ecological resources by production and living, and villagers'

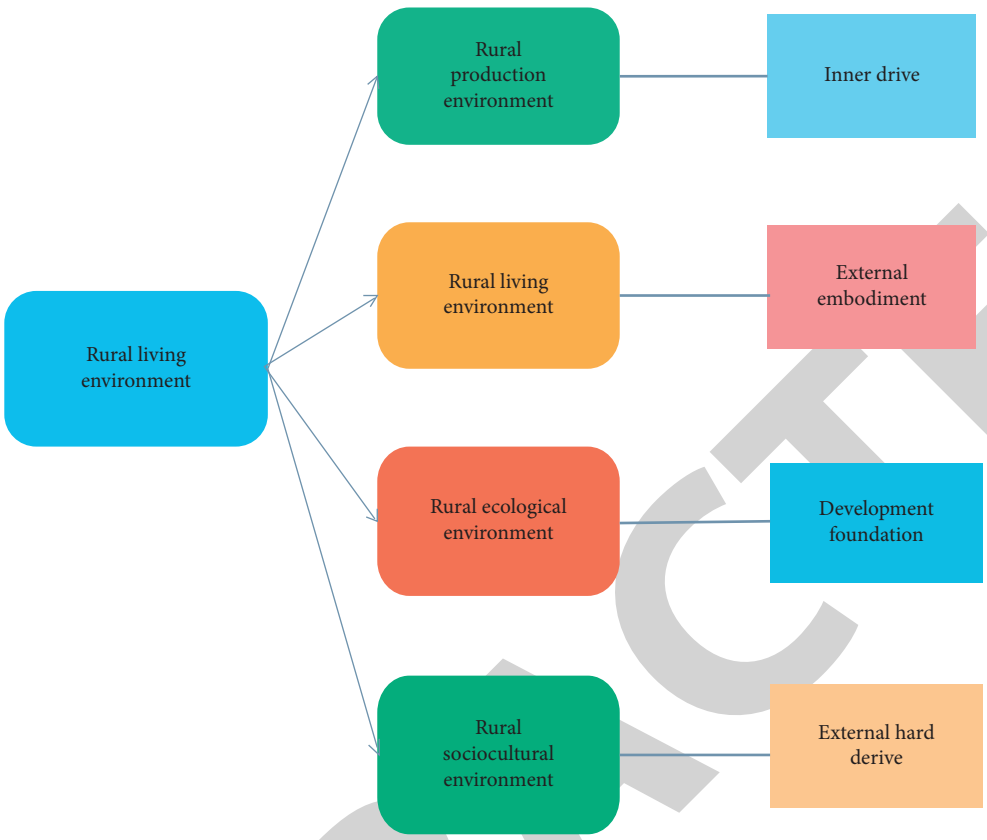


Figure 5: Construction system of rural human settlement environment quality.

environmental treatment and protection [22]. Rural social and cultural environment is the general term of rural poverty alleviation, policy support, organizational form, population structure, and farmers' education level. These four environments can reinforce and echo each other, but they can also contradict each other and even destroy each other. Among them, production is the key, ecology is the foundation, life is the core, and social culture is the carrier.

3.2.3. Evolution Analysis of Rural Human Settlement Environment Quality. With the promotion of urbanization, cultural factors have entered the countryside with colorful characteristics and gradually shaken the characteristics of traditional rural culture. While rural residents are exposed to new cultural elements, they are also constantly choosing, and the rural living environment changes accordingly. However, the evolution of rural human settlement environment quality and sub-system quality is not completely synchronous (Figure 6).

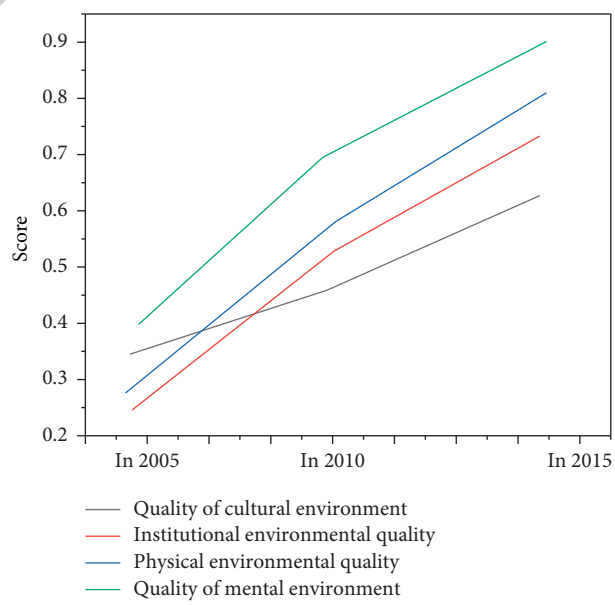


Figure 6: Evolution trajectory of cultural environment quality and sub-system quality of rural human settlements.

3.2.4. Driving Mechanism of Rural Human Settlement Quality Evolution. The dynamic mechanism of environmental quality development in rural areas refers to the rules of operation of dynamic, dynamic systems, interactions of the environmental system of rural settlements, and interaction of various factors and systematic evolution. As part of the rural rehabilitation strategy, the reasons for the current poor quality of rural settlements and the rapid development of rural areas are being analyzed in general. The material culture of the population, or the optimization and

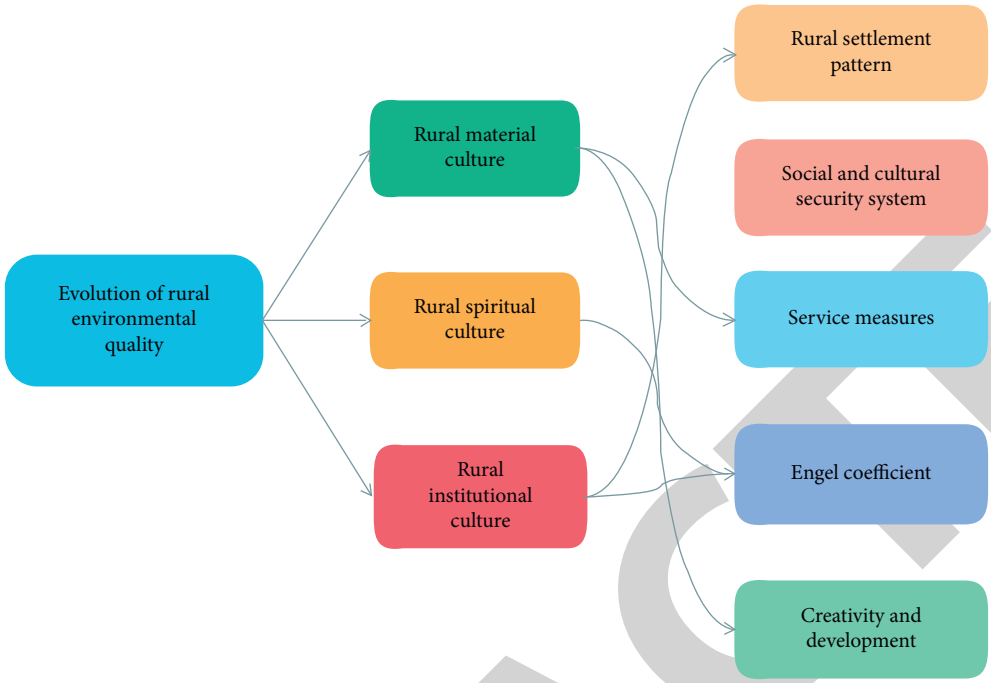


Figure 7: Driving mechanism of rural human settlement quality evolution.

improvement of the quality of the rural environment in the future, is inseparable from government support, support for the production system, diversified needs, and basic public service delivery (Figure 7).

3.3. Relationship between Rural Revitalization and Optimization of Rural Living Environment. The rural revitalization work plan proposed in the plan mainly includes coordinating urban and rural development space, optimizing the layout of rural development, targeted poverty alleviation in rural areas, modern agricultural production and operation, agricultural science and technology, industrial integration, and innovation and entrepreneurship'; we will build an ecologically livable and beautiful countryside, improve the appearance of villages, and develop a prosperous rural culture, building a modern rural governance system, building rural infrastructure, rural public service supply and social security system, rural talent training, and so on. And the rural living environment is studied by the author, and the physical elements include rural natural ecology, rural spatial organization, housing and public service facilities, road transportation, and municipal infrastructure; nonmaterial elements include economy and population, social life, rural cultural environment, and policy system [23]. It follows that the work content of rural revitalization and the research content of rural living environment are interrelated in many aspects, and optimizing the rural living environment is an important aspect of rural revitalization. Rural revitalization involves a broader range of issues; in addition to the living environment, it also pays attention to rural industrial development, rural governance system, and urban-rural and regional relations, does these things well, and plays an important positive role in improving rural habitats. Therefore, in terms of their relationship, the optimization of the rural settlement environment is part of the rural renaissance and is a necessary condition for rural recovery. In short, the concept of rural revitalization is extremely comprehensive; ultimately, we will achieve comprehensive and all-round revitalization of rural areas, and the optimization of rural living environment is also an important aspect of rural revitalization. Only the living conditions of the villagers have been improved, the overall appearance of the village has been improved, the construction of various facilities in the village has been improved, the quality of rural life felt by villagers has improved, and rural revitalization will be truly realized. Improving the rural living environment is an integral part of rural revitalization and is a core component of rural revitalization; and committed to rural revitalization, it will provide more solid guarantee for the construction of rural living environment. See Figure 8.

4. Optimization Strategy

4.1. Theoretical Framework of Comprehensive Evaluation of Rural Human Settlement Environment Based on "Production-Production-Production" Space. Rural living environment is essentially one of the manifestations of man-land relationship regional system, and it is a dynamic complex system. Production space, living space, and ecological space are the three basic elements of national space, and it is also the three subsystems of rural human settlement environment system. There has been an exchange of material, energy, information, and other elements in the rural human settlement system, and it fits in with the full utilization and orderly integration of production function, living function,

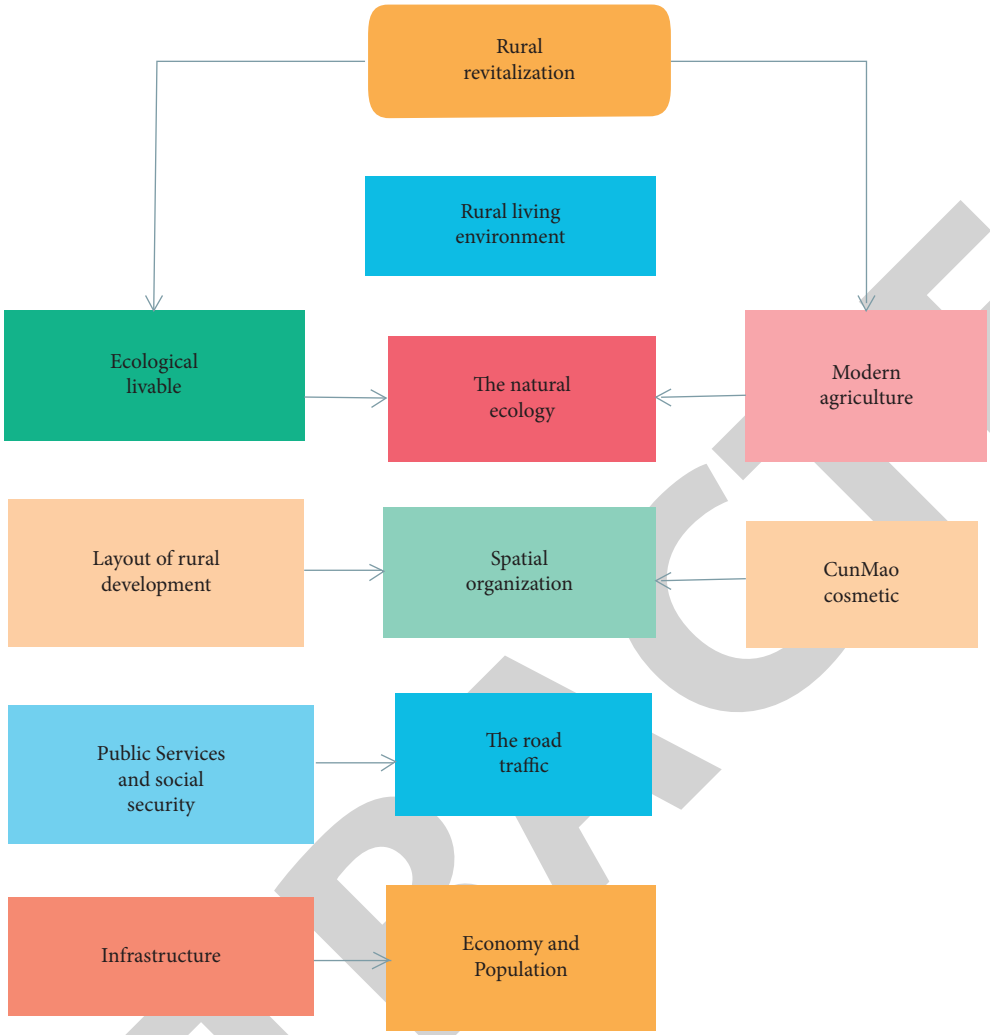


Figure 8: Relationship between rural revitalization and optimization of rural living environment.

and ecological function in the "production-production-production" space. Evaluate the quality of rural living environment by integrating production space, living space, and ecological space, and then form the theoretical guidance framework of the trinity. Production space is a space where people produce in order to obtain products and increase social wealth, and it is also the basic space field of rural human settlement environment construction and improvement. Living space is a spatial aggregation that provides people with daily activities such as living, employment, consumption, and leisure, and it is an important field of rural human settlement environment construction. Ecological space is not only the natural base of rural living environment construction, but also an important space to provide ecological products and services for rural residents.

4.2. Construction of Comprehensive Evaluation Index System of Rural Human Settlement Environment Based on "Production-Production-Production" Space. Combined with the complexity of rural living environment system, with the development level of rural living environment, the particularity of the problems they face, the differences of actual relevant statistical indicators among provinces and cities, following the principles of scientific, dynamic, hierarchical, comparable, and operable, construct a system consisting of target layer, system index layer, and the evaluation index system composed of three parts of specific index layer (Table 1).

(1) Production space, select the rural employment rate, per capita local fiscal revenue, per capita fixed asset investment, rural per capita disposable income, and per capita balance of household savings deposit, 5 indicators to represent the overall situation of rural economic production; select the per capita total power of agricultural machinery and the proportion of effective irrigated area in cultivated land area, and two indicators were used to represent the modernization level of agricultural production in rural areas, both of which were positive indicators.

(2) Living space, rural per capita housing area, road mileage per 10,000 people, and rural per capita electricity consumption; three indicators were used

Table 1: Evaluation system and weight of rural human settlement environment quality measurement index.

System layer and weight	Index layer and weight	Index properties
Production space sub-system	Rural employment rate: 0.09542	+
	Per capita local fiscal revenue: 0.05184	+
Living space sub-system	Per capita housing area: 0.08546	+
	Per capita electricity consumption: 0.04895	+
Ecospatial sub-system	Pesticide application amount: 0.05462	+
	Mulching film coverage: 0.23545	−
	Village forest coverage rate: 0.6515	−

to represent the living security level of rural residents, ten thousand people with hospitals, beds in health centers, ten thousand doctors (licensed physician + licensed assistant physician), the teacher-student ratio of regular middle schools, the teacher-student ratio of regular primary schools, the number of regular middle schools per 10,000 people, and five indicators are used to represent the welfare security level of rural medical care and education, all of which are positive indicators, as shown in Figure 9.

(3) Ecological space involves not only the direct ecological supply of nature, but also the self-purification of ecology under human activities, but given the availability of data, the author selected the fertilizer application amount, pesticide application amount, mulching film coverage rate, village forest coverage, and 4 indicators to represent the strength of rural ecological function. The village forest coverage rate is a positive index, and the larger the value is, the stronger the rural ecological function will be; the other indexes are all negative indexes.

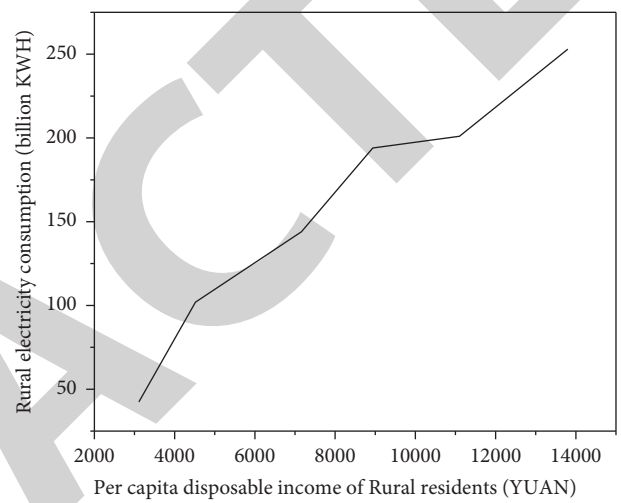


Figure 9: Per capita disposable income and electricity consumption of rural residents.

4.3. Improved Entropy Method. To minimize and avoid subjective factors and some objective limitations in the weighting process, the entropy method was used to assign weights to each indicator of the quality of the human settlement environment countryside. In information theory, the calculation formula (1) of information entropy is as follows:

$$H_{(x)} = -\sum_{j=1}^{m} p(x_i) Inp(x_i). \tag{1}$$

Information entropy mainly reflects the chaos degree of the system, information mainly reflects the degree of order, entropy is equal to the absolute value of information, but the sign is the opposite. The more information an indicator provides, the corresponding weight should also be larger and vice versa. On the one hand, when the entropy method is used for evaluation, extreme values often occur; however, to ensure data integrity, extreme values cannot be deleted directly; therefore, it is necessary to change the index data; in order to improve the entropy method, the author chooses the method of standardizing the transformation of each index first. On the other hand, when calculating the final result of rural human settlements quality, the original value is magnified by 1000 times, and the results are horizontally aligned and accurately clustered. The main calculation steps of the improved entropy method are as follows:

① Standardization of raw data: positive indicators are treated as formula (2), and negative indicators are treated as formula (3).

$$x_y = \frac{\left(x_{ij} - \overline{x}\right)}{s_j}, \tag{2}$$

$$x_y = \frac{\left(\overline{x} - x_{ij}\right)}{s_j}. \tag{3}$$

Type: x_{ij} is the standardized index value; $\overline{x}$ is the mean value of the JTH index; x_{ij} is the original value of the index of the ith region and item j; s_j is the standard deviation of the JTH index value.

In order to reasonably solve the impact caused by negative numbers, the normalized values are shifted as shown in

$$Z_{ij} = x_y + A. \tag{4}$$

Where z_{ij} is the translated value and A is the translation.

② Quantize the uniformity of each indicator and calculate the specific gravity p_{ij} of the region I index value of item J, as shown in

$$P_{ij} = \frac{Z_{ij}}{\sum_{i=1}^{n} Z_y}, \quad (i = 1, 2, 3, \ldots) \tag{5}$$

where n is the number of regions and M is the number of indicators.

③ Calculate the entropy E_j of item j index, as shown in

$$E_j = -k \sum_{i=1}^{n} P_{ij} In\left(\mathrm{P_{ij}}\right). \tag{6}$$

Type: $k = 1/\mathrm{Inn}$, $E \geq 0$.

④ Calculate the difference coefficient (D) of item J, as shown in

$$D_j = 1 - E_j. \tag{7}$$

⑤ To normalize the difference coefficient, calculate the weight (W) of item j, as shown in

$$W_j = \frac{D_j}{\sum_{j=1}^{m} D_j}, \quad (j = 1, 2, 3, \ldots, m). \tag{8}$$

⑥ Calculate the quality of rural human settlements in region I (F), as shown in

$$F_i = \sum_{j=1}^{m} W_j P_{ij} \cdot 1000, \quad (i = 1, 2, 3, \ldots). \tag{9}$$

Type: w_j is the weight value of item j; P_{ij} is the index value after the double conversion of standardization and homogeneity quantization of each index.

4.4. Research Methods and Data Sources. A comprehensive assessment of the quality of a rural settlement environment involves many factors, and the lack of a linear relationship between them makes it difficult to determine to avoid artificial interference caused by subjective distribution methods to ensure the accuracy and reliability of test results. The author selects a key component analysis to assign weight to each evaluation index.

4.4.1. Dimensionless Treatment. Range standardization is used to deal with positive and negative orientations and dimensional differences of data.

$$\text{Positive indicators}: X_y = \frac{X_y - X_{\min(y)}}{X_{\max(ij)} - X_{\min(ij)}}, \tag{10}$$

$$\text{Negative indicators}: X_y = \frac{X_{\max(ij)} - X_{ij}}{X_{\max(ij)} - X_{\min(ij)}}. \tag{11}$$

In equations (10) and (11), X_{ij} represents the value of the ith sample and the jth index; $X_{\max(ij)}$ represents the maximum value of the sample matrix; $X_{\min(ij)}$ represents the minimum value of the sample matrix; and $X_{(ij)}$ represents the standardized value.

4.4.2. Comprehensive Evaluation Score. The standardized data are weighted and summed with the index weights, and the comprehensive evaluation score of rural human settlement environment quality was obtained.

$$T_i = \sum_{j=1}^{n} E_{ij} U_{ij}. \tag{12}$$

In formula (12), Ti represents the evaluation value of rural human settlement environment quality, E_{ij} represents the weight of evaluation index, and U_{ij} represents the score of A single index.

4.5. Index System Construction. Centering on the overall requirements of the rural vitalization strategy, starting from the actual situation of rural construction, based on the four levels of rural production environment, rural living environment, rural ecological environment, and rural social support environment, the index system is established (Table 2) and complied with the principles of comparability, objectivity, and availability of indicator data, 39 second-level indicators were selected and basically include the five areas of rural industry revitalization, talent revival, cultural revival, ecological restoration, and organization restoration, and it can reflect the human settlement environment construction situation rural people holistically.

4.6. Evaluation and Analysis of Rural Human Settlement Environment Quality

4.6.1. Measurement and Evaluation of Rural Human Settlement Environment Quality. According to the above calculation steps, the quality of rural human settlement in 17 provincial cities in a province has been processed, and the comprehensive score of the quality of rural human settlement environment in each city and the score of each subsystem was obtained (Table 3).

X province is an important economic and populous province in the north, it is also a region with prominent urban and rural problems, showing obvious coastal and inland dual characteristics in economic and social aspects, and this feature is also reflected in the quality of rural living environment. Among them, CITY A is the highest quality rural town in the aimag, with a rating score twice that of the last city, D. The quality of rural settlements in most cities in the province is above average (0.4635). The aimag has a good socioeconomic background, a good ecological environment, and the quality of the rural population. The quality of the rural population of the peninsula is highly concentrated, top 4 cities in A, B, C, and E; the spatial distribution of rural human settlement quality in inland areas is relatively random, but there are still some regional differences. The fact that the quality of the rural environment is highly positively correlated with the level of economic development in the region shows that economic development is an important

Table 2: Evaluation index system of rural human settlement environment quality.

Rule layer	Index layer	Unit	Attribute	The weight
Rural production environment	Per capita agricultural output value	Yuan	Positive	0.0256
	Value-added of service industry	%	Positive	0.2415
Rural living environment	Per capita electricity consumption	Kw/人	Positive	0.5484
	Disposable income	Yuan	Positive	0.0452
Rural ecological environment	The proportion of energy	%	Negative	0.0125
	Centralized processing rate	%	Positive	0.0136
	Forest coverage	%	Positive	0.0321

Table 3: Score and ranking of rural human settlement environment quality.

	Rural production environment	Rural living environment	Rural ecological environment
A	0.0412	0.0235	0.0452
B	0.0234	0.0156	0.0631
C	0.0148	0.0544	0.0196
D	0.0248	0.0577	0.0128
E	0.0123	0.0724	0.0345

guarantee to reduce the disparity in the rural environment. Using the Jenks natural fault method, the quality assessment scores of the rural population of 17 cities in the aimag and the scores of each sub-system were evaluated as material elements. The villagers are concerned about rural social life and policies that benefit farmers. Based on the villagers' own understanding, at the same time, combined with relevant literature research, the components and research objects of rural living environment are determined, as shown in Figure 10.

4.6.2. Analysis of Spatial Differences in Rural Human Settlement Environment Quality

(1) Areas With High-Quality Rural Living Environment. Including *A*, *B*, *C*, and *D*4 city, the quality evaluation score is above 0.55, and its common characteristics are developed social economy, good ecological environment, and relatively rich rural life. 4 cities are located in the economically and socially developed peninsula region, excellent location, relatively perfect infrastructure, urban and rural integration level, and high level of public services. In the future, we should give full play to the shining role and promote urbanization and new industrialization in rural revitalization; cultivating rural-specific industries, we will build a system modern agricultural industry, production system, and management system. Outstanding natural conditions and developed urban economy have promoted the integration of urban and rural areas; scores of rural life, ecology, and sociocultural factors are all at the top; however, the development of rural industries needs to be further strengthened [23]. City *B* has the longest coastline in a province; with the highest score of rural production environment quality, the ecological and social and cultural environment is also in the forefront, forming a good rural environment suitable for living; however, the next step is to strengthen the construction of new rural communities, as shown in Table 4. City *C* has the highest score in rural social and cultural environment, but the level of industrial integration development is low. In the future, we should vigorously develop new forms of agriculture, especially circular agriculture, and further improve the efficiency of agricultural production. *C* city is the region with the lowest and highest level of agricultural industrialization development in China; with a high degree of intensification of agricultural production and a good degree of grassroots organization construction, the next step is to increase the development of circular agriculture, reduce the use of chemical fertilizers and pesticides, and constantly improve the ecological environment.

(2) Areas With High Quality of Rural Living Environment. The average level of rural living environment quality is 0.5541. The five cities all have a good foundation for agricultural development, the quality of rural living environment is good on the whole, but there are weaknesses to varying degrees, and the coordinated development of all subsystems is low, which restricts the overall improvement of rural human settlement environment quality. On the basis of sound agricultural development, exploring a new model of rural collective economy, improve the land transfer mechanism, and raise the level of intensive production. We should actively change the development model, and we will focus on increasing investment in ecological and environmental governance. We will vigorously develop rural tourism and agriculture with local characteristics, extend the industrial chain, build industrial clusters, continuously improve the production environment, increase the efficiency of industrial production, and contribute to the continuous improvement of rural habitats. There is still a need to improve rural living conditions, so attention should be paid to the development of rural infrastructure and public services, vigorously develop new forms of agricultural business, and intensify efforts to improve the agricultural ecological environment.

(3) Areas with Low Quality of Rural Living Environment. The overall characteristics of rural industrial structure are single,

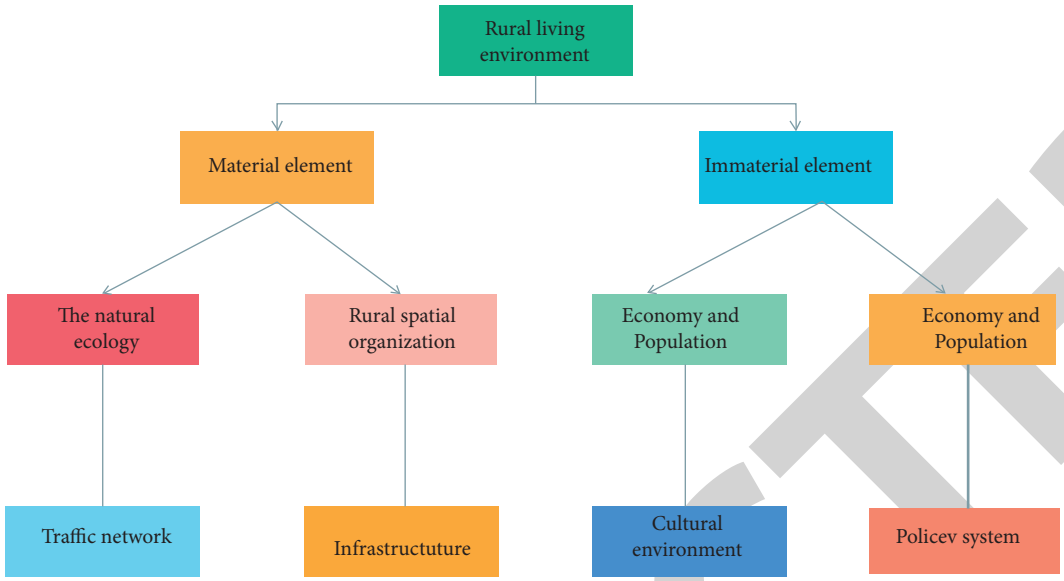


Figure 10: Constituent elements of rural human settlement environment.

Table 4: Regression analysis results of economic indicators and human settlement environment level.

The index type	Coefficient k	Significant	Adjust the R square
C	0.314	≤0.001	0.545
GDP per capita	0.324	0.011	0.322
Per capita disposable income	0.158	0.074	0.645
Collective gross income	−0.042	0.752	0.478

agricultural production is based on traditional agriculture, and rural infrastructure construction is relatively poor. Planning for the improvement of rural living environment should be made scientifically and rationally; with infrastructure construction as the guide, adopting a growth-driven cluster development model, we will constantly improve the living environment in rural areas.

(4) Areas with Low Quality of Rural Living Environment. The average score of rural living environment quality was 0.2456, the common characteristics are relatively backward agricultural development model, high incidence of rural poverty, and the basic living facilities are not perfect. Agricultural output value, villagers' living standard, living conditions, and public service level are all at the bottom of the province.

4.7. Results and Analysis. In order to directly reflect the evolution law of rural human settlement quality, relying on ArcGIS10.2 software platform, based on the established index system and weight calculation, the evaluation index and ranking of rural human settlement environment in central China are obtained, natural breakpoint method was used to classify the rural human settlement environment and sub-system quality in 2000, 2010, 2015, and 2017, and the quality grade from low to high is divided into five grades: poor, poor, general, good, and excellent.

4.7.1. Spatial and Temporal Characteristics of Comprehensive Quality of Rural Human Settlements. Select the comprehensive score of rural living environment quality, using ArcGIS global spatial autocorrelation analysis tool, the global Moran's SI estimate can be calculated. If the value is less than 0, the spatial correlation is negative, and a value equal to 0 indicates that the spatial distribution is random. The global Moran's SI estimated value of human settlements in 2000 is 0.277, and the Z score and P value of the normal statistics in that year passed the significance test (Table 5); that is, the distribution of the comprehensive quality of rural human settlements in 2000 presents an agglomeration trend. The global Moran's SI estimates of human settlements in 2010, 2015, and 2017 are all close to 0, and normal statistics Z score and P value did not pass the significance test; it shows that the overall distribution of comprehensive quality of rural human settlement environment does not exist spatial dependence, and it is scattered. The comprehensive quality of rural human settlements in the west of the study area is gradually higher than that in the east. The internal interaction intensity of rural human settlement environment system gradually increases in the west, even higher than that in the east. The upward trend line from south to north in the study area evolved from "L" shape with large curvature to "inverted U" shape with small curvature, this shows that the comprehensive quality of human settlements in the north is improving rapidly, and the gap between the interaction

Table 5: Moran's SI estimates of the comprehensive quality of rural human settlements.

year	Moran' SI	The variance	Score	*P* values
2000	0.258	0.015	2.475	0.003
2010	−0.054	0.017	−0.034	0.845
2015	−0.087	0.013	−0.019	0.914
2017	−0.014	0.014	0.214	0.847

intensities of rural human settlements in the north and south is gradually narrowing.

4.7.2. There Is an Obvious Upward Trend of Differentiation

① In terms of time, since 2000, on the whole, remarkable progress has been made in improving the rural living environment. On the one hand, the rural living environment in prefecture-level cities has been greatly improved, the growth rate of the comprehensive score of rural living environment in most regions reached more than 14%, and the growth rate of the comprehensive score of some rural living environment was 4.52%. On the other hand, for the most part, in 18 years of development, the rural living environment fluctuates. This can be attributed to, first, local economies which have witnessed rapid growth. Second, the growth of rural human settlement environment in some areas from 2000 to 2017 was special; with a small population and high forest coverage rate, although the ecological foundation is good, due to the continuous improvement of urbanization and industrialization, the rural human settlement environment system has undergone drastic changes.

② From the spatial dimension, the development of rural human settlement quality areas is uneven; in the study area, there is a relative decline in the southeast and a gradual rise in the northwest. First, central cities in each region, especially provincial capital cities, have obvious advantages in rural living environment; among them, the quality of rural human settlements in Wuhan and Changsha is always at a high level. Second, there are differences in the construction of rural human settlements in the three urban circles; among them, the rural habitat score in urban agglomerations ranged from the highest average to the lowest average since 2010, and the overall urban aggregation score is slightly higher than the other two since 2010. Third, there are differences in rural habitats. Within the three urban districts, habitats have improved to varying degrees in all parts of the urban agglomeration, but with little internal change, this is reflected in the coherent development of the different regions in the urban agglomeration, the rural living environment within urban agglomerations has steadily improved, the gap between different regions within urban agglomerations has widened, the rural human settlement environment in all areas of the urban circle has maintained a high improvement rate, and internal differences are relatively narrow.

On the one hand, provincial capitals have excellent economic conditions, there are various types of public services in the villages under its jurisdiction, and the basic supporting facilities for rural living environment are complete; meanwhile, the positive interaction between rural and urban areas in these areas, and the income of rural residents in this area are relatively high and the rural industry is vigorous. On the other hand, there are big differences in infrastructure, public service facilities, information accessibility, economic base, and other original living environments within provinces and regions, and policies to improve the living environment vary from region to region.

4.7.3. Temporal and Spatial Evolution Process of Rural Human Settlement Sub-System Quality

① The overall level of development of the production space sub-system is increasing, and major changes have taken place in the spatial model. First of all, the average production space of the rural human settlement environment in the Middle Triangle increased significantly, from 2,603 in 2000 to 3,238 in 2017, and the growth rate reached 24.39%. With the rapid development of urbanization and industrialization in this period, comprehensive rural reform was deepened, various policies have been implemented to support and benefit agriculture, in a market economy, factors of production are fully mobile, rural areas are moving from closed to open, the number of migrant workers in cities has increased, and rural economic development has become increasingly diversified; in turn, more jobs were created in rural areas, the income of rural residents increases, and the living environment from the perspective of production space is optimized. Second, with the improvement of agricultural modernization, mechanization of farming, irrigation, transportation, and processing of agricultural products was gradually realized, agricultural land became more productive, rural labor was liberated by the mechanization of agriculture, at the same time, the brand construction of agricultural products has been promoted, and the integration of agricultural resources has also been increased; local academy of agricultural sciences has established a strategic alliance of agricultural science and technology innovation in urban agglomerations, it provides a better platform for the output and transformation of agricultural scientific and technological achievements in the region, and this has also boosted the income of rural residents and local government revenue, and then improved the rural living environment. The spatial pattern of production space sub-system of rural human settlement environment has changed greatly. During this period, with the major strategic decision of building "city

circle" put forward in 2003, superior location and resource conditions are used more effectively, other areas within the city circle have achieved rapid economic development, and agricultural modernization has also improved rapidly; therefore, the production space sub-system of rural human settlement environment in urban circle is improved relatively quickly. In addition, the spatial distribution of excellent grade regions still shows a triangular distribution pattern; that is, the regional centers with better continuous comprehensive strength still maintain relative advantages in quality.

5. Conclusion

(1) Rational habitat optimization is an important part of the implementation of the rural rehabilitation strategy, and the rural habitat covers all aspects of the natural and social environment of the residents countryside. It is consistent with the meaning of rural habitat, rural industrial environment, rural habitat, rural ecological environment, rural socio-cultural environment, construction of numbers from four angles, environmental quality test analysis, and measurement results.

(2) The driving mechanism of temporal and spatial evolution of rural human settlement environment is preliminarily analyzed. The results show that the government support and security system have been optimized, and the rural cultural industry has been gradually modernized. The needs of rural residents, social organizations, and other diversified subjects have changed, and public cultural service facilities have also been improved.

Data Availability

No data were used to support this study.

Conflicts of Interest

The authors declare that they have no conflicts of interest.

Acknowledgments

This work was supported by the Guangxi University young and middle-aged teachers scientific research basic ability improvement project (Nos. 2022KY0647 and 2022KY0620).

References

[1] Y. Wang, R. R. Yang, Y. X. Xu, X. Li, and J. L. Shi, "Research on multi-agent task optimization and scheduling based on improved ant colony algorithm," *IOP Conference Series: Materials Science and Engineering*, vol. 1043, no. 11, Article ID 032007, 2021.

[2] X. Jiang, X. Chen, and Z. Wang, "Research on modeling and control strategy of hydraulic turbine governing system based on improved genetic algorithm," *IOP Conference Series: Earth and Environmental Science*, vol. 774, no. 11, Article ID 012136, 2021.

[3] Y. Yu, T. Zhang, and Y. Zhao, "Optimization strategy of multiarea interconnected integrated energy system based on consistency theory," *Mobile Information Systems*, vol. 2020, no. 7, 10 pages, Article ID 8884525, 2020.

[4] C. Song, K. Gong, J. Bu, and L. Huang, "Research on stability of optimal sheet-cutting strategy based on improved real-coded genetic algorithm," *E3S Web of Conferences*, vol. 162, no. 11, Article ID 03007, 2020.

[5] Y. U. Jingke, "Development of mountain tourism in central yunnan in the context of rural revitalization strategy," *Asian Agricultural Research*, vol. 13, no. 1, p. 5, 2021.

[6] P. Lyu, M. Yu, and Y. Hu, "Contradictions in and improvements to urban and rural residents' housing rights in China's urbanization process," *Habitat International*, vol. 97, no. 1, Article ID 102101, 2020.

[7] X. Zheng, W. Feng, M. Huang, and S. Feng, "Optimization of pbft algorithm based on improved c4.5," *Mathematical Problems in Engineering*, vol. 2021, no. 2, 7 pages, Article ID 5542078, 2021.

[8] M. Jun, W. Hongzhou, Z. Xiu, Z. Huijuan, and C. Yufei, "Research on customized passenger route optimization based on improved genetic algorithms," *IOP Conference Series: Earth and Environmental Science*, vol. 638, no. 1, Article ID 012011, 2021.

[9] S. Jia, S. Sun, J. Wang, and F. Xu, "Research based on the improved grey wolf optimization algorithm," *Journal of Physics: Conference Series*, vol. 1883, no. 6, Article ID 012036, 2021.

[10] H. Lu, M. Li, and Y. Zhang, "Research on optimization method of computer network service quality based on feature matching algorithm," *Journal of Physics: Conference Series*, vol. 1982, no. 7, Article ID 012005, 2021.

[11] K. Zhou, J. Hu, Y. Li, Q. Wang, and Y. Tong, "Research on cloud forging resource service selection optimization based on genetic algorithm," *Journal of Physics: Conference Series*, vol. 1812, no. 8, Article ID 012023, 2021.

[12] M. Wang, K. Lu, W. Song, and Y. Zhang, "Optimization and upgrading of marine fishery industry under the background of rural revitalization strategy," *IOP Conference Series: Earth and Environmental Science*, vol. 510, no. 3, Article ID 032016, 2020.

[13] Z. Ying, "Research on guangdong tourism resources development and integration development under the background of rural revitalization strategy," *IOP Conference Series: Earth and Environmental Science*, vol. 546, no. 3, Article ID 032013, 2020.

[14] B. Yang, Z. Wang, B. Zhang, and D. Zhang, "Allocation efficiency, influencing factors and optimization path of rural land resources: a case study in fang county of hubei province, China," *International Journal of Environmental Research and Public Health*, vol. 17, no. 16, p. 5898, 2020.

[15] Y.-l. Wang, Z.-p. Wu, G. Guan, K. Li, and S.-h. Chai, "Research on intelligent design method of ship multi-deck compartment layout based on improved taboo search genetic algorithm," *Ocean Engineering*, vol. 225, no. 2, Article ID 108823, 2021.

[16] S. C. Ji, D. X. Lu, and L. Deng, "The optimization of machining cutting zone based on improved genetic algorithm," *Journal of Physics: Conference Series*, vol. 1948, no. 1, Article ID 012009, 2021.

[17] Y. Zhou, Y. Li, and F. Chao, "Research on intelligent test paper generating system based on improved genetic algorithm," *Journal of Physics: Conference Series*, vol. 1744, no. 3, Article ID 032203, 2021.

Hindawi
Mobile Information Systems
Volume 2022, Article ID 7539240, 13 pages
https://doi.org/10.1155/2022/7539240

Research Article

Metaverse Space Ecological Scene Design Based on Multimedia Digital Technology

Xuheng Xu,[1] Guiheng Zou,[2] Lifeng Chen ,[3,4] and Ting Zhou[5]

[1]*Theatre and Film Institute, Zhejiang Vocational Academy of Art, Hangzhou 310053, Zhejiang, China*
[2]*Security and Protection Department, Zhejiang Police Vocational Academy, Hangzhou 310018, Zhejiang, China*
[3]*School of Public Affairs, Zhejiang University, Hangzhou 310058, Zhejiang, China*
[4]*School of Business, Zhejiang University City College, Hangzhou 310015, Zhejiang, China*
[5]*College of International Business, Zhejiang Yuexiu University of Foreign Languages, Shaoxing 312000, Zhejiang, China*

Correspondence should be addressed to Lifeng Chen; chenlifeng@zucc.edu.cn

Received 29 March 2022; Revised 28 April 2022; Accepted 6 June 2022; Published 6 July 2022

Academic Editor: Liming Chen

Yuan cosmos is a virtual world linked and created by scientific and technological means, which is mapped and interacted with the real world, and a digital living space with a new social system. With the increasing popularity of data acquisition and production equipment, people are increasingly convenient to produce multimedia data such as images, graphics, audio, video, animation, and three-dimensional models. In addition to the rapid development of digital technology itself, the biological information technology related to digital technology also greatly promotes the emergence of the metauniverse. This paper aims to study the application of multimedia digital technology to the ecological scene design of metauniverse space, introduces the related concepts of metauniverse and multimedia digital technology, expounds the related methods of multimedia digital technology and neural network related algorithms, and then takes the three-dimensional simulation of the auditory system in the interactive multisensory simulation system of the constituent elements of metauniverse as an example. The mel-frequency cepstrum coefficient (MFCC) is used to simulate the auditory characteristics of the auditory periphery (cochlea) as the perceptual end of the model. A variety of bionic mechanisms are used in the model, such as designing the connection mode of neurons, learning state and release effect, and the regeneration mechanism of neurons. For the verification of the performance of the model, the speech sample database, including English words and phrases, is recorded and the speech content information recognized by the model by means of speech recognition is experimented. The experimental results show that, in terms of phrase accuracy, the DN-1 model improves 2.59% and the DN-2 model improves 2.77% compared with MFCC feature on the basis of mixed features. When only DBN features are used, the performance improvement rate of the developmental network model is small.

1. Introduction

Multimedia digitization is an innovative technology brought about by the development of modern computer technology. Digital media technology has not only changed the original mode of radio and television production and broadcasting but also spawned many new production and broadcasting platforms involved in collecting, editing, and broadcasting. The application of digital multimedia is suitable for platforms for the development of modern network environments. With the existence of mobile Internet and growing ubiquitous perception systems, such as cameras and voice controllers citywide, the entire city can be effectively collected and processed in real time. The emergence of smart phones has greatly promoted the digital mapping process of individuals. Therefore, smart phones have greatly promoted the collection of personal data. Using smart phones can accurately make data portraits for users, thus forming massive individual uploads of natural information, thereby building the foundation of Metaverse Space for personal information and social interaction. Big data has also promoted the development of artificial intelligence accordingly. The rapid development of artificial intelligence in the 20th century is essentially due to the rapid accumulation of data

materials, thus forming an evolutionary path with "deep neural network + big data" as the core method and changing the long-standing limitations of symbolic logic methods on the development of artificial intelligence.

Judging from the status quo of artificial intelligence, although it still lags behind humans in overall cognition and adaptability, it has approached or surpassed the human levels in most subfields. The development of artificial intelligence has laid the foundation of intelligent control technology for the development of the Metaverse Space. In this context, the traditional concept of "interface design" has been broken and the interactive display experience design in a brand-new multimedia environment is carried out. Through the research of the paper, it can promote further development of the comprehensive application of multimedia interaction technology in the Metaverse Space ecological scene and quickly improve their ability to use interactive technology in multimedia interface design. By in-depth research on the realization and research of various elements in multimedia interactive production technology, the paper explores the application of designing a brand-new interactive display and experience environment through the effective use of multimedia interactive technology.

The innovation of this paper is that (1) it takes digital media art as the research object, deeply studies and explores the radar application cases of digital media art in virtual reality technology, and summarizes the relevant theoretical exploration and forward-looking prediction for the future. (2) In this paper, multimedia digital technology is applied to the ecological scene design of metaspace, which is innovative and practical.

2. Related Work

With the passage of time, digital media art has gradually infiltrated our daily lives. It is not only a new technology but also a new way of life and aesthetic form. A wealth of research has been carried out by scholars on digital media arts. Under the background of contemporary cultural protection and dynamic inheritance, the interpretation and re-expression of the artistic connotations of Chinese literati paintings have become the main direction of heritage research. Digital technology and multimedia expression have become important means of cultural expression and dissemination. Chinese literati paintings are mostly ink paintings. The particularity of ink paintings makes it difficult to decompose and extract the content of the pictures in a simple way, which to a certain extent causes difficulties in digitization, re-expression, and public interpretation. To solve this problem, Zhang et al. proposed a new robust multiview fuzzy clustering algorithm through multimedia digital technology for image segmentation of Chinese literati paintings to achieve effective decomposition and extraction of ancient paintings. In this way, the electronic and digital conversion and preservation of literati paintings could be realized. This preservation method could preserve the artistry of literati paintings better than the traditional scanning method and is of great value to the re-expression and dissemination of cultural heritage [1]. The world of communications and computing has changed dramatically over the past few years. The advent of social media has made data transfer easier, which has raised issues of unauthorized use and redistribution of digital content. This copyright scheme has hardly affected the publishing rights of authors and publishers. Hassan et al. proposed a robust framework to protect copyright property and prevent illegal use or copying of data in the event that only authorized users could legally use the data [2]. Evolved Multimedia Broadcast Multicast Service (eMBMS) is a technology in Long-Term Evolution (LTE) that provides a broadcast bearer to deliver video content and files to an unlimited number of users. The bearer utilizes multiple cell sites to build a "Single-Frequency Network" (SFN) area with identical downlink transmissions over a portion of the LTE Orthogonal Frequency-Division Multiplexing (OFDM) waveform. The main data needs are the Internet, DVB, and higher-speed cellular broadcasting. The resulting signals are combined at the antenna of the user equipment in such a way that adjacent cell sites, which are usually interfering, become sources of useful signals, thereby improving the overall signal-to-interference ratio and spectral efficiency. Luo introduced eMBMS technology and architecture and evaluated its performance and impact on wireless network engineering [3]. Dongmei believed that compared with new media, the biggest advantage of paper media was that the content was authentic and professional. At the same time, paper media is more in line with people's reading habits. He analyzed the path of the integration of broadcast television and digital network technology based on the multimedia editing platform. By analyzing the background and motivation of the integration of radio and television and new media, he analyzed the reasons for the successful transformation and development of related enterprises, explored the path of radio and television and new media integration, and provided strategic suggestions for the development of China's radio and television [4]. Meng et al. believed that the application of digital multimedia technology has been the inevitable result of the social development of higher education, and it was also an inevitable choice to achieve innovation and development. Therefore, colleges and universities should strengthen the emphasis and investment on digital multimedia technology in the actual teaching process. The national education department should strengthen support and guidance and strengthen the integration of traditional teaching methods and digital multimedia technology [5]. Digital multimedia is a computer-based graphics and image application technology, which is widely used in the field of design engineering. In his research, Li analyzed the optimization and development of urban landscape design under the influence of digital multimedia technology. In actual work, a large number of display drawings and information are usually required to express the intention of landscape design. Li's research found that digital technology has strong practical value in garden design [6]. With the development of new media, student management faces more challenges. New media has a larger network system, including digital technology and mobile technology. Wang and Wang innovated the optimization mode of college student management based on multimedia network platform. The diversification of new media has brought difficulties to the management of college students, and the immediacy of

new media communication has also brought challenges to higher education. Therefore, Wang proposed a student management optimization platform based on information management technology. While using the emerging multimedia education platform, teachers also need to continuously improve management model innovation [7]. The disadvantages of these research studies are that digital media technology is still a relatively new art and technology industry, some theoretical studies are not perfect, and there are still many practical problems that need to be solved.

3. The Method of Multimedia Digital Technology for Metaverse Space Scene Design

The concept of digital media is based on the leading role and method of digital technology in information dissemination. The concepts of "digital media" and "multimedia" are also different. The full name of multimedia should be multisensory media, which is not a kind of media but a technology and method for digital media to encode, process, store, and present information [8].

3.1. The Application Concept of Digital Media Technology in Public Art Creation. The continuous development of digitization has put the current human civilization in a major historical transformation stage, that is, it is facing the singularity of civilization development [9]. The so-called singularity often refers to discontinuous points with important special properties in mathematics and physics. In the social sciences, it refers to those important historical nodes in the evolution of civilization. Since the evolution of human civilization, it has a history of tens of thousands of years. In the long history of human evolution, there are often multiple significant historical moments, which lead human civilization from primitive, backward, and barbaric to a relatively prosperous human civilization [10].

3.1.1. Digital Holographic Projection Technology. Holographic projection technology, also known as holographic 3D technology, is a recording and reproduction technology that uses the principles of interference and diffraction to record all information in the reflected light waves of the object and reproduce the real three-dimensional image of the object [11]. The related pictures are shown in Figure 1.

Holographic projection technology has a wide range of applications and has bright development prospects in education, aerospace, national defense, film and television, entertainment, and art. Many countries and institutions are vigorously researching and developing, and it also has very broad application prospects in the field of public art [12, 13].

3.1.2. VR and AR Technology

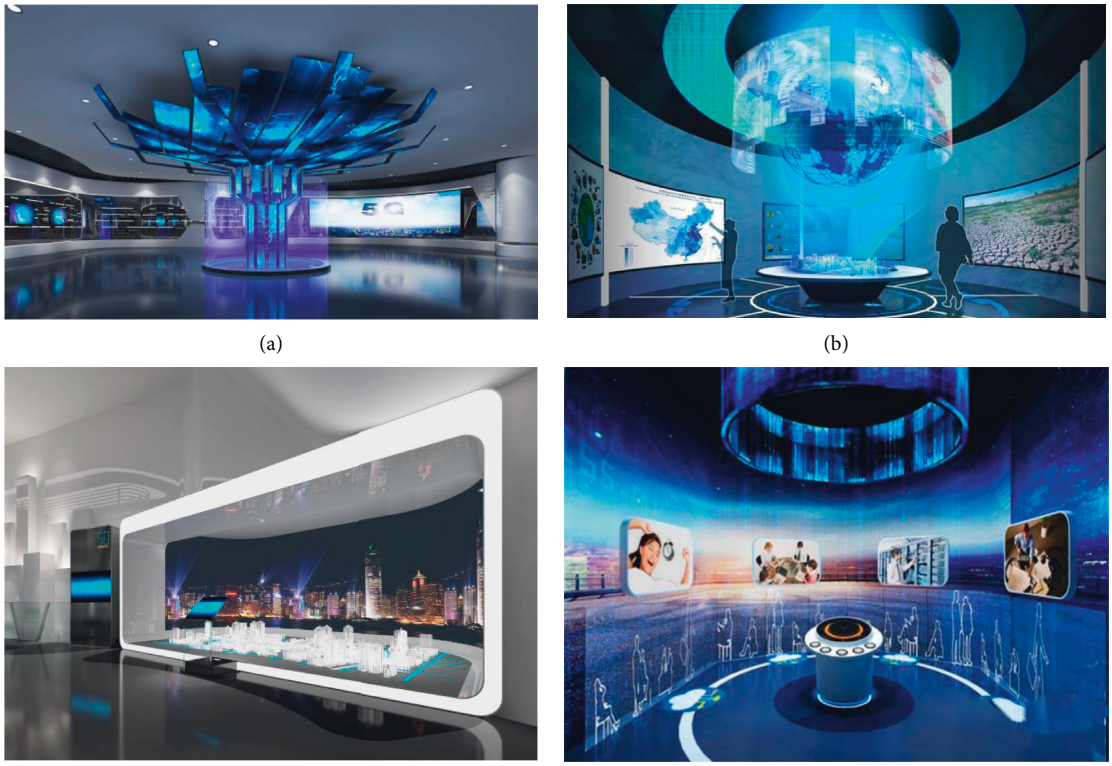
(1) Virtual Reality Technology. Virtual reality technology (abbreviated as VR), also known as spiritual environment technology, is a computer system that can create and experience the virtual world. In recent years, medical design, art, real estate, archaeology, military, entertainment, and other fields have begun to apply VR technology to their respective industries, creating large wealth for the society (Figure 2).

Virtual reality technology integrates digital images, sensors, multimedia technology, artificial intelligence, computer graphics, network, and other information technologies, gradually establishes its brand-new development achievements, provides a certain degree of support for the creation and experience of the virtual world, and greatly promotes the rapid development of information technology. The biggest feature of VR technology is to establish an artificial virtual environment through the computer. This environment is to copy other real environments, apply them to the computer, and produce a new "virtual environment" or a three-dimensional space formed only through the computer, and make the user feel immersive.

(2) Augmented Reality Technology. Augmented reality (AR) superimposes the real environment and virtual objects on the same screen or space in real time [14]. It does not present a completely virtual world to users, but superimposes our real world with virtual objects to produce an experience that we cannot obtain in our normal state. It can be said that it is the virtualization and expansion of the real world.

3.2. The Origin of the Metaverse Space and Its Components. With the "Internet+" thinking, wisdom and technology extend their influence on politics, economy, culture, and life. With the development and popularization of mobile Internet and the formation of users' user habits, the growth momentum of mobile terminal users has slowed down and the dividend of consuming Internet is gradually decreasing. The outbreak of the pandemic in 2020 has caused heavy damage to the tourism industry, and the consumption and travel modes of tourists are undergoing changes. "Cloud tourism" and "cloud live broadcast" further expand the online digitization process of users. With the advent of the concept of "meta," the Internet has become a hot spot in the industry.

3.2.1. From the Internet to the Universe. The development of artificial intelligence has laid the foundation of intelligent control technology for the development of metauniverse. In addition to the rapid development of digital technology itself, the biological information technology related to digital technology also greatly promotes the emergence of the metauniverse. In recent years, a series of developments in human-computer interaction of biological and digital technology, especially the coupling development of the nervous system and electronic systems, are of great help to the development of metauniverse. It mainly includes three categories: one is the motion perception system [15]. The whole body sensors can accurately perceive human actions by digital processing. At present, they have been fully applied in the field of entertainment, especially in the field of film. The second is organ perception and feedback system, such as



(a) (b) (c) (d)

Figure 1: Digital holographic projection.

(a) (b)

Figure 2: VR experience.

artificial cochlea, electronic skin, and tactile gloves. Artificial cochlea has been widely used in medicine. In essence, it is an artificial organ that directly acts on the nervous system. Electronic skin and tactile gloves can more accurately measure and perceive fine hand movements and imitate various feelings to feed back to the skin. At present, it is applied in some very high-end manufacturing and medical fields [16, 17]. The third is brain wave control and brain interface: one is not deep into the skin and uses brain waves emitted by the brain to control digital devices; the other is to directly connect the nerve to the electrode to form a biological electronic nervous system. The former has been applied in many fields. For example, there are civilian products for UAV control, while the latter still has ethical and technical difficulties.

In addition, the expansion of a series of digital technologies in all aspects of economy and society, including blockchain, e-commerce, online games, digital economy, and smart cities, has made the corresponding technical preparations for the emergence of the metauniverse, which

makes the birth of the met-universe a natural and desirable product [18].

The connotation of metauniverse is to absorb the achievements of information revolution (5g/6g), Internet Revolution (Web3.0), artificial intelligence revolution, and virtual reality technology revolution including VR, AR, and MR, especially game engine, and show mankind the possibility of building a holographic digital world parallel to the traditional physical world.

The technology group supporting the metauniverse includes five parts: (1) network and computing technology; (2) artificial intelligence; (3) video game technology; (4) display technology: VR, AR, and MR; (5) blockchain technology.

3.2.2. Elements of the Yuan Universe

(1) Highly Immersive 3D Visual Experience. As a high degree of simulation of the real world and the formation of individual immersive experience, the first thing to form is the natural substitution of the visual system, which requires a higher degree of accuracy of the 3D visual system.

(2) Interactive Multisensory Simulation System. Simulating vision alone is far from forming a metauniverse. Human exploration in the field of nature depends not only on vision but also on hearing, smell, taste, touch, and other sensory organs to perceive the world [19]. Therefore, the highly realistic metauniverse must form an all-round perceptual simulation, not just a visual simulation. At present, the stereo simulation of the auditory system has developed to a high level, and its algorithm is relatively simple, but for the simulation of multiple sound sources in a complex scene, a more powerful algorithm simulation is still needed. The simulation technology of taste and smell system is relatively slow to develop, mainly because the human taste and smell system is too complex to form a compound taste and smell, which needs the support of more complex chemical technology. For example, it is still difficult to form a complex and accurate flavor through a simple concentration of the proportion of chemical raw materials. There are far from enough scenes of smell and taste in the existing entertainment scenes; therefore, it is difficult to form a commercial development [20].

This paper will take the stereo simulation of the auditory system as an example.

(3) Simulation of Natural Systems. To achieve more realistic scenario simulation, metauniverse must be able to accurately simulate natural systems; otherwise, it is an upgraded online game. This requires that the metauniverse can accurately simulate the natural systems and phenomena on the earth, including pure natural systems such as weather systems, ocean system, and biological systems, as well as the simulation of physical and chemical changes caused by human operations. In the current 3D system, preliminary simulation has been roughly achieved. For example, with the change of time, there will be changes in the rise and fall of the sun, wind, frost, rain, and snow. The recent illusory engine can even make the light and shadow close to the real picture. However, these are only preliminary visual simulations. To accurately simulate the objects in the metauniverse, we need to model a large number of objects at different levels.

(4) Intelligent Scenes with Strong AI. Whether it is the entertainment purpose of metauniverse or other life and work purposes, its value is not only to provide a pure 3D immersion digital analog place but also to provide each user with greater freedom, richer event activities, and more convenient service perception. This requires a variety of highly anthropomorphic social scenes in the metauniverse. Of course, in the early stage, the metauniverse can integrate different special AI algorithms through the support of powerful computing power to form the early general intelligence. With the further development of the general AI model, the digital subject formed by AI can evolve by itself in the metauniverse to form a digital subject in line with the internal situational characteristics of the metauniverse.

(5) Participation and Entry of a Large Number of Social Subjects and Behaviors. The above elements are actually the technical preparation or objective elements of the metauniverse, forming the environmental basis of the metauniverse. The final formation of the metauniverse requires the entry of more abundant natural persons, to form various rich practical scenes similar to the real society. This mainly includes several categories: first, entertainment scenes. This is the original motivation of the metauniverse. The interaction between humans and AI is always a lack of realism. This feeling not only comes from the rigidity of AI but also produces digital estrangement due to the inability to integrate it with offline even after AI is highly intelligent. Therefore, the integration of more social real individuals will make the metauniverse more vivid and entertaining. The second is the working scene. Various current online communication mechanisms, such as online meetings, can be nested into the scene of the metauniverse to replace most of the offline actual communication. The third is the consumption scenario. The vast majority of today's e-commerce systems can display and interact in a more realistic form in the metauniverse. The fourth is the social scenes. Metauniverse is an immersive virtual space in which users can carry out cultural, social, and entertainment activities. Its core lies in the bearing of virtual assets and virtual identity. Also, its four technical pillars are blockchain, game, network computing power, and VR [21]. As a high degree of simulation of the real world and the formation of individual immersive experience, the first thing to form is the natural substitution of the visual system, which requires a higher degree of accuracy of the 3D visual system. The seven elements that make up the metauniverse are shown in Figure 3.

In short, the value of the metauniverse is to enable the vast majority of human activities to reproduce in the metauniverse, to form a more convenient digital twin system. This requires that the metauniverse can be supported by

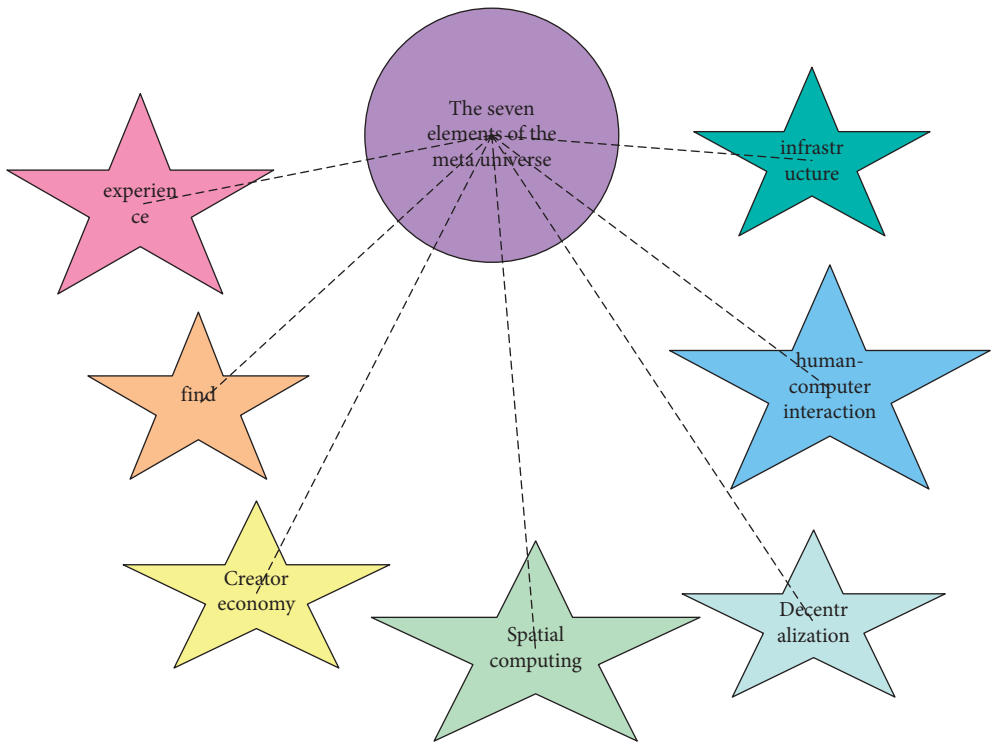


Figure 3: The seven elements of the metauniverse.

the vast majority of natural people and participate in its construction. It is not just a unilateral passive park. This means that the metauniverse will be an open digital space system with three-dimensional depth. The ultimate prosperity of this space system depends on the participation and construction of countless subjects, and metauniverse is a more infrastructure developer [22].

3.3. Fundamentals of a Metaverse Space-Based Interactive Virtual Auditory Environment Real-Time Rendering System

3.3.1. Neuronal Competition Mechanism

(1) Related Concepts of Neural Network. Artificial neural networks (abbreviated as ANNs) are also referred to as neural networks (NNs) or connection model. It is an algorithmic mathematical model that imitates the behavior characteristics of animal neural networks and carries out distributed parallel information processing. Neural network is a technology to simulate human intelligent behavior. The structure of a single neuron is shown in Figure 4.

It is similar to a nonlinear threshold device with multiple inputs and unique outputs. Define the input vector of the neuron:

$$A = [A_1, A_2, A_3, \ldots, A_n]^T. \tag{1}$$

Define weight vector ε:

$$\varepsilon = [\varepsilon_1, \varepsilon_2, \varepsilon_3, \ldots, \varepsilon_n]^T. \tag{2}$$

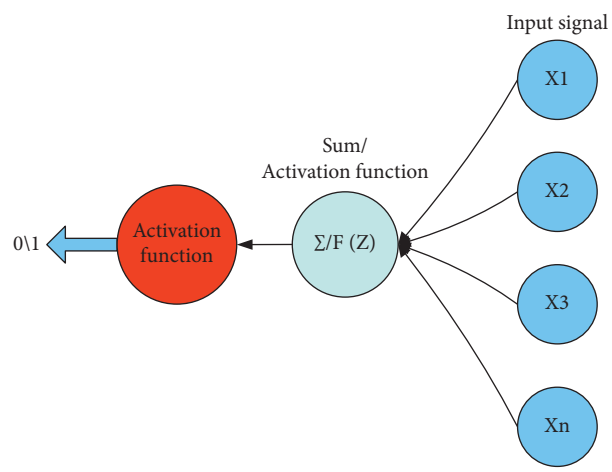


Figure 4: Neuron structure.

∂ is the threshold of neurons, and F is the activation function of neural elements. Then, the neuron output vector B is

$$B = \left(\sum_{j}^{N} A_j \varepsilon_j + \partial \right). \tag{3}$$

(2) Neural Network Type. According to the network architecture, neural networks can be divided into feedforward neural networks and recursive neural networks [23]. The neurons in the feedforward network are arranged in layers, and each neuron is only connected to the neurons in the

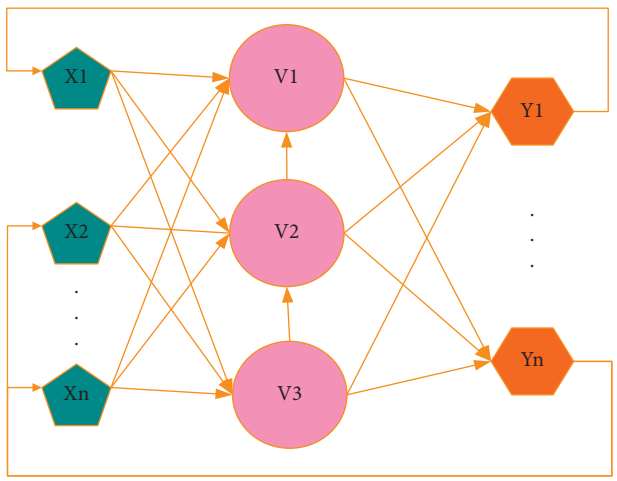


Figure 5: Schematic diagram of the forward network structure with feedback from input to output.

upper layer. Figure 5 shows an example of a feedforward neural network.

3.4. Related Technologies of Deep Neural Network. In real life, the deep neural network is widely used to extract and analyze image semantic features, which lays a solid foundation for the research of image classification technology.

3.4.1. Development of Deep Neural Network Learning. People began to study neural networks very early. The perceptron model is a basic criterion based on modern neural networks. It is a network model that can realize the function of classification and recognition through training [24]. It is a real neural network.

3.4.2. Deep Neural Network Model. Deep learning technology originated from neuroscience, also known as deep neural network. Because the current deep neural network mainly uses convolution structure, deep neural network is sometimes called deep convolution neural network. Machine learning is a method to realize artificial intelligence. Machine learning is the process of analyzing and training a large amount of data by using algorithms. Deep learning originated from a perceptron-based artificial neural network. The first-generation neural network perceptron model is shown in Figure 6.

(1) RBM Neural Network. Further research on the RBM model is one of the core contents of deep learning, which is of great significance. The RBM energy model is shown in Figure 6.

RBM is an undirected graph probability model, which is based on energy. We define the joint probability distribution by combining the energy function of the input layer vector x and the hidden layer vector h as follows:

$$p(x,h) = \frac{e^{-\text{energy}(x,h)}}{z}, \tag{4}$$

where the normalization constant $Z = \sum_{x,h} e^{-\text{energy}(x,h)}$. The marginal probability distribution of the observable input data X is

$$p(x) = \sum_h p(x,h) = \sum_h \frac{e^{-\text{energy}(x,h)}}{z}. \tag{5}$$

Introduce free energy to change equation (5) into

$$p(x) = \frac{e^{-\text{freeEnergy}(x)}}{z}. \tag{6}$$

$Z = \sum_x e^{-\text{freeEnergy}(x)}$ in equation (6), i.e.,

$$\text{freeEnergy}(x) = -\log \sum_h e^{-\text{energy}(x,h)}. \tag{7}$$

θ represents the parameters of the model, which can be obtained by taking the logarithm and derivation of equation (6):

$$\begin{aligned}\frac{\partial \log\ p(x)}{\partial\theta} &= -\frac{\partial \text{freeEnergy}(x)}{\partial\theta} \\ &\quad + \frac{1}{z}\sum_{\widehat{x}} e^{-\text{freeEnergy}(\widehat{x})}\frac{\partial \text{freeEnergy}(\widehat{x})}{\partial\theta} \\ &= -\frac{\partial \text{freeEnergy}(x)}{\partial\theta} + \sum_{\widehat{x}} p(\widehat{x})\frac{\partial \text{freeEnergy}(\widehat{x})}{\partial\theta}.\end{aligned} \tag{8}$$

To deal with the difficult calculation of RBM partition function, the approximate value of log likelihood gradient $\partial \log\ p(x)/\partial\theta$ is usually used for training. The model parameter update rule is defined by the free energy gradient of the sample $x \sim p\ (x)$ subject to the data distribution and the sample $\widehat{x} \sim p(\widehat{x})$ subject to the model distribution as follows:

$$\begin{aligned}E_{\widehat{p}}\left[\frac{\partial \log\ p(x)}{\partial\theta}\right] &= -E_{\widehat{p}}\left[\frac{\partial \text{freeEnergy}(x)}{\partial\theta}\right] \\ &\quad + E_p\left[\frac{\partial \text{freeEnergy}(\widehat{x})}{\partial\theta}\right],\end{aligned} \tag{9}$$

where p is the model probability distribution, $E_{\widehat{p}}$ and E_p are the expected values under the corresponding probability distribution, and $\widehat{p}$ is the empirical probability distribution of the training dataset. The first term of equation (9) is relatively simple, which is generally replaced by the expectation of training samples; the second item contains the samples obtained from model P. Generally, samples are sampled by Monte Carlo Markov chain (MCMC) algorithm.

(2) Self-Coding Network. Automatic coder is an unsupervised learning algorithm, which adopts a backpropagation algorithm and is mainly used for high-dimensional complex data processing or feature extraction. The self-coding network is a special feedforward neural network, which is mainly used in dimensionality reduction, nonlinear feature extraction, expression learning, and other tasks [25]. The structure is shown in Figure 7.

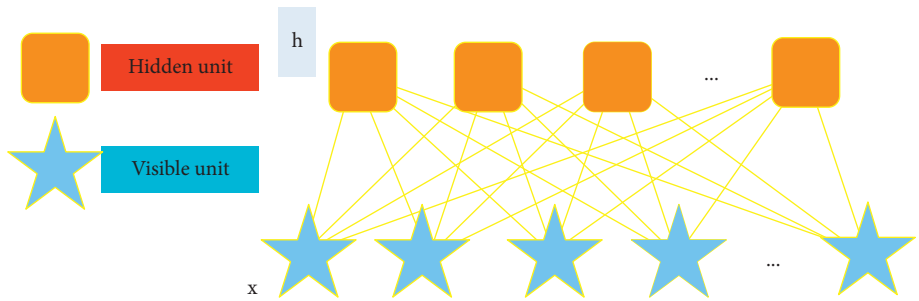


Figure 6: RBM energy model.

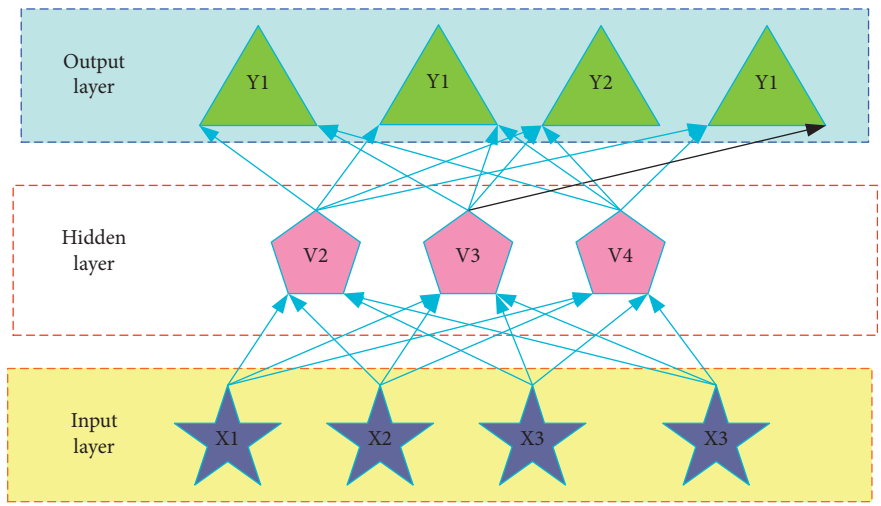


Figure 7: Self-coding network structure with only one hidden layer.

The automatic encoder is mainly composed of an encoder and a reconstructed decoder. The encoder can be represented by function $D = F(x)$, and the decoder can be represented by function $S = J(D)$. The main function of the encoder is to extract features from the input data, while the function of the decoder is to restore the features extracted by the encoder to the original information. The relevant formula is as follows:

$$\begin{aligned} D_i &= F(Qx_i + B), \\ \hat{x}_i &= F(Q'x + A), \end{aligned} \tag{10}$$

where F represents the nonlinear activation function, which is generally a sigmoid function, and $Q = \sum_{i=1}^{N} Q_{ij}x_i$ and $Q' = \sum_{i=1}^{M} Q_{ij}x_i$ are the weight matrix of the encoder and decoder, respectively. B and A are the deviations of hidden layer D and input layer x, respectively. Because of the limited ability of single-layer automatic encoders to extract signal features, SVM, softmax, and other classifiers are generally added to the automatic encoder.

(3) DBN Model Structure and Training. Deep belief network (DBN) is a typical deep learning network model, which is mainly stacked by a restricted Boltzmann machine (RBM) or automatic encoder. The RBM structure and its learning algorithm have been introduced in the previous two sections. In this section, multiple RBMs are stacked to form a deep belief network, and the DBN with three-tier structure is selected as the speech feature of this chapter. Through layer-by-layer greedy and training, a deep belief network with three-layer structure can be obtained. The model structure is shown in Figure 8. In this paper, the output eigenvector of DBN is taken as the input eigenvector of the developmental network model, and the speech data in this paper are one-dimensional [26].

As can be seen from Figure 8, the DBN is formed by the superposition of multiple RBMs, with one visible layer and the others as a hidden layer or output layer. The layer nodes are connected to each other, and there is no connection between the nodes in the layer. The training and learning of DBN network mainly have two processes: training process and fine-tuning process. The training of DBN is carried out layer by layer, that is, the output of the previous layer is used as the input of the next layer.

(4) DN Learning Algorithm. Developmental network (DN) is a new intelligent neural network proposed for simulating the autonomous mental development of the human brain. The DN model is evolved from the LCA network, and the learning algorithm of DN is based on the LCA algorithm. The leaf component analysis method can be understood as a biology-based *in situ* learning algorithm, which is possible.

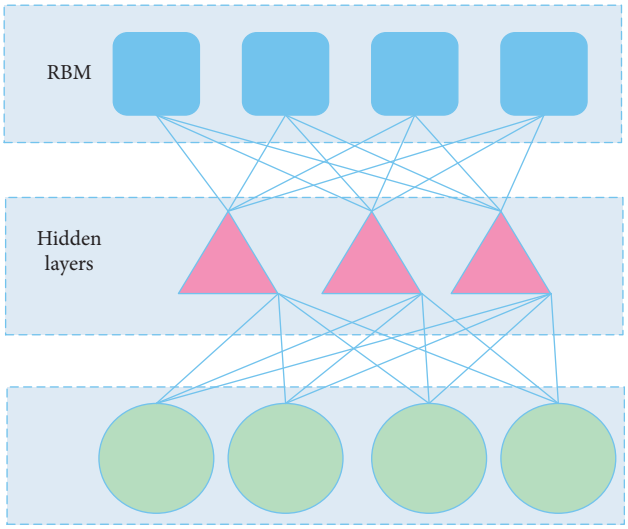


Figure 8: DBN model structure diagram.

The meaning of the concept of "leaf" can be understood through two simple concepts: leaf region and leaf component. The leaf region refers to several components of the mapping space, and each part represents a leaf region. The leaf component is discussed for each leaf region, which means that in a leaf region, a vector is used to approximate the surface of the leaf region, and the vector used as the representation is the leaf component of the region. From the concept of leaf region and leaf component, we can see that the leaf is related to a certain region. Region refers to a certain region, and the component is the component of the region. It is conceivable that leaves represent regions with certain characteristics. For several regions divided in the mapping space, the selection principle of the region optimal component is to make all or more samples in the region fall on this vector or distributed on both sides of this vector as much as possible.

3.5. Establishment of an Interactive Multisensor Simulation System for Metauniverse Based on Convolutional Neural Network. Convolutional neural network is essentially an end-to-end mapping from one end to the other, and the content of the network model is this end-to-end mapping rule. There is no explicit mathematical expression for this rule. It comes from learning by recognizing a large number of training data. In the process of training, all weights need to be initialized. Generally, small random numbers are used to initialize the network. The purpose of doing so is to avoid reaching saturation in advance due to the influence of some weight abnormal items in the process of training because too large weight items will lead to training failure. Second, because of the random nature of random numbers, different values will be generated, which can ensure the normal training and learning of the model. The training process is described below.

The training process includes four steps and can be divided into two main stages:

(1) The first stage is the forward communication stage.

(1) Take a sample (A, B_v) from the dataset and input it into the network.

(2) Calculate its corresponding actual output U_v.

At this stage, the sample information is transformed from the input layer to the output layer. The expression of the execution process of the network is

$$U_v = g_n\left(\ldots\left(g_2 g_1\left(A_v T^1\right)T^2\right)T^n\ldots\right). \tag{11}$$

(2) The second stage is the backpropagation stage.

(1) The difference between the actual output value U_v and the ideal output value B_v is taken as the error value.

(2) Adjust the weight coefficient by minimizing the error.

The above two stages of operation have accuracy requirements. Here, E_v is defined as the error size of the vth training sample in the model. The overall error of the whole network model is defined as E, and the mathematical description is as follows:

$$\begin{aligned} E_v &= \frac{1}{2}\sum_{j=1}^{n}\left(B_{vj} - U_{vj}\right)^2, \\ E &= \sum E_v. \end{aligned} \tag{12}$$

As can be seen from the above description, the input sample data first carry out forward propagation to calculate the error, then carry out backpropagation to transfer the error layer by layer, and then adjust and update the weight. To fully describe the training process, the number of input layer, hidden layer, and output layer are o, P, and Q, respectively.

Set separately

$$A = (a_1, a_2, \ldots, a_o), \tag{13}$$

which is the input vector added to the network,

$$R = \left(r_1, r_2, \ldots, r_p\right), \tag{14}$$

which is the middle-layer output vector,

$$B = \left(b_1, b_2, \ldots, b_q\right), \tag{15}$$

which is the actual output vector of the network, and

$$C = \left(c_1, c_2, \ldots, c_q\right), \tag{16}$$

which represents the target output vector of each module of training data. The weight from output unit I to intermediate unit J is set as W_{ij}, and the weight from intermediate unit J to output unit m is set as T_{jm}. The thresholds of the output unit and the intermediate unit are represented by ε_m and φ_j.

Thus, the output of the middle layer is

$$S_j = g\left(\sum_{i=0}^{o} W_{ij}A_i + \varphi_j\right). \tag{17}$$

The output of the output layer is

$$B_m = g\sum_{j=0}^{p} T_n R_j + \varepsilon_m, \tag{18}$$

where $g(\bullet)$ is the excitation function, and the sigmoid function adopted above is expressed as follows:

$$g(A) = \frac{1}{1 + E^{-ma}}. \tag{19}$$

4. Experiment and Analysis of Auditory System in an Interactive Multisensory Simulation System Based on Metauniverse

In this paper, the auditory system in the interactive multisensory simulation system based on the metauniverse is experimented. Combined with the developmental network, the developmental network auditory model of the human auditory system is roughly constructed. The auditory characteristics of the auditory periphery (cochlea) simulated by mel-frequency cepstrum coefficient (MFCC) are used as the perceptual end of the model. A variety of bionic mechanisms are used in the model, such as designing the connection mode of neurons, learning state and release effect, and the regeneration mechanism of neurons. For the verification of the performance of the model, record the speech sample database, including English words and phrases, and experiment the speech content information recognized by the model by means of speech recognition.

4.1. Experiment and Development Network Analysis. To test the influence of DBN features on the performance of the developmental network model, the parameters of DBN feature extractor are reasonably set and the matching threshold of the developmental network model is set to 0.95 to make the model in the optimal state. On the basis of MFCC features, the DBN feature extractor is used to extract depth features (mixed features) for the recognition experiment of English words and phrases in the developmental network model. In the experiment, MFCC features, DBN features, and the combined features (mixed features, i.e., MFCC + DBN features) are compared in the recognition performance of the developmental network model. The DBN feature in the experiment refers to the feature obtained by the DBN feature extractor after the simple preprocessing described in the previous chapter. The specific experimental results are shown in Tables 1 and 2.

From the experimental results in Tables 1 and 2, it can be seen that the new features extracted by the DBN feature extractor based on MFCC features have significantly improved the recognition performance of English words and phrases compared with MFCC features. Among them, for the correct recognition rate of English words, the DN-1 model is 1.66% higher than MFCC feature on the basis of mixed features and the DN-2 model is 1.86% higher than MFCC feature. There is little difference in the performance change rate between the two. In terms of phrase accuracy, the DN-1 model improves 2.59% and the DN-2 model improves 2.77% compared with MFCC feature on the basis of mixed features. When only DBN features are used, the performance improvement rate of the developmental network model is small. The reason for this phenomenon is that, on the basis of MFCC features, the multilayer structure of deep belief network is conducive to the decomposition and reconstruction of speech features and can improve the correlation of speech features. The correlation of speech conceptual features is improved, and the performance of the developmental network model will naturally be improved. Based on the analysis of the above results, the performance comparison results of the two types of developmental network models with mixed features can be obtained, as shown in Table 3.

Table 1: Correct rate of English word recognition under different features of the developmental network model based on metauniverse context (%).

Model type	DN-1 model	DN-2 model
MFCC	92.11	95.32
DBN	93.01	96.02
MFCC + DBN	94.55	97.52

Table 2: Correct rate of phrase recognition based on the developmental network model in metauniverse context under different features (%).

Model type	DN-1 model	DN-2 model
MFCC	85.44	91.88
DBN	86.88	92.54
MFCC + DBN	88.06	93.99

Table 3 shows the comparison results of the recognition performance of DN-1 and DN-2 models for English words and phrases based on the mixed features. In this paper, the mixed features refer to the new features extracted by the DBN feature extractor based on MFCC features. It can be seen that the deep belief network is introduced into the model x area to deeply extract the input information features. Whether it is the DN-1 model or DN-2 model, compared with the MFCC features in Section 4, the performance of the development network model has been greatly improved, which shows that it is feasible to introduce the deep belief network as the feature extractor.

4.2. Performance Comparison of Various Speech Recognition Models. To reflect the performance of the model in speech recognition, the recognition rate of this model and other models under the same experimental conditions is compared through experiments. The same experimental conditions refer to the use of the self-recorded speech database, the same training sample set and test sample set, and the same new speech feature extraction method. Other models are dynamic time warping (DTW), hidden Markov model (HMM), improved backpropagation neural network (BP), and convolutional neural network (CNN). DTW matches by calculating the minimum cumulative distance between the two vectors, which requires the training sample set as the

Table 3: Comparison of DN-1 and DN-2 model performance in mixed characteristics (%).

Identify object	English words	Phrase
DN-1 model	92.66	89.10
DN-2 model	95.58	93.01

template. The HMM model sets six states, and each state has three mixed Gaussian probability density functions. In the BP neural network, the selection of the number of hidden layer neurons is essential. In the experiment, the number of hidden layer neurons is 35 and the structure is 3 layers. The selection principle of DN-1 and DN-2 model parameters is to optimize the recognition performance of the model. CNN selects the maximum pool size of 3, and the step size of the pool window is set to 3. Experiments are carried out on the above speech recognition models and repeated 10 times to obtain the steady-state value or average value as the recognition result, as shown in Figure 9.

It can be seen intuitively from Figure 9 that, for simple English words and phrases in low-noise environment, compared with the traditional speech recognition model, the developmental network model constructed in this paper generally has high recognition rate, strong antinoise ability, and small difference in recognition rate between English words and phrases. Compared with CNN in neural network, the recognition rate of the model constructed in this paper is slightly lower than that of CNN. The reason for this phenomenon does not rule out the influence of model structure parameters.

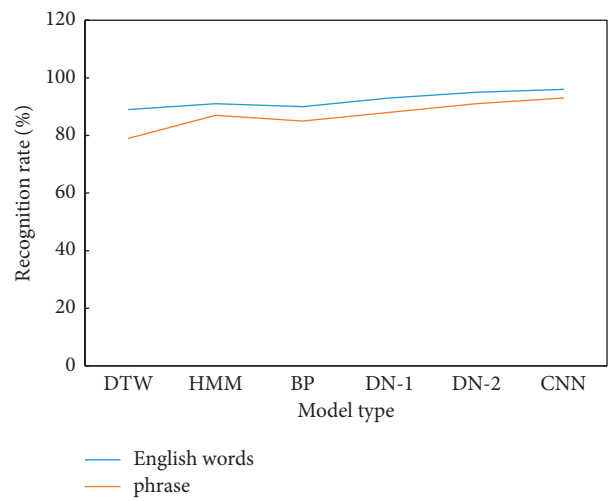


Figure 9: Comparison results of recognition rates of different speech recognition models.

5. Discussion

As an important historical node of human civilization, the Metaverse Space requires the high attention and vigilance of the whole society at the beginning of its birth. The Metaverse Space itself has three natural drawbacks, namely, knowingness, certainty, and nonpractice. Therefore, the governance of the Metaverse Space must adhere to the pregovernance orientation of embedding the Metaverse Space in the real society and forming a symbiotic civilization. This requires the common vigilance and awareness of all human beings, from the elite to the public, as well as the restriction and guidance of national policies and regulations. The idea that the Metaverse Space will form a completely self-circulating and unregulated virtual universe is very dangerous and wrong. The return of human civilization must be the extension of civilization based on the real world, rather than the self-limitation of the digital world.

Virtual reality technology uses computers to virtualize real objects to construct a simulated world. With the continuous extension of the network, corresponding digital technologies are also advancing simultaneously, such as big data and artificial intelligence technology. The full penetration of the network in society is bound to form a continuous digital mapping of the real world because only through digital collection and construction can interactive transmission be carried out on the network. It can be said that networking is the main thread of the digital process.

Enhancing visual authenticity and vividness enables people to feel a stronger visual experience and psychological experience. In strengthening the information conveyed, we show design pays more attention to the relationship between virtual objects, the relationship between reality and objects in the virtual world, and the study of the way information is conveyed, rather than focusing on the relationship between real objects and people.

6. Conclusion

At present, the research of machine vision has not become a perfect subject, which has great significance compared with the research of human hearing. Human auditory system is an important channel of information second only to the visual system. It has superior performance in listening, sound and object discrimination, which is unmatched by computers. Aiming at the channel structure of the human auditory system for speech information processing, combined with the basic theory of developmental networks, this paper roughly simulates the human auditory system and establishes an artificial auditory model. Before the establishment of the model, this paper briefly introduces the structure and information processing pathway of the human auditory system, expounds the basic theory of developmental networks in detail, and finally explores the establishment of the model and the performance of the model.

The emergence and development of digital media have promoted the expansion of information communication from one-way communication to interactive two-way communication. Therefore, information communication design should not only pay attention to the link of information expression but also pay attention to the interactive process of information communication. In this way, as a part of the visual expression of information, visual communication design should not only express information through design forms but also consider the experience and emotion of information recipients or audiences to achieve the effectiveness of information transmission. The media

represented by the network has been popularized and applied, and all kinds of multimedia technology, interactive technology, and virtual reality technology have begun to enter people's lives, which provides a broader platform and unpredictable possibilities for visual design. Digital design software also provides more convenience for design. However, no matter how many technical forms are, they are just the carriers of ideas, and the blind worship of technology is not what we pursue. Therefore, designers need to travel with things not tired of technology, open up design thinking, pay attention to the thinking of the essence of design, and make meaningful design to promote the progress of human thought.

Data Availability

The data underlying the results presented in the study are available within the article.

Conflicts of Interest

The authors declare that they have no conflicts of interest.

Acknowledgments

This work was financially supported by the Science Foundation of Zhejiang Vocational Academy of Art (QNTD2020006).

References

[1] J. Zhang, Y. Zhou, K. Xia, Y. Jiang, and Y. Liu, "A novel automatic image segmentation method for Chinese literati paintings using multi-view fuzzy clustering technology," *Multimedia Systems*, vol. 26, no. 1, pp. 37–51, 2020.

[2] E. R. Hassan, M. Tahoun, and G. S. ElTaweel, "A robust computational DRM framework for protecting multimedia contents using AES and ECC," *Alexandria Engineering Journal*, vol. 59, no. 3, pp. 1275–1286, 2020.

[3] Y. Luo, "Evolved multimedia broadcast Multicast service in LTE along with cognitive radio on TV bands," *International Journal of Electronics Engineering Research*, vol. 11, no. 2, pp. 171–182, 2019.

[4] Y. Dongmei, "Fusion path of radio TV and digital network technology based on multimedia editing platform and paper media innovation," *Paper Asia*, vol. 2, no. 2, pp. 172–175, 2019.

[5] L. Meng, X. Zhao, and Y. Sun, "An advanced investigation and analysis of teaching innovation in universities based on digital multimedia technology," *Boletin Tecnico/Technical Bulletin*, vol. 55, no. 18, pp. 458–462, 2017.

[6] X. Li, "Optimization and development of city landscape design under the influence of digital multimedia technology," *Boletin Tecnico/Technical Bulletin*, vol. 55, no. 18, pp. 108–113, 2017.

[7] B. Wang and A. Wang, "An optimization model innovation for college student management based on multimedia network platform," *Boletin Tecnico/Technical Bulletin*, vol. 55, no. 8, pp. 195–202, 2017.

[8] X. Tang, J. Bian, and S. Liu, "Application of multimedia digital technology in traditional residence architectural analysis and protection," *Revista de la Facultad de Ingenieria*, vol. 32, no. 4, pp. 796–803, 2017.

[9] C. Inquimbert, P. Tramini, O. Romieu, and N. Giraudeau, "Pedagogical evaluation of digital technology to enhance dental student learning," *European Journal of Dermatology*, vol. 13, no. 01, pp. 053–057, 2019.

[10] E. Bonacini, "A survey on the digital enhancement of the archaeological sites on Google and a multimedia pilot project in the Agrigento Valley of the Temples in Sicily (Italy)," *International Journal of Internet Technology and Secured Transactions*, vol. 7, no. 1, p. 28, 2017.

[11] H. Yu, "Application analysis of new Internet multimedia technology in optimizing the ideological and political education system of college students," *Wireless Communications and Mobile Computing*, vol. 2021, no. 4, Article ID 5557343, pp. 1–12, 2021.

[12] E. Borba, A. G. Corrêa, R. D. D. Lopes, and M. Zuffo, "Usability in virtual reality: evaluating user experience with interactive archaeometry tools in digital simulations," *Multimedia Tools and Applications*, vol. 79, no. 5-6, pp. 3425–3447, 2020.

[13] Y. Zhang, X. Zhang, T. Zhang, and B. Yin, "Crowd motion editing based on mesh deformation," *International Journal of Data Mining and Bioinformatics*, vol. 2020, no. 3,Article ID 3634054, pp. 1–13, 2020.

[14] S. Bratt and L. Hodgins, "Towards the design of a digital fluency course - an exploratory study," *Journal of Educational Multimedia and Hypermedia*, vol. 28, no. 1, pp. 21–38, 2019.

[15] Y. Li, "Research and application of the teaching mode with the integration of multimedia technology and teaching management," *Agro Food Industry Hi-Tech*, vol. 28, no. 1, pp. 2764–2768, 2017.

[16] Q. Wang and X. Ji, "Research on the 3d animation design and model simulation optimization based on multimedia technology," *Boletin Tecnico/Technical Bulletin*, vol. 55, no. 6, pp. 541–547, 2017.

[17] K. Khamadi and A. Senoprabowo, "Adaptasi permainan tradisional mul-mulan ke dalam perancangan game design document," *ANDHARUPA: Jurnal Desain Komunikasi Visual & Multimedia*, vol. 4, no. 01, pp. 100–118, 2018.

[18] C. Yufu, "Application and value analysis optimization of multimedia virtual reality technology in urban gardens landscape design," *Boletin Tecnico/Technical Bulletin*, vol. 55, no. 15, pp. 219–226, 2017.

[19] A. Saad, K. Robin, S. B. O. Khan, and N. H. Ubaidullah, "The evaluation of user acceptance of an iban digital story telling (IDST) application among iban language teachers," *The International Journal of Multimedia & Its Applications*, vol. 9, no. 4/5/6, pp. 01–14, 2017.

[20] N. Alherbawi, Z. Shukur, and R. Sulaiman, "JPEG image classification in digital forensic via DCT coefficient analysis," *Multimedia Tools and Applications*, vol. 77, no. 10, pp. 12805–12835, 2018.

[21] X. Gong, W. Li, and W. Jing, "Blind extraction of digital watermarking algorithm for color images," *The International Journal of Multimedia & Its Applications*, vol. 13, no. 2, pp. 15–26, 2021.

[22] A. O. Isah, J. K. Alhassan, S. S. Olanrewaju, and E. F. Aminu, "Enhancing AES with time-bound and feedback artificial agent algorithms for security and tracking of multimedia data on transition," *International Journal of Cyber-Security and Digital Forensics*, vol. 6, no. 4, pp. 162–178, 2017.

[23] S. Zhang, L. Zhou, M. Lu, and Y. Wang, "Design and simulation of a target scene generator with a telecentric structure

in the image space," *Applied Optics*, vol. 58, no. 9, p. 2394, 2019.

[24] J. K. H. Martin, A. M. Stromberg, M. Chen, and M. I. Mizuko, "Comparing embedded and non-embedded visual scene displays for one adult diagnosed with autism spectrum disorder: a clinical application of single case design," *Child Language Teaching and Therapy*, vol. 36, no. 1, pp. 3–18, 2020.

[25] Y. Xiaozhou, B. Fan, and P. Jones, "Recognition method of outdoor design scene based on support vector machine and feature fusion," *Journal of Intelligent and Fuzzy Systems*, vol. 39, no. 6, pp. 8757–8766, 2020.

[26] F. Aliyu and C. A. Talib, "Virtual reality technology," *Asia Proceedings of Social Sciences*, vol. 4, no. 3, pp. 66–68, 2019.

Hindawi
Mobile Information Systems
Volume 2023, Article ID 9764723, 1 page
https://doi.org/10.1155/2023/9764723

Retraction

Retracted: Construction Scheme of Quantitative Assessment of College Teachers' Performance Based on Big Data Analysis

Mobile Information Systems

Received 1 August 2023; Accepted 1 August 2023; Published 2 August 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. Zheng and C. Sun, "Construction Scheme of Quantitative Assessment of College Teachers' Performance Based on Big Data Analysis," *Mobile Information Systems*, vol. 2022, Article ID 8373164, 10 pages, 2022.

Hindawi
Mobile Information Systems
Volume 2022, Article ID 8373164, 10 pages
https://doi.org/10.1155/2022/8373164

Research Article

Construction Scheme of Quantitative Assessment of College Teachers' Performance Based on Big Data Analysis

Yi Zheng and Chuan Sun

Hubei University of Education, Wuhan 430205, Hubei, China

Correspondence should be addressed to Yi Zheng; zhengyi2@hue.edu.cn

Received 15 March 2022; Revised 22 April 2022; Accepted 31 May 2022; Published 6 July 2022

Academic Editor: Liming Chen

Big data is widely used for its large capacity. Performance appraisal is the evaluation of work, which can serve as a warning and motivation for employees. College teachers play an important role in the development of higher education. How to realize the rational use of college resources is a problem that needs to be solved urgently. This paper aims to study the construction scheme of quantitative assessment of college teachers' performance based on big data analysis, and use big data analysis methods to make more scientific and reasonable performance assessment methods. Based on the research of relevant theories, this paper analyzes the characteristics and existing problems of the performance appraisal system of college teachers according to the current situation of college teachers' performance appraisal. In addition, considering the particularity of college teachers, based on questionnaires and field interviews to understand their assessment status and teachers' expectations for assessment; based on the construction principles of college teachers' performance assessment system, a college teacher performance assessment system is constructed. The experimental results of this paper show that 140 people believe that performance appraisal is related to salary, accounting for 35% of the total number of teachers. This data shows that the correlation between performance appraisal and salary is relatively high.

1. Introduction

Education directly contributes to the growth of national economy and the advance of S&T, especially the higher education, which provides huge human resources and material wealth to the society. In the process of cultivating talents, teachers in colleges and universities determine to a certain extent whether the school can cultivate outstanding talents. Therefore, how to motivate and spur teachers through quantitative assessment is an important content of college reform. The emergence of the reform and opening-up policy has provided opportunities for the development of China's economy and technology. In the process of development, data has become an indispensable part of it. This paper aims to study the construction scheme of quantitative assessment of college teachers' performance based on big data analysis, and use big data analysis methods to make more scientific and reasonable performance assessment methods.

Teachers, as an essential part of the tertiary sector, can be fully motivated and motivated if their role is fully exploited, and cultivate more talents. The implementation of performance appraisal facilitates the developmental review of teachers, the growth of their professionalism, and the quality of education.

This paper presents an analysis of the proposed system, which has a very good role in promoting the strengthening of the teaching staff of the college. The topic selection is based on the performance assessment of college teachers, and the quantitative assessment is introduced into the assessment of college teachers' teams, which puts forward new ideas for improving the teacher assessment system. Combined with the characteristics of college teachers' positions and work characteristics, according to the current situation of college teachers' performance assessment, a teacher performance assessment index system suitable for the characteristics of colleges and universities is established.

2. Related Work

As an important means of enterprise inspection work, performance appraisal is conducive to the scientific development of enterprise work. As a special enterprise in colleges and universities, teachers' performance appraisal is also very important. Abell *T* N aims to provide an analysis of the FA practice of chemistry teachers through the lens of the chemistry frame of mind. Two groups of middle and high school science teachers participated in a year-long professional development aimed at enhancing their FA practice in teaching chemistry. To develop a methodology used in ongoing research to analyze teacher progress throughout the year, he provides an analysis of the participants' final FA portfolio chapters to describe the FA task design, the purpose for which teachers implement FA, and how teachers evaluate students' work. The experiment revealed a pattern that echoes broader research in science education, but with instantiation in chemistry [1]. The study described by Schafer A assessed item responses by identifying patterns of teacher attention. Results show that comparing the two can reveal potential targets for formative assessment of responses [2]. Deng and Deng studied the results of teaching evaluation of science and technology undergraduates and directed students to pay attention to the main contents of science and technology courses that are highly related to teaching outcomes. Based on factor analysis, he used association rules to obtain high correlations among three factors and found that students studying science and technology courses focused on [3]. The current research on PPDM mainly focuses on how to reduce the privacy risks brought by data mining operations, but actually in data collection, data release, and information (ie, data mining results) delivery. Xu takes a broader perspective on privacy issues related to data mining and studies various methods that help protect sensitive information. For each type of user, he discusses his privacy concerns and the methods he can use to protect sensitive information. He briefly introduces the basics of related research topics, reviews state-of-the-art methods, and presents some preliminary ideas for future research directions [4]. Based on the effect of historical time, Wu classified the samples. To solve the related problems, he integrated the bagging-based ensemble method into back propagation [5].Li envisions these challenges for feature selection in big data analytics. He first introduces feature selection, and then details the structuring problem. Finally, to facilitate and improve the research on feature selection, he proposes an open source feature selection library containing feature selection algorithms [6]. The proliferation of networks of all types has made the types, problems, and problems of big data more varied than ever. Chi Lu reviews the latest research on the types of data associated with Big Data on the Web. He concludes with a summary of Big Data trends and evolutions to anticipate ongoing and upcoming issues [7].While these theories go some way to elaborating on big data and teacher performance appraisal, there is less of a link between the two to achieve meaningful results.

3. Construction Method of Quantitative Assessment of College Teachers' Performance Based on Big Data Analysis

3.1. Performance Overview. Performance is a very important part of business management and is a view of how employees are doing as a whole [8, 9]. In practical terms, performance can be divided into a variety of different elements depending on the situation and it can be influenced by the individual employee's abilities, resulting in different outcomes [10, 11].

Performance appraisal is an effective means to check the quality of employees' work, which is usually measured in years in practice [12]. Through performance appraisal, we can know the actual ability and inadequacy of the staff, and understand the gap with the organizational goal, so as to improve the work and improve the work efficiency [13]. Teacher performance appraisal refers to a series of behavioral evaluations of college staff in the organizational environment of colleges and universities. It includes teachers' own morality, work attitude, teaching quality, scientific research quantity, etc. Through these evaluations, it is determined whether the teaching staff meet the post standards, so as to promote the enthusiasm of the teaching staff and achieve the organizational goals of the university [14, 15]. In the performance appraisal, teachers should follow the principle of openness to enhance the transparency of the assessment work; the principle of goal consistency, to provide teachers with a guide, so that teachers can give full play to their important role in the work process; the principle of feasibility and practicality.Figure 1 is a schematic diagram of stakeholders.

There are two types of performance appraisals in the organization. Formal appraisals are carried out on a regular basis, with clear rules and clear goals. Informal assessment does not have a specific assessment date, and the purpose is not unique. The common informal assessments include verbal praise and encouragement from supervisors to employees [16, 17]. Performance can exist in many ways. For example, in a PPP project, performance is broken down into two components. For firms, performance is an important indication of profitability. For governments, performance is a method of comparison[18]. The properties intrinsic to PPP items dictate that when conducting performance evaluation, attention should be paid not only to the balance between investment and delivery, but also to the public and utility nature of PPP items.Due to the particularity of the teaching profession in colleges and universities, teachers are different from the performance assessment of other organizations while emphasizing their conduct and performance, and have higher requirements in terms of teaching ability and knowledge reserve [19].The human capital investment of college teachers is larger than that of other industries; the sense of achievement needs of college teachers is strong; the labor objects of college teachers are complex and special; the realization cycle of labor value results of college teachers is long.

3.2. Data Mining Technology. Data mining is a method of obtaining information on data resources. It is used in a total variety of ways, driven by IoT technology.Data mining technology finds useful information from massive data and provides decision-making assistance to decision-makers. Introduce data mining technology into the field of performance appraisal, through a variety of data mining techniques, to find out the potential factors that affect teachers' performance appraisal, so as to provide relevant information for relevant functional departments, promote teachers' teaching, scientific research and other work to be better carried out, improve teaching and learning. and research service quality.The decision tree is an information analysis tool, which is output in the form of nodes and they represent different information. The concrete architecture is displayed in Figure 2.

The poor information representation of the raw data, which we represent as a function of

$$G(C) = L(c_1)P(c_1) + L(c_2)P(c_2) + \ldots + L(c_l)P(c_l) = -\sum_{v}^{l} L(c_v)\log_2 L(c_v). \tag{1}$$

When $L(c_1) = L(c_2)$, $G(C) = 1$.

$$\begin{aligned} p(l,v) &= -\frac{l}{l+v}\log_2\frac{l}{l+v} - \frac{v}{l+v}\log_2\frac{v}{l+v}, \\ U(R) &= \sum_{K}^{s}\frac{f_k + l_k}{f+l} j(f_k, l_k). \end{aligned} \tag{2}$$

Here B stands for the set of copies, j for the message desired and $U(R)$ for the mean message desired.

$$\text{Info}(P) = -\sum_{1}^{O} K_V \log_3(K_V), \tag{3}$$

where K_V stands for the share of the representative specimen in the total number of persons.

$$\begin{aligned} \text{Info}_x(S) &= \sum_{1}^{o}\frac{|S_1|}{|S|} * \text{Info}(S), \\ \text{Gaint}(S) &= \text{Info}(S) - \text{Info}_X(S), \\ W_a &= \alpha + \beta W_{a-1} + \delta_a, \end{aligned} \tag{4}$$

where W_a is the need, β is the variation among needs and α is a constraint.

In order to analyze the data objectively, we need to analyze the data in detail, and compare the first-level elements to quantitative description:

$$W = (w_{op}) = \begin{bmatrix} w_{11} & w_{12} & \cdots & \text{w}_{1\text{k}} \\ w_{21} & w_{22} & \cdots & \text{w}_{2\text{k}} \\ w_{31} & w_{32} & \cdots & \text{w}_{3\text{k}} \end{bmatrix}. \tag{5}$$

Formula (5) represents the judgment matrix function expression.

$$w_{op} = h(o = 1, 2, \ldots, t). \tag{6}$$

$$w_{op} = \frac{h}{w_{op}} (p = 1, 2, \ldots, t). \tag{7}$$

$$w_{op} = \frac{y_{ou}}{r_{pu}} (o, p = 1, 2, \ldots, t). \tag{8}$$

Formulas (6)–(8) represent matrix properties, and when the matrix elements are completely consistent with the above function expressions, it indicates that the constructed matrix is consistent.

$$\begin{aligned} \overline{W}_a &= \frac{\sum_s^{a-1} W_a}{s}, \\ F_a^3 &= \frac{\sum_j^{a-1}\left(W_j - \overline{W}_j\right)^3}{j-2}. \end{aligned} \tag{9}$$

$$\text{New\_}R(U, C_s) = \sum_{c}\frac{|U_l|}{|U|} R(U_l). \tag{10}$$

Equation (10) shows the sub-tree expression as a function of water density, and U_l shows the profile of the properties of the model.

$$\begin{aligned} G(V) &= P(K,T) - U(V), \\ P(O_Q) &= -\sum_{E}^{x} L_E \log_2(L_E), \\ \eta_u &= T_{(\text{u})} * T_{(\text{u}-1)} \ldots T_{(3)} * T_{(2)}, \end{aligned} \tag{11}$$

where $\eta_{(\text{u})}$ represents the column vector matrix of elements in the uth layer.

$$\begin{aligned} YK^{(u)} &= \left(YK_1^{(u)}, \ldots YK_k^{(u)}\right) * \eta^{(u-1)}, \\ MK^{(u)} &= \left(MK_1^{(u)}, \ldots MK_k^{(u)}\right) * \eta^{(u-1)}, \\ YM^{(u)} &= \left(YM_1^{(u-1)} + \frac{YK^{(u)}}{MK^{(u)}}\right). \end{aligned} \tag{12}$$

If the scheme layer combines the consistency ratio $YM^{(u)} < 0.1$, it means that the matrix passes the consistency test, and vice versa.

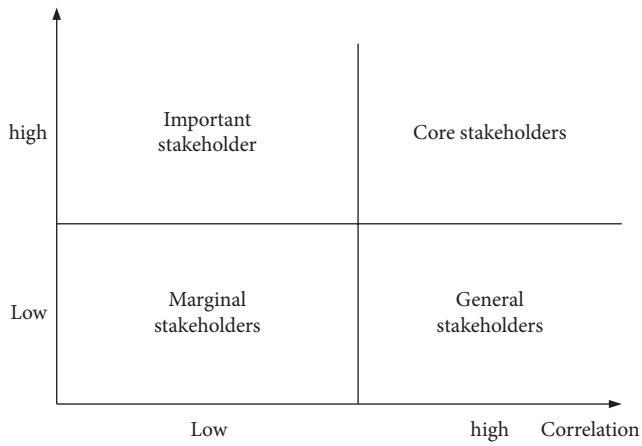


Figure 1: Two-dimensional map of PPP project stakeholders.

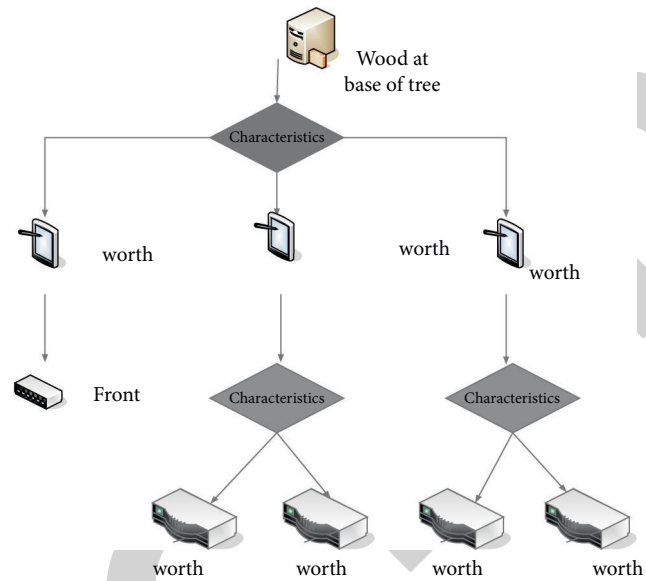


Figure 2: Decision tree structure.

3.3. Overview of Big Data. There is still no single explanation for Big Data, but our society is closely related to it. Figure 3 shows a diagram of the Big Data structure.

We are in the era of knowledge economy, time is money, finding the right solution to get the best value for you in the shortest possible time is a hot topic of current research. DMX technology can find out the critical pieces of data from the huge amount of data and get the latent value of the information. Since the IOT technology has been promoted, big data has become more and more abundant in daily life, and its application scope has been continuously expanded. The structure of the big data system is shown in Figure 4.

As sensor engineering evolves, the increasing amount of data collected drives the concept of ubiquitous connectivity for the IoT, connecting every object at all times. Processing data is a complex process that requires different processing procedures to be prepared for various cases. The structure of data pre-processing is illustrated in Figure 5.

As the growth of big digital data, big data technology has begun to be combined with the field of social production, such as the combination of big data and cloud computing, and the combination of big data and environmental monitoring. The use of big data can achieve effective processing of performance data to a certain extent, and then realize the smooth progress of human resources performance appraisal. Adjust the method of performance appraisal work to provide reliable support for the development of teachers' work.- Insufficient understanding and implementation of the current performance assessment in colleges and universities and its indicators, weights, processes, etc.; the design of assessment indicators is not standardized and rigorous enough.[30]. There are many factors that affect protection, as shown in Figure 6.

4. Construction Experiment of Quantitative Assessment of College Teachers' Performance Based on Big Data Analysis

4.1. Data Mining Data. The focus of this paper is the performance evaluation of college teachers. In order to collect the number and basic situation of teachers in colleges and universities, we have investigated the basic situation of teachers in a college in A, the specific situation is as follows:

According to the data in Table 1, we have investigated the situation of teachers in place A. According to the classification, we have divided teachers into four categories: teaching assistants, lecturers, associate professors and professors, and conducted a comprehensive analysis of teachers with four professional titles. According to the specific data, most of the teaching assistants have master's degrees, the teaching experience is generally about 4 years, and the average evaluation score is 67. Most of the lecturers have a bachelor's degree, and their teaching experience is generally about 12 years. The average assessment score is 69. Most of the associate professors have doctoral degrees, and their teaching experience is generally around 29 years. The average assessment score is 88. Most of the professors have master's degrees, and the teaching experience is generally about 23 years. The average evaluation score is 85. According to the survey data, the evaluation scores of college teachers will increase with the increase of teaching age, which is related to the teaching experience of college teachers.

According to the data in Table 2, we have subdivided the weight of the performance appraisal of college teachers. In the whole weight division, it is divided into teacher morality, academic qualifications and basic quality. Teachers' morality accounts for 35%, academic qualifications account for 35%, and teachers' basic quality accounts for 30%. We have subdivided teachers' morality, of which ideological style accounts for 33%, moral cultivation accounts for 39%, and collaboration ability among teachers accounts for 15%, teachers' participation in public welfare activities accounted for 8%, and discipline compliance accounted for 5%. In the education classification, the first degree accounted for 32%, the final degree accounted for 40%, and the further education accounted for 28%. In the basic quality classification, the foreign language level accounts for 30%, the technical

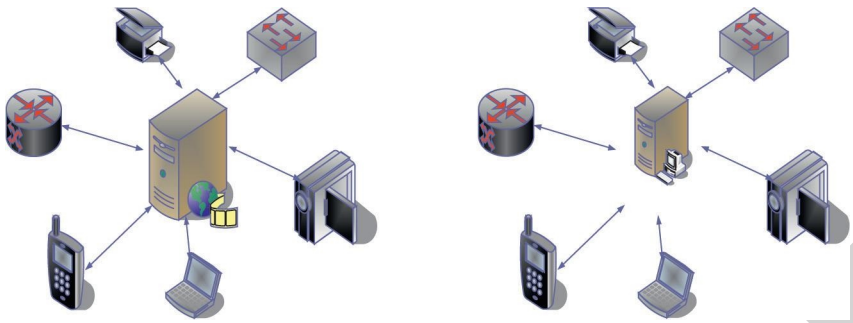


Figure 3: Big data structure diagram.

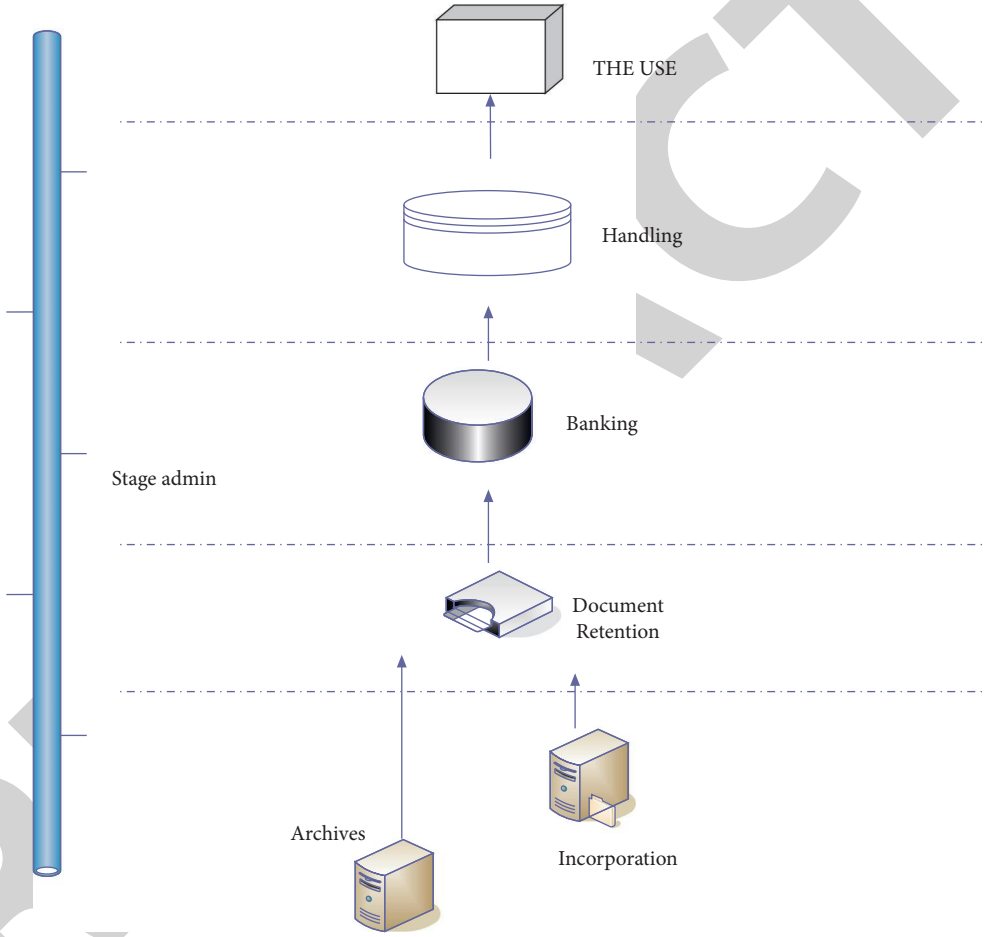


Figure 4: Big data system structure.

application ability accounts for 30%, and the double-qualification situation accounts for 40%. According to the data, it can be seen that teachers' ideological and moral style and educational background are more important, in addition, teachers' ability to unite and cooperate is also more important.

4.2. Preparation of Teachers' Lesson Plans. Lesson plans are the basis of teachers' teaching, and teachers' different standards for lesson plan preparation reflect teachers' different teaching attitudes. In order to explore the teachers in place A, we analyzed the situation of the teachers, the specific situation is as follows:

According to the data in Table 3, we classified the preparation level of the teaching plan when assessing the teacher's teaching plan, and divided the teaching plan into four categories: excellent, good, pass, and poor. At the same time, the different components of the lesson plan are subdivided. When the readiness of the components of the lesson plan is less than 0, the comprehensive assessment results are 82, 65, 43 and 16 respectively. When the readiness level of the components of the lesson plan is 0–15, the

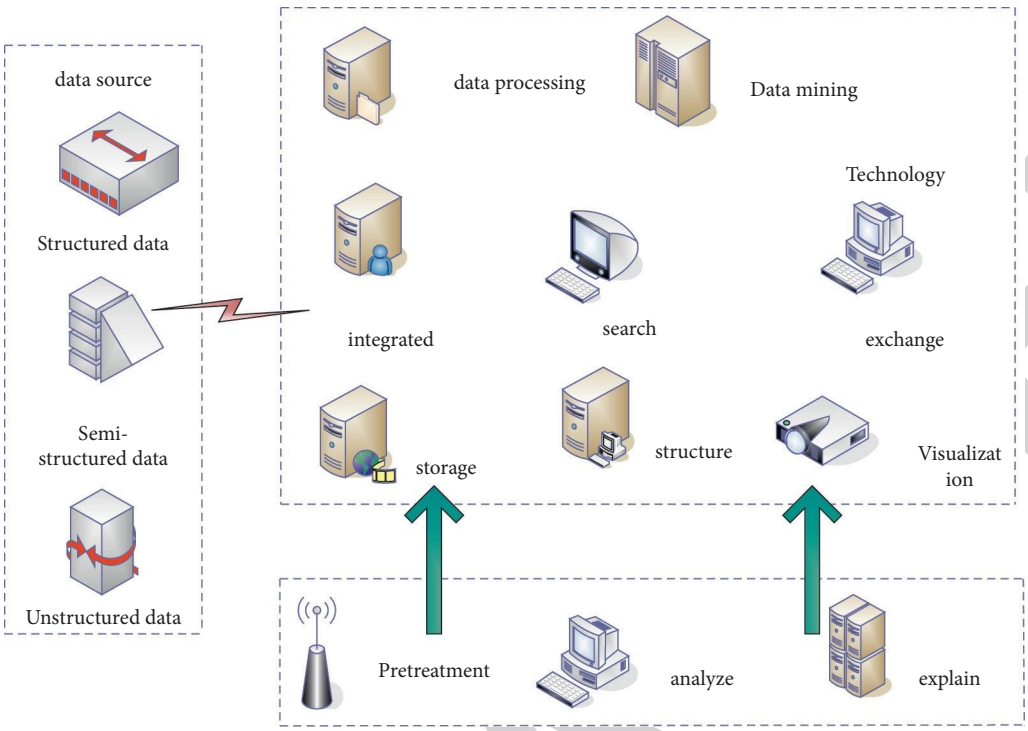


Figure 5: Data pre-processing structure.

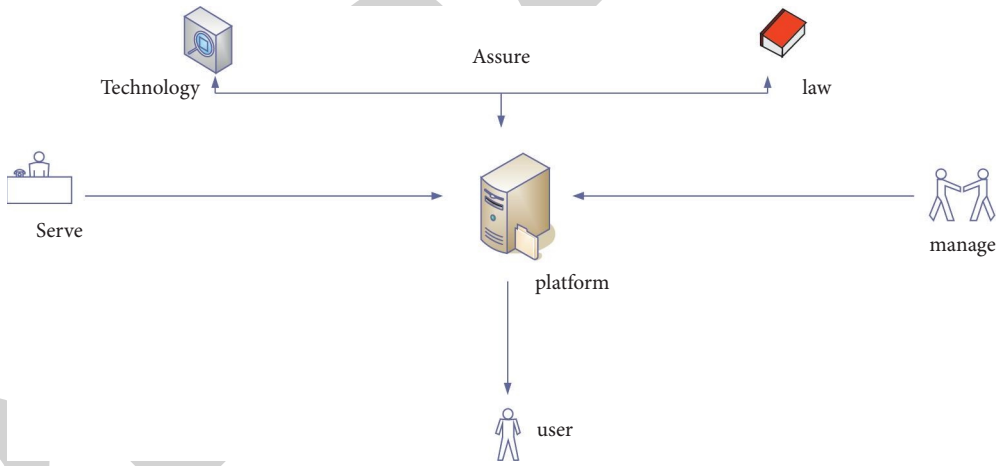


Figure 6: Privacy security factors.

Table 1: Basic information of teachers in colleges and universities in A.

Title	Academic qualifications	Teaching experience	Rating score
Assistant professor	Master	4	67
Lecturer	Bachelors	12	69
Associate professor	PhD	29	88
Professor	Master	23	85

comprehensive assessment results are 87, 72, 52 and 27 respectively. When the preparation level of the components of the lesson plan is 15–30, the comprehensive assessment results are 91, 78, 63 and 42 respectively. When the preparation level of the components of the lesson plan is 30–60, the comprehensive assessment results are 93, 82, 67 and 55 respectively. When the preparation level of the components of the lesson plan is greater than 60, the comprehensive assessment results are 95, 89, 78 and 65 respectively.

4.3. Attendance Assessment. In addition to students' attendance assessment, teachers' attendance is also an important part of the assessment. In order to explore the teachers in place A, we have analyzed the teachers' attendance. The details are as follows:

Table 2: Performance assessment weights of university teachers' positions.

Indicators	Weighting (%)	Indicators	Weighting (%)
		Ideological style	33
		Moral cultivation	39
Teacher ethics	35	Collaboration	15
		Public welfare activities	8
		Discipline	5
		First degree	32
Academic qualifications	35	Last degree	40
		Further education	28
		Foreign language level	30
Basic qualifications	30	Technical ability	30
		Dual teacher status	40

Table 3: Preparation of teachers' lesson plans.

Level of lesson plan preparation		Comprehensive assessment			
		Excellent	Good	Pass	Poor
Ringgit improvement ratio	<0	82	65	43	16
	0–15	87	72	52	27
	15–30	91	78	63	42
	30–60	93	82	67	55
	>60	95	89	78	65

Table 4: Attendance assessment.

Attendance		Comprehensive assessment of attendance			
		Excellent	Good	Pass	Poor
Absence frequency	>4	83	65	43	13
	2–4	92	73	53	42
	<2	99	86	67	58

According to the situation in Table 4, we classified the frequency of absenteeism when assessing teachers' absenteeism, and divided absenteeism into four categories: excellent, good, pass, and poor. At the same time, the frequency of absenteeism was subdivided. When the absences were more than 4 times, the comprehensive assessments were 83, 65, 43 and 13 respectively. When there are 2–4 absences, the comprehensive assessment is 92, 73, 53 and 42 respectively. When the absences were less than 2 times, the comprehensive assessments were 99, 86, 67 and 58 respectively. According to this data, the higher the absenteeism frequency of teachers, the lower the comprehensive examination score.

5. Construction Scheme of Quantitative Assessment of College Teachers' Performance Based on Big Data Analysis

5.1. Current Situation of Teachers in Colleges and Universities. College teachers are an important part of the activities of colleges and universities. In order to evaluate the performance of college teachers, we need to analyze the basic situation of college teachers.

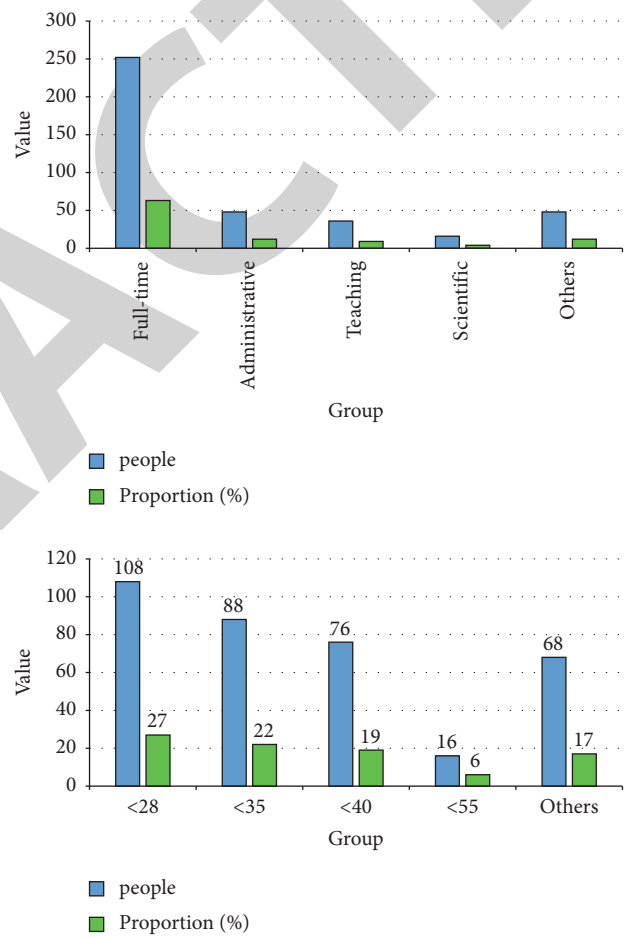


Figure 7: Basic situation analysis of university teachers.

According to the data in Figure 7, there are 252 full-time teachers in place A, accounting for 63%, and 48 administrative staff, accounting for 12%. There are 36 teaching assistants, accounting for 9%, 16 scientific researchers, accounting for 4%, and 48 other teaching staff, accounting for 12%. According to the data, there are many teaching staff in colleges and universities, of which the proportion of full-time teachers is the highest, and the proportion of scientific research personnel is the least. From this data, it can be seen that there are fewer scientific research talents and more faculty members in colleges and universities.

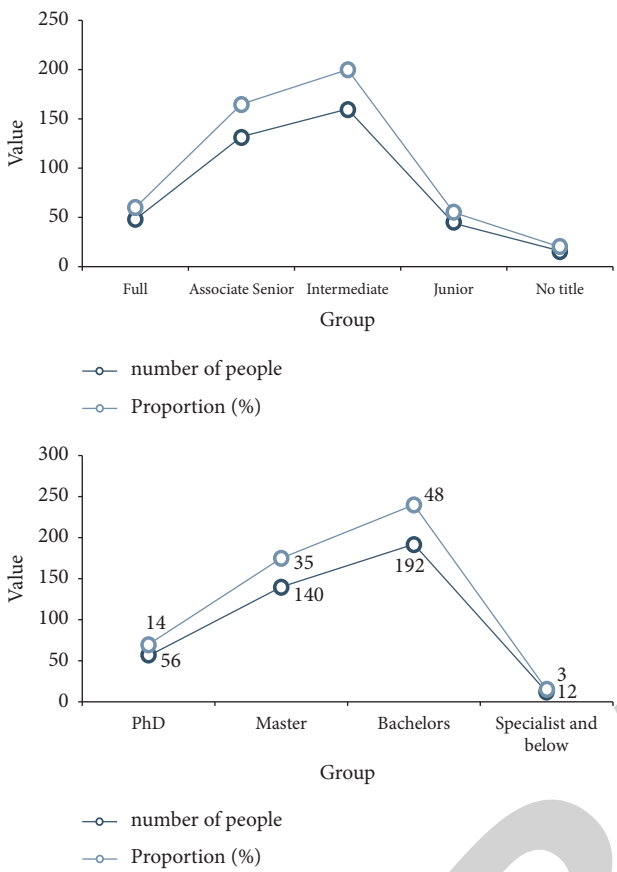


Figure 8: Distribution of university teachers' education.

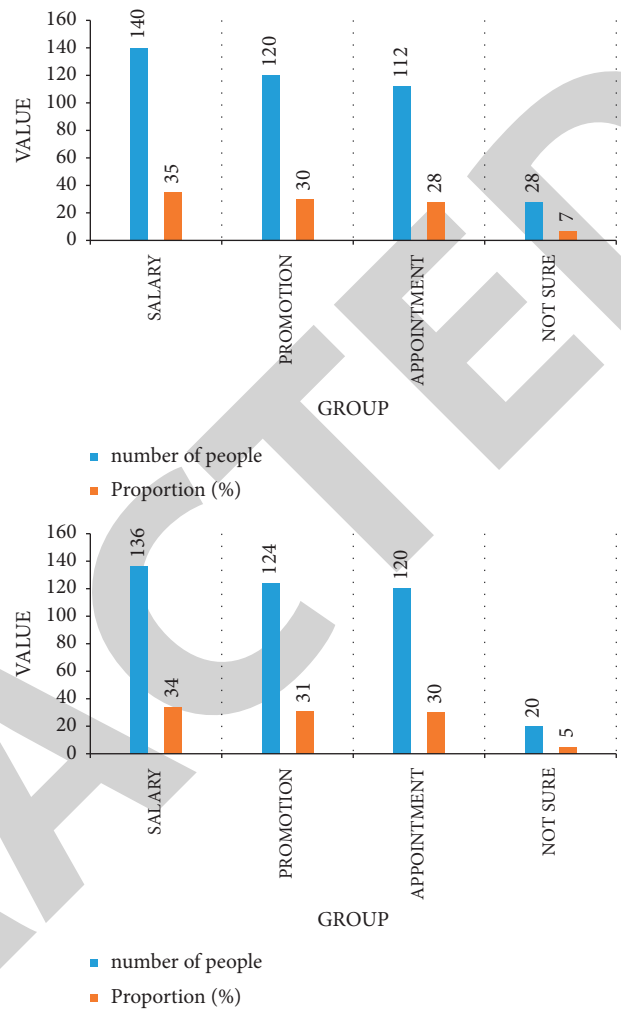


Figure 9: Performance appraisal impact analysis.

Teachers in colleges and universities are an important part of educating students. In order to investigate the age of teachers, we divide them into categories such as less than 28 years old, less than 35 years old, less than 40 years old, less than 55 years old and others. According to the specific data, there are 108 teachers under the age of 28 in place A, accounting for 27%, and 88 teachers under the age of 35, accounting for 22%. There are 76 teachers younger than 40 years old, accounting for 19%, 16 teachers younger than 55 years old, accounting for 6%, and 68 teachers older than 55 years old, accounting for 17%. According to the data, with the continuous development of the teaching team, more and more young people have joined the teaching team, which will inject fresh blood into the entire teaching team.

According to the data in Figure 8, in order to understand the teaching status of college employees, we investigated the teachers' professional titles in place A. Among them, there are 48 senior teachers, 12% of instructors, 132 associate senior teachers (33% of instructors). There were 160 intermediate teachers, 40% of faculty, 44 junior teachers, 11% of faculty, and 16 teachers without a title, 4% of faculty. Based on the information, the proportion of intermediate teachers is the highest, and the number of senior and junior titles is less.

In addition to the survey of the professional titles of college teachers, we also surveyed the academic qualifications of teachers. Among them, 56 have doctoral degrees, 14% of faculty, 140 have a master's degree, 35% of faculty. 192 teachers have a bachelor's degree, 48% of faculty, and 12 have a college degree or less, 3% of faculty members. The data shows that the highest percentage of teachers have a bachelor's degree, including more middle-aged teachers, which can promote the further study of in-service teachers. The proportion of teachers with a junior college or below is the lowest, indicating that college teachers have higher and higher requirements for academic qualifications, which also shows that the overall academic qualifications of the entire industry have generally increased.

5.2. Impact of Performance Appraisal. Performance appraisal can not only check the work situation of employees, but also motivate employees, but if performance appraisal is not scientific, it may also have the opposite effect.

According to the data in Figure 9, we have analyzed the assessments implemented in colleges and universities and conducted interviews with local teachers. Among them, 140 think that performance appraisal is related to salary, 35% of judges, 120 (30% of teachers) thought that performance appraisal was related to promotion. One hundred and twelve thought that performance appraisal was related to employment, 28% of instructors, and 28 were unclear about the

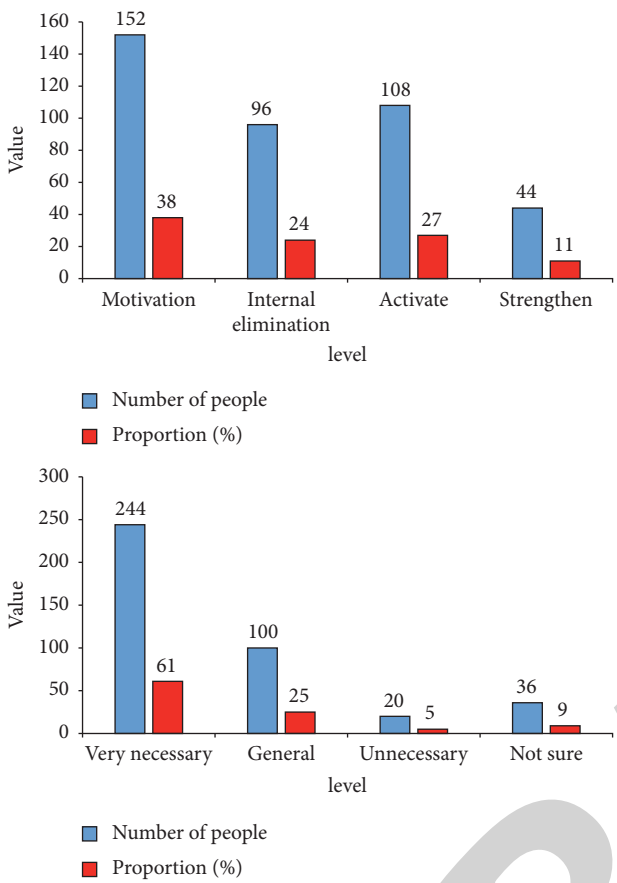


Figure 10: Analysis of the role of teacher performance appraisal.

factors influencing performance appraisal, 5% of instructors. The data show that in those universities where the appointment system for university teachers is in place, there is no focus on linking the results of performance appraisals to the appointment of teachers, which is an appointment system that does not live up to its name. However, according to survey research, not all performance appraisals have a clear purpose.

In addition to the influencing factors of performance appraisal, we also investigated which factors are related to teachers' expectation of performance appraisal results. According to the survey data, 136 teachers expect the assessment results to be related to their salary, 34% of instructors, 124 instructors, or 31% of instructors, expected assessment results to be related to promotion. One hundred and twenty teachers, or 30% of instructors, expected assessment results to be related to appointment, and twenty teachers, or 5% of instructors, had no clear requirements for assessment or promotion. Based on the data, performance appraisal needs to combine the strategic positioning of different universities and the management of teachers to formulate a performance appraisal system that conforms to their own development.

5.3. The Role of Teacher Performance Appraisal. According to the data in Figure 10, in order to investigate the role of performance appraisal in colleges and universities, we surveyed teachers in local colleges and universities. Among them, 152 people think that performance appraisal will mobilize the enthusiasm of teachers, accounting for 38%. There are 96 people believe that performance appraisal will introduce external competition, lead to internal elimination, and improve the local teaching level of teachers, accounting for 24%. There are 108 people believe that performance appraisal will stimulate the personnel mechanism in colleges and universities, accounting for 27%, and 44 people think that performance appraisal can better complete supervision and management, accounting for 11%. According to the data, in the whole performance effect, mobilizing teachers' enthusiasm accounts for the highest proportion, indicating that the motivational effect of performance analysis is very obvious.

According to the current performance appraisal situation, 244 people believe that the current appraisal system needs to be rectified, accounting for 61%. There are 100 people think that the current assessment system is very general, accounting for 25%. There are 20 people think that the current appraisal system does not need to be rectified, accounting for 5%, and 36 people have no opinion on the current performance appraisal system, accounting for 9%. According to the data, most employees in colleges and universities believe that the current performance appraisal system needs to be rectified.

6. Conclusions

The problem of cultivating engineering talents in the 21st century is a key issue in the industrial development and international competition of various countries. With the development of the socialist economy with Chinese characteristics, the current society pays more and more attention to the quality of education, and teachers, as an important part of colleges and universities, are of great significance to the education of students. This paper aims to study the construction scheme of quantitative assessment of college teachers' performance based on big data analysis, and use big data analysis methods to make more scientific and reasonable performance assessment methods. Although this paper explores the performance appraisal of college teachers, there are still some shortcomings: (1) Colleges and universities are in the process of continuous development and improvement, and talent management should also be constantly transformed, which is not mentioned in this part of the article. (2) How to improve teachers' own moral construction and make moral construction and system construction develop together is difficult in practice.

Data Availability

No data were used to support this study.

Conflicts of Interest

The authors declare that there are no conflicts of interest regarding the publication of this article.

Hindawi
Mobile Information Systems
Volume 2022, Article ID 8125969, 5 pages
https://doi.org/10.1155/2022/8125969

Research Article

Image Recognition Algorithm Based on Artificial Intelligence and Machine Learning

Lipeng Si, Baolong Liu, and Yanfang Fu

School of Computer Science and Engineering, Xi'an Technological University, Xi'an 710021, Shaanxi, China

Correspondence should be addressed to Lipeng Si; silipeng@xatu.edu.cn

Received 23 March 2022; Revised 20 April 2022; Accepted 25 May 2022; Published 5 July 2022

Academic Editor: Liming Chen

At present, most of the existing image recognition methods are not only cumbersome in process but also require manual design of functions, resulting in poor recognition results and time-consuming training. This study explores image recognition algorithms based on artificial intelligence and machine learning, which can simulate the hierarchical structure of the human brain and nervous system, realize automatic extraction of complex features, and have powerful data representation capabilities. In this study, the structure of artificial neuron is introduced first, and the training process of the neural network is introduced in detail. At the same time, this study improves the traditional training algorithm and proposes two new machine learning models for different application scenarios, which effectively improves the performance of the optimal model. In relevant tests, the effect is significant. On the basis of these improved algorithms, an online recognition system is designed and implemented. The recognition accuracy rate of the system for the hidden layer reaches more than 90%, which verifies the effectiveness of the technology. At the same time, after repeated experiments, the results show that the multiview algorithm effectively solves the problem that the recognition results of the traditional multiview algorithm are affected by the size of the target contour.

1. Introduction

Image recognition is the input image obtained from vision. Through a series of calculation, analysis, and learning processes, the object recognition in the scene, the description of the relationship between the objects in the scene, and the recognition of the scene are obtained [1]. In short, image recognition. It is to use computers to realize human's visual understanding of images, for example, fingerprint recognition technology, face detection, and recognition technology in various embedded systems such as smart phones and tablet computers [2]; surface defect detection technology and product shape recognition technology in industrial automated inspection systems [3]; robot vision in artificial intelligence, autonomous driving of unmanned cars, and automatic human-machine tracking [4]; and military target tracking, missile guidance, and air remote sensing [5]. Nowadays, the demand for intelligent automation equipment and instruments is becoming more and more urgent [6].

Generally speaking, the existing image recognition methods can be divided into methods based on expert knowledge and methods based on machine automatic learning [7, 8]. In contrast, machine-based automatic learning methods are based on the "machine" self-learning ability [9]. The idea is to design machines with self-learning capabilities by relying as little as possible on "human" experience [10]. For example, given only the structure of the machine and some simple operation measures, the machine can automatically learn the specific rules hidden in the image data [11, 12]. Using "machines" instead of "humans" to learn can reduce the workload of manual design [13, 14]. Therefore, it is more common to rely on the advantages of "machines" in computing speed to solve these problems.

This study proposes a novel research direction of the image recognition algorithm, which can effectively improve the quality and effect of image recognition and can also provide new ideas for the research of artificial intelligence and machine learning technology.

2. Proposed Method

2.1. The Structure of Artificial Neurons. The artificial neural network can be regarded as a directed graph connected by directed weighted arcs with artificial neurons as nodes. The structure of the artificial neuron is shown in Figure 1.

If a local feature appears in one location, it may also appear in any other location. Mathematically, the operation of the feature map based on the convolution kernel corresponds to discrete convolution.

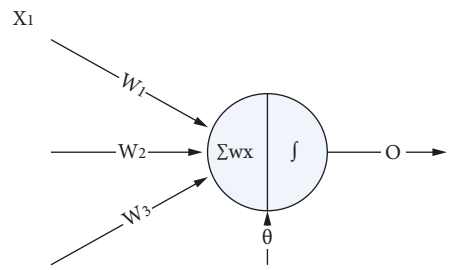


Figure 1: Structural diagram of an artificial neuron.

2.2. The Training Process of the Neural Network. By using the min-batch method, back propagation is performed to update the parameters in the neuron.

$$v_{n+1} = 0.85v_n - 0.001\alpha A - \left(\frac{\partial L}{\partial W}|w_n\right)D_n,$$
$$w_{n+1} = w_n + v_{n+1}. \tag{1}$$

The whole training process and training results are shown in Figure 2.

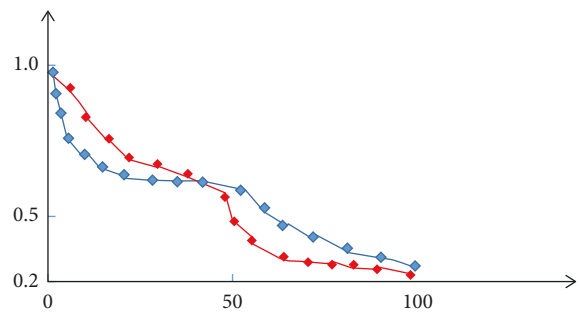


Figure 2: Training process of the deep neural network.

2.3. Neural Network Training Result Analysis. Based on the above learning model, the convolution kernel of the first layer of the neural network is obtained, as shown in Figure 3.

The segmentation training of the convolutional layer is not performed. In contrast, the overall performance of the model in this study is better. This article integrates multiple models and merges their output with postresort, as given in Table 1.

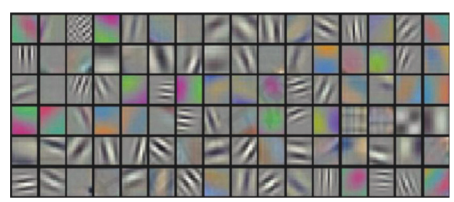


Figure 3: The convolution kernel graph obtained by training.

Table 1: Comparison of the methods in this study with other methods.

Model	p-1 error rate (%)	p-5 error rate (%)
Sparse coding	46.9	28.1
SIFT + FVs	45.2	25.5
1KCNN	40.5	18.5
1MyCNN	40.1	18.0
5MyCNN	37.5	17.1

2.4. Improvement of the Model

2.4.1. Optimizes with Optimizer. It is set at the beginning of training to initialize the cumulants of gradients and square cumulants.

$$v_{dw} = 0, v_{db} = 0; \quad s_{dw} = 0, s_{db} = 0. \tag{2}$$

Assuming that in the training phase of the t-round training, two basic momentum parameter updates can be calculated at first.

$$v_{dw} = \beta_1 v_{dw} + (1-\beta_1)dw,$$
$$v_{db} = \beta_1 v_{db} + (1-\beta_1)db,$$
$$s_{dw} = \beta_2 s_{dw} + (1-\beta_2)dw^2,$$
$$s_{db} = \beta_2 s_{db} + (1-\beta_2)db^2. \tag{3}$$

Since the average value of the moving index at the beginning of the iteration will cause a large difference between the initial value and the initial value, the deviation of the above value needs to be corrected.

$$v_{dw}^c = \frac{v_{dw}}{1-\beta_1^t},$$
$$v_{db}^c = \frac{v_{db}}{1-\beta_1^t},$$
$$s_{dw}^c = \frac{v_{dw}}{1-\beta_1^t},$$
$$s_{db}^c = \frac{v_{db}}{1-\beta_1^t}. \tag{4}$$

Through the above formula, the correction value of the cumulative parameter evaluation can be obtained in the t-round iteration process, and the weight and deviation can be updated.

$$w = w - a\frac{v_{dw}^{c}}{\sqrt{s_{dw}^{c} + \varepsilon}}. \quad (5)$$

In summary, the learning rate decay method can make the network's early training converge quickly, and in the later training, it can converge to the optimal value of the function to the greatest extent.

2.4.2. Improvement of the Multiview Method. By comparing the recognition error rates of different methods, Table 2 is obtained.

Observing the data in the table, we find that the error rate and accuracy of the improved algorithm are lower than those of the previous and traditional test methods. Of course, the improved algorithm is not perfect; it also has some problems, the number of improved images is too much, and the problem of frequent testing is unavoidable.

2.5. Level Classification Algorithm. The probability of misclassification of m and K are calculated by the following formulas. X is used to indicate the number of objects to be identified, and ε m and K are used to represent the frequency of misclassification of m to K.

$$\rho_{m,k} = \frac{\varepsilon_{m,k}}{\sum_{i+1}^{N} \varepsilon m, i}. \quad (6)$$

The principle of undirected graph $G = (V, E)$ is applied. A class is a node, the set of nodes is V, and the set of edges is E. The weight of the edge between two points is used as the probability value of the two classes. Then, use the global minimum cut algorithm to repeatedly find the global minimum cut on this graph, and then, we can get the set of errors that are easiest to classify, as given in Table 3.

3. Experiments

The platform used in the experiment is Python++Theano. SVM is used as the baseline test. Each pixel is used as the input of the SVM algorithm. We can test the effectiveness of the proposed method. Under the Java platform, use LIBSVM for testing.

3.1. The Number of Samples, the Number of Nodes, and the Number of Layers. This part of the experiment is based on the MATLAB R2009a computing platform, and the SVM classifier uses the LIBSVM toolbox. The number of training samples used in the experiment is 1000, and the number of test samples is 200. As given in Table 4. The image recognition network model is shown in Figure 4.

Two kinds of training samples and test samples are separately removed, and different hidden nodes and layers are selected to compare the effects of training samples, nodes, and layers. Among them, the training sample of Figure 5 is 1000, and the testing sample is 200.

Figure 6 shows the comparison of the prediction accuracy of this method and the CNN method for different hidden layer nodes when there are two hidden layers. The

Table 2: Comparison of recognition error rates for different test methods.

Model	p-1 error rate (%)	p-5 error rate (%)
CNN1	40.01	17.56
CNN5	37.52	17.40
Multiview 1	40.12	17.55
New multiview 1	38.54	18.12
Multiview 5	37.10	16.50
New multiview 5	36.50	16.00

Table 3: Basic classification and number of categories.

Basic classes on data sets	Number of corresponding subclasses
Dog	110
Cat	36
Car	49
Leaf	88
Aircraft	61
Handbag	25

Table 4: Number of samples.

Category	0	1	2	3	4	5	6	7	8
Training sample size	67	172	87	76	56	98	95	200	123
Number of samples tested	12	23	17	20	14	21	19	10	32
Training sample	479	663	588	593	635	534	501	550	462
Test sample	85	176	166	111	110	87	87	99	89

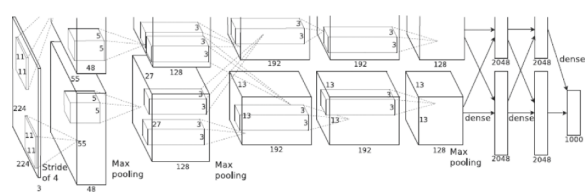


Figure 4: Network model of image recognition.

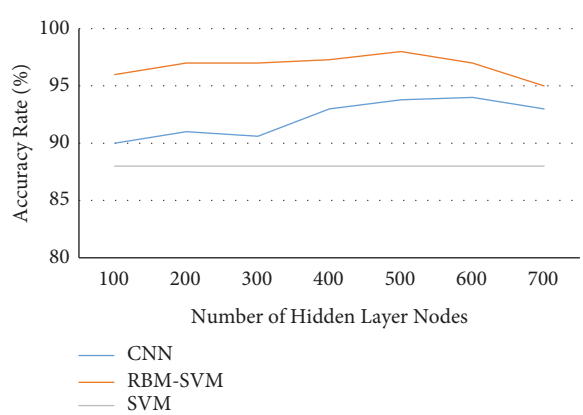


Figure 5: Prediction accuracy rate (%) of different methods in single hidden layer 1000/200.

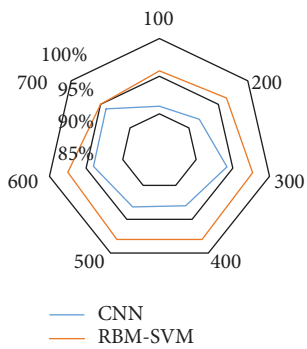


Figure 6: Prediction accuracy of two layers of the hidden layer (%).

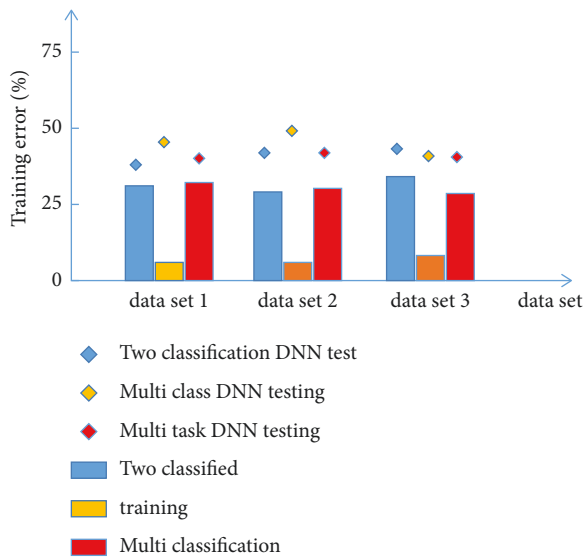


Figure 7: Two-class, multiclass, and multitask DNN experimental results.

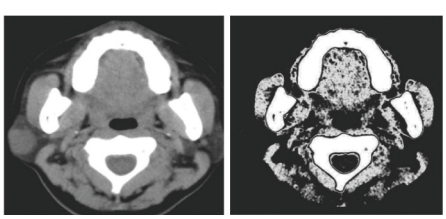


Figure 8: Noise reduction processing chart.

training sample is 5000, the test sample is 1000, and the number of the first layer hidden layer is 450.

4. Discussion

4.1. Experimental Comparison with Nondeep Learning Algorithms. As shown in Figure 7, the prediction probability of the class in the multiclass DNN is shown. The multiclass DNN performs the worst when the data are unevenly distributed.

From the processing results of Figures 8 and 9 (picture source network library), the performance of the multitask DNN based on ring training is stable, and the final results on different datasets can basically remain unchanged.

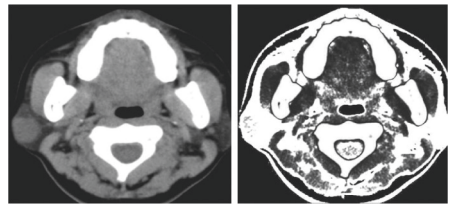


Figure 9: Boundary processing diagram.

5. Conclusions

In image recognition methods, artificial intelligence machine learning algorithms have the advantages of parallel processing, self-learning capabilities, and flexible nonlinear expression capabilities compared with traditional algorithms. This study proposes a multiview algorithm based on artificial intelligence machine learning. After repeated experiments, the results show that the multiview algorithm effectively solves the problem that the recognition result of the traditional multiview algorithm is affected by the size of the target contour. The structure of the traditional model is optimized, and some problems in the field of traditional image recognition are solved. Through the improvement of related algorithms, the error rate of image recognition is reduced, which has special reference significance for the design and development of related systems in the future.

There are still many deficiencies in the research of this study. The depth and breadth of the research in this study are not enough, and some interference factors involved in the practice of image recognition are not considered. The evaluation of the algorithm is also restricted by many factors. The level of research is also limited, and the research on image recognition algorithms is still in the preliminary stage. In the future work, based on the existing technology and level, we will improve the performance of recognition image recognition accuracy from more angles and continuously optimize the research method.

Data Availability

No data were used to support this study.

Conflicts of Interest

The authors declare that they have no conflicts of interest.

Acknowledgments

This work was supported by Science and Technology Program of Shaanxi Province. (2017XT-02) and International S&T Cooperation Program (2021KW-07).

References

[1] S. Kiakojoori and K. Khorasani, "Dynamie neural networks for jet EngineDegradation prediction and prognosis," in

Proceedings of the International Joint Conference on Neural Networks, pp. 2531–2538, Beijing, China, July 2015.

[2] S. Shatnyi, "Neural network-based information technology for biomedical signal processing," in *Proceedings of the International Conference on Microwaves, Radar, and Wireless Communication*, pp. 1–3, Gdansk, Poland, June 2016.

[3] J. Li, K. Ouazzane, H. B. Kazemian, and M. S. Afzal, "Neural network approaches for noisy language modeling," *IEEE Transactions on Neural Networks and Learning Systems*, vol. 24, no. 11, pp. 1773–1784, 2013.

[4] D. Reid, A. J. Hussain, and H. Tawfik, "Spiking neural networks for financial DataPrediction," in *Proceedings of the International Joint Conference on Neural Networks*, pp. 1–10, Dallas, TX, U.S.A, August 2017.

[5] B. H. Gary, L. Honglak, and L. M. Erik, "Learning hierarchical representations for face verification with convolutional deep belief networks," in *Proceedings of the IEEE Conference on Computer Vision and Pattern Recognition*, Providence, RI, USA, June 2012.

[6] M. H. Rabie, I. A. E. Khodary, and A. T. Assem, "A particle swarm optimization algorithm for the continuous absolute p-center location problem with Euclidean distance," *International Journal of Advanced Computer Science and Applications*, vol. 4, no. 12, 2013.

[7] B. Yelbay, Ş. İ. Birbil, and K. Bülbül, "The set covering problem revisited: an empirical study of the value of dual information," *Journal of Industrial and Management Optimization*, vol. 11, no. 2, pp. 575–594, 2015.

[8] B. Crawford, R. Soto, R. Cuesta, and F. Paredes, "Application of the artificial bee colony algorithm for solving the set covering problem," *The Scientific World Journal*, vol. 2014, no. 1, pp. 1–8, Article ID 189164, 2014.

[9] A. E. Zade, A. Sadegheih, and M. M. Lotfi, "A modified NSGA-II solution for a new multi-objective hub maximal covering problem under uncertain shipments," *Journal of Industrial Engineering International*, vol. 10, no. 4, pp. 185–197, 2014.

[10] G. E. Hinton, "Learning multiple layers of representation," *Trends in Cognitive Sciences*, vol. 1l, no. 10, 2007.

[11] Z. Wang, H. Wu, G. Zhao et al., "Corrigendum to "One-dimensional finite difference modeling on temperature history and freezing time of individual food," *Journal of Food Engineering*, vol. 79, no. 2, pp. 502–510, 2007.

[12] S. A. G. Kustrin and R. Beresford, "Basic concepts of artificial neural network (ANN) modeling and its applic ation in pharmaceutical res earch," *Joumal of pharmaceutical and-biomedical analysis*, vol. 22, no. 5, pp. 717–727, 2015.

[13] W. S. McCulloch and W. Pitts, "A logical calculus of the ideas immanent in nervous activity," *Bulletin of Mathematical Biology*, vol. 5, no. 1-2, pp. 115–133, 1943.

[14] C. Helma, T. Cramer, S. Kramer, and L. D. Raedt, "Data mining and machine learning techniques for the identification of mutagenicity inducing substructures and structure activity relationships of noncongeneric compounds," *Journal of Chemical Information and Computer Sciences*, vol. 44, no. 4, pp. 1402–1411, 2004.

Hindawi
Mobile Information Systems
Volume 2022, Article ID 9154351, 7 pages
https://doi.org/10.1155/2022/9154351

Research Article

Marketing Strategy of Rural Tourism Based on Big Data and Artificial Intelligence

Dan Xie[1] **and Yu He**[2]

[1]*International Cruise Service and Tourism Management Department, Tianjin Maritime College, Tianjin 300350, China*
[2]*Neworld Technologies Co.,Limited, Tianjin 300382, China*

Correspondence should be addressed to Dan Xie; xiedan@tjmc.edu.cn

Received 28 March 2022; Accepted 1 June 2022; Published 30 June 2022

Academic Editor: Liming Chen

In recent years, with the rapid development of artificial intelligence technology and big data application and the continuous optimization of algorithms such as deep learning algorithms and reinforcement learning algorithms, tourist attractions using "smart tourism" technology can obtain more accurate and in-depth knowledge from tourism big data and mine the value behind the data. As an important branch of tourism, the rise of rural tourism has inspired rural areas to protect the local environment, inherit characteristic culture, develop tourism resources, develop tourism economy, and increase rural income, which has well responded to the call of the rural revitalization strategy. However, due to lack of information resources and technology, some rural scenic spots still adopt traditional marketing methods without the support of big data and artificial intelligence technology. This paper proposes a research work on the marketing strategy of rural tourist attractions based on big data and artificial intelligence, analyzes current application of big data and artificial intelligence in rural tourism, and discusses the transformation of rural tourism marketing to a new fusion model with the support of big data and artificial intelligence, aiming to study every step involved and supported deeply by big data and artificial intelligence, from the awakening of intentions before the travel to the analysis of behaviors and preferences during the travel and the collection of evaluation after the travel. The research results of this paper show that more sufficient and deep integration between rural tourism and artificial intelligence/big data are needed to make tourists get better tour experience and marketing strategy of rural scenic spots to get better effects and income.

1. Introduction

In recent years, the modern information society has entered the era of big data, and big data has rapidly developed into a popular category favored by academia and industry, and it has been widely used. With the rapid development of technology in the field of artificial intelligence in recent years, the technology in the field of artificial intelligence itself has high uniqueness and complexity. For the 2021 London Olympics, Teradata used big data to help citizens plan their travel via a dedicated website by sifting through and creating target emails. This enabled people to avoid the crowds of the games accurately and changing the travel decisions of nearly 35% of people. The use of big data to guide people to make travel plans also greatly alleviates the traffic pressure in London, improves people's travel experience, and helps tourists to make scientific evaluation of their travel [1].

Although artificial intelligence covers a wide range of fields, at this stage, the main force driving the progress of artificial intelligence lies in the improvement of various artificial intelligence basic algorithms, such as Artificial Neural Network, Bayesian, Decision Tree, and Association Rule Learning, and the combination of these algorithms with specific scenarios. With the popularization of Internet technology across the country, the role of big data and artificial intelligence in promoting the development of rural tourism is becoming more and more obvious. With big data as the background, it is an excellent opportunity for the development of rural tourism. However, there are many deficiencies in the marketing of rural tourism: the concept is not updated, the methods are traditional, and the methods are old-fashioned, which restrict the sustainable development of rural tourism to a certain extent.

Tourism is an industry with great development potential. Giving full play to the advantages of big data analysis technology and artificial intelligence to realize rural smart tourism can inject new impetus into the development of rural areas. Through the development of rural tourism in rural areas, it is helpful to combine the primary and tertiary industries, drive the development of the local economy, increase the income of farmers, and promote the multi-functional development of agriculture. We analyze the current marketing situation and existing problems of rural tourism in order to find a suitable marketing strategy to boost the development of rural tourism and improve the economic and social benefits of rural tourism. Rural tourism research based on big data analysis technology can not only realize the sharing of tourism information resources but also deeply mine tourism data resources. Let the tourism industry achieve precise marketing before tourists travel, enjoy refined and considerate services during tourists travel, and get comfortable after-sales experience after tourists travel, which has made a huge contribution to the future development of the tourism industry.

The innovations of this paper are (1) this paper combines the needs of industrial policy and the development trend of artificial intelligence and proposes an extended "technical" extension to build a new marketing model. (2) The research in this paper discusses the application of the efficient storage and management of big data and provides new ideas for the marketing strategy of big data for rural tourist attractions. (3) This research builds a novel fusion model of artificial intelligence, big data technology, and rural tourism marketing.

2. Related Work

With the development of economy and technology, the role of big data and artificial intelligence algorithms in promoting the development of rural tourism has become more and more obvious, and many scholars have carried out research on this. Artificial intelligence technology has been well applied in big data analysis such as data classification. Zhang analyzed the application of support vector machine methods in machine learning to multiclassification problems [2]. Yao et al. initially conducted joint research on the design of the measurement matrix and the signal reconstruction algorithm [3]. With the development of the Internet and big data, we have ushered in the era of massive data, which makes people urgently need to mine important information from a large amount of data, and data mining can develop rapidly. For the abnormal detection of image data, Wen proposed a new artificial intelligence hybrid algorithm to optimize the processing and realize the rapid detection and identification of abnormal data points [4]. Starting from big data and artificial intelligence technology, using machine learning and deep learning in artificial intelligence, Chen and Xu used Python to obtain various tourist behavior data to build an intelligent tourism big data analysis model based on artificial intelligence [5]. Based on artificial intelligence technology, the strategy of transformation and upgrading and sustainable development of eco-agricultural characteristic tourism is analyzed in many aspects by Li, and new science and technology are integrated into agricultural tourism to drive innovation and upgrade the agricultural tourism industry and promote the development of eco-agricultural tourism [6]. Yu studied and designed the intelligent tourism management system. The whole system used Java EE technology to realize the business process of the whole system, used UML to analyze and model, designed the whole system based on the determined business function modules, gave the detailed architecture design content, analyzed the whole tourism data, and made it convenient to determine better tourism policy [7]. Niu tried to introduce big data technology in tourism, service, marketing, management, and other fields, leading the development of tourism towards intelligence and information [8].

However, the shortcoming of these studies is the uncertainty of data quality, and the calculation and analysis of massive data are very complicated, so the research data aspects still need to be improved. Meanwhile, with the support of big data and artificial intelligence technology, the analysis of the composition of the new mode of rural tourism marketing strategy is not specific and profound, and the way of the integration of big data and artificial intelligence and rural tourism marketing needs further research.

3. Artificial Intelligence Algorithms and Big Data

3.1. Artificial Intelligence Algorithms. The core competitiveness of artificial intelligence invention lies in the creative improvement of algorithms and the progress of the times. The development process of algorithms can also be called the development process of artificial intelligence technology. Artificial intelligence exists in daily life, and intelligent robots, food delivery software, etc., all use algorithms to improve service efficiency [9]. The rapid development of artificial intelligence in recent years is closely related to the rapid development of intelligent algorithms, so "intelligent algorithms" are also called the soul of artificial intelligence.

Artificial intelligence is a grand concept as long as tools have a way to imitate human learning, which is artificial intelligence. If there is a connection between the data, the weight of the connection coefficient in the network will increase, and if there is no connection between the data, the weight will increase. The system continuously adjusts the weight of the connection coefficient through the above process, and after thousands of times of learning, an algorithm with predictive function is formed [10]. For example, predicting which consumers have more purchasing power in the travel market? Which products will sell more next month? Then, tourism operators can be targeted to increase the advertising of certain products or increase advertising to some consumers.

With the development of artificial intelligence technology, the manifestations of artificial intelligence algorithms are very complex, some of which are very similar to the manifestations of traditional computer program algorithms, and some have very huge changes. Even professionals in the technical field cannot predict the changing direction of the algorithm form [11].

In recent years, with the introduction of artificial intelligence algorithms, especially machine learning and deep

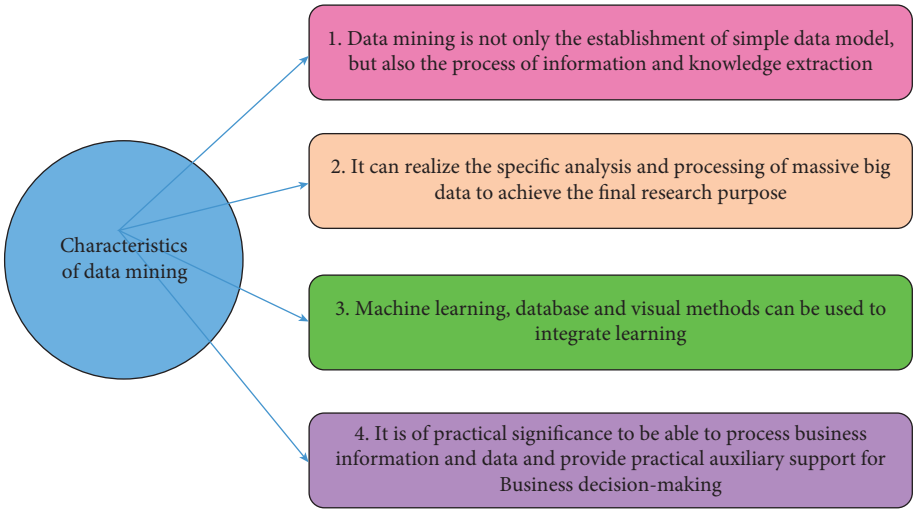


Figure 1: Data mining feature map.

learning, the enhancement of the computing power of computer equipment and the large amount of data accumulated by the outbreak of the Internet industry, artificial intelligence technology, and artificial intelligence-related industries have developed rapidly [12].

3.2. Big Data. Big data is made up of data reports from different aspects. With the technology development, the volume of big data has increased from the previous TB level to PB level. Various tourist guides, itineraries, and hotel information released by WeChat and the microblog of travel experts on the Internet are increasing the volume of big data. Big data types are diversified, including text, pictures , videos, and so on. But not all data are highly valuable. Some video plays for a long time, but only a few minutes or even a few seconds of data are efficient and effective data.

In the context of big data, data mining has become a way to realize the value of big data. Only through data mining technology can the value contained in big data be transformed into something useful. To some extent, big data is another term for data mining [13]. Data mining is an interdisciplinary topic in many fields, including comprehensive databases, mathematical statistics, artificial intelligence, and machine learning. The characteristics of data mining have the below points (as show in Figure 1). Data mining is a multistage process not only a modeling process but also a step-by-step data exploration process. This application can greatly improve the efficiency of data processing and reduce the probability of deviation.

4. Analysis of Rural Tourism Marketing Based on Big Data and Artificial Intelligence

4.1. Current Status of Big Data and Artificial Intelligence in Rural Tourism

4.1.1. Low Level of Informatization Hardware in Rural Tourism Scenic Spots. The economic level of some rural areas is low, and the operation status of tourist attractions is poor, so it is unable to attract domestic and foreign funds to further build the smart travel in rural tourist attractions. Especially in the rural tourist attractions in the central and western regions in China, most of them still adopt the original manual ticketing mode, and the resources in the scenic areas are mainly primitive natural landscapes. There is no big data collection and management and no data sharing platform either. For such scenic spots, it is impossible to collect tourists' data and carry out scenic spot marketing strategies with big data.

Other rural scenic spots with better economic conditions have built intelligent tourism data platforms under the guidance of the government, but these platforms are mainly aimed at collecting data to support scenic spot management not at the development of marketing strategies. The lack of marketing function means the revenue capacity of scenic spots can not be developed.

4.1.2. Short of Effective Mining Methods with Big Data Technology. Big data mining mainly includes association analysis, classification, clustering, regression, decision tree, and sequence analysis. At present, it is difficult to use these methods to mine tourism data to get very accurate results. The volume of tourism data itself is very large [14]. Tourists release various tourism guides or share tourism information through different social platforms. As time goes by, a large amount of tourism data is accumulated. The data can exist in a variety of forms, such as text, pictures, or videos [15]. No matter it is a picture or an evaluation, such unstructured data are difficult to be directly qualitative, and any deviation is highly likely to have an impact on the formulation of tourists' travel plans [16].

4.1.3. Insufficient Integration between Rural Tourism and Artificial Intelligence/Big Data. At present, the integration of rural tourism with artificial intelligence and big data mostly focuses on the data collection of tourists in the process of travel, which is analyzed according to the behaviors of tourists in the tour process. The integration level only stays in the analysis of behavior and preference in the travel process,

which greatly restricts the formulation and in-depth development of the rural tourism marketing strategy [17]. The objects of big data mining should include all kinds of data before, during, and after travel in order to get the data in the whole travel process, but these data involve a very wide range, and it is very difficult to fully mine them.

4.1.4. Rural Tourism Operators' Perception of Business Development with Big Data and Artificial Intelligence Is Moderate. Some rural tourism operators do not show much interest in the use of big data and artificial intelligence due to their small scale of operation and insufficient understanding of smart tourism. They tend to use traditional tourism sales and marketing methods [18]. Although many rural scenic spots have begun to use big data and artificial intelligence skills, most of them exist as independent tourist attractions and do not participate in intelligent tourism platforms in the whole region. The big data platform should also be associated with the government, meteorological department, transportation department, and other departments to provide smooth and better service to tourists. For example, by sharing the data with the transportation department and meteorological department, the scenic spot can master the road conditions and weather conditions around the scenic spot immediately and inform tourists together with the marketing plan. For example, it will soon rain, so the scenic spot could immediately deliver weather warnings to tourists and recommend surrounding hotels according to tourists' preferences. However, there are many departments involved such as the transportation department and meteorological department, so the platform construction is very difficult and need more investment [19]. The poor effect and high investment make more rural tourism operators afraid of using big data and artificial intelligence technology.

4.2. The Marketing Strategy of Rural Tourism. The most important feature of rural tourism is that tourists should be highly involved and deeply integrated into the specific activities of tourism, and can more naturally and closely contact the tourism environment [20]. This paper explores new rural tourism products and rural tourism models by integrating the existing tourism resources and facilities. The first step is to create products that consumers are interested in. Secondly, the consumers will be attracted by the products with effective price strategies and promotion strategies. Finally, more and more consumers will come to the rural spots to enjoy the holiday and boost the development of rural tourism. Some successful experiences with smart tourism technology were used for reference in the analysis process, and they were not copied but improved and utilized according to the reality of rural tourism, aiming to promote the healthy and sustainable development of rural tourism. Figure 2 shows the transformation of the rural tourism marketing model.

4.3. The Contrast with the Traditional Marketing Model. Traditional marketing methods only rely on experience and a small amount of data to obtain customer needs. Requiring a large amount of manpower and material resources, the results are not necessarily satisfactory to both tourism service providers and tourism service experiencers [21]. In the process of obtaining customer needs, the real needs of tourists cannot be fully explored and mined, and various tourism resources cannot be integrated.

With the development of artificial intelligence technology, the rural tourism marketing strategy based on artificial intelligence and big data can reasonably and efficiently integrate tourism resources, accurately find tourist needs, and provide tourists with the best and most suitable tourism services. Smart tourism has become an important development direction of the tourism industry [22]. Through the comprehensive application of big data, artificial intelligence, and other technologies, tourists can have a subjective perception of tourism information, and adjust and arrange their travel plans according to the specific information. For example, tourists could buy the tickets from the intelligent ticket purchase system before the travel, see the attractions via intelligent voice navigation before the travel, know how to park via the intelligent parking system before the travel, etc. According to the different needs of tourists, the operator will provide tourists with more warm and thoughtful services, improve the overall image of rural tourism, reduce the queuing time of tourists, and create better tourism service experience for tourists [23].

4.4. The Fusion Model of Artificial Intelligence, Big Data Technology, and Rural Tourism Marketing. Big data has been integrated into the daily life of modern people [24]. Various behaviors of modern people, such as searching, inquiring, booking, and writing, will generate a large amount of data, which is crucial for the development of tourism. Some tourism operators will collect users' information through a questionnaire survey, and by analyzing the user data, they can recommend appropriate tourist attractions and travel modes for users and provide personalized customized tourism services for users according to their preferences and characteristics [25]. Tourism operators can also collect review data, establish a special database, and use artificial intelligence technology to understand the consumer's psychology and behavior to improve and innovate products, so as to improve the service quality and gain profits from them. Figure 3 shows the fusion model of artificial intelligence, big data technology, and rural tourism marketing. This fusion model shows the process of data collection, analysis, and application, and analyzes the forms of tourism big data and artificial intelligence application and marketing effects generated by these forms from three stages: before the travel, in the travel, and after the travel.

4.4.1. Before the Travel: Precision Marketing. Through 3D modeling and VR technology, the comprehensive three-dimensional map of rural scenic spots will be presented via Internet to tourists before they travel. By using digital resources, the natural characteristics and cultural characteristics of scenic spots as well as the characteristics of "Restaurant, Home stay, Shopping and Entertainment" will be transmitted

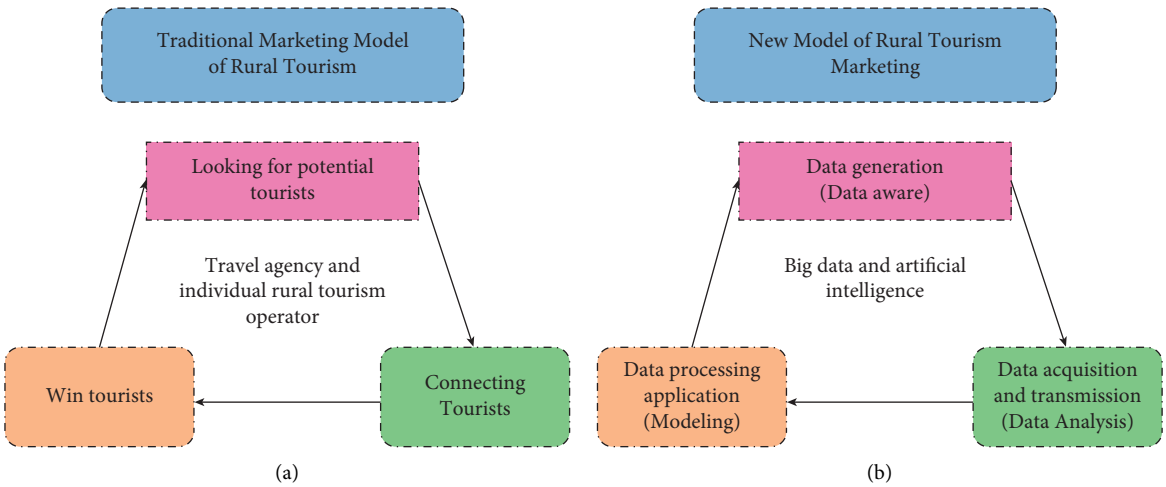


Figure 2: Transformation of the rural tourism marketing model.

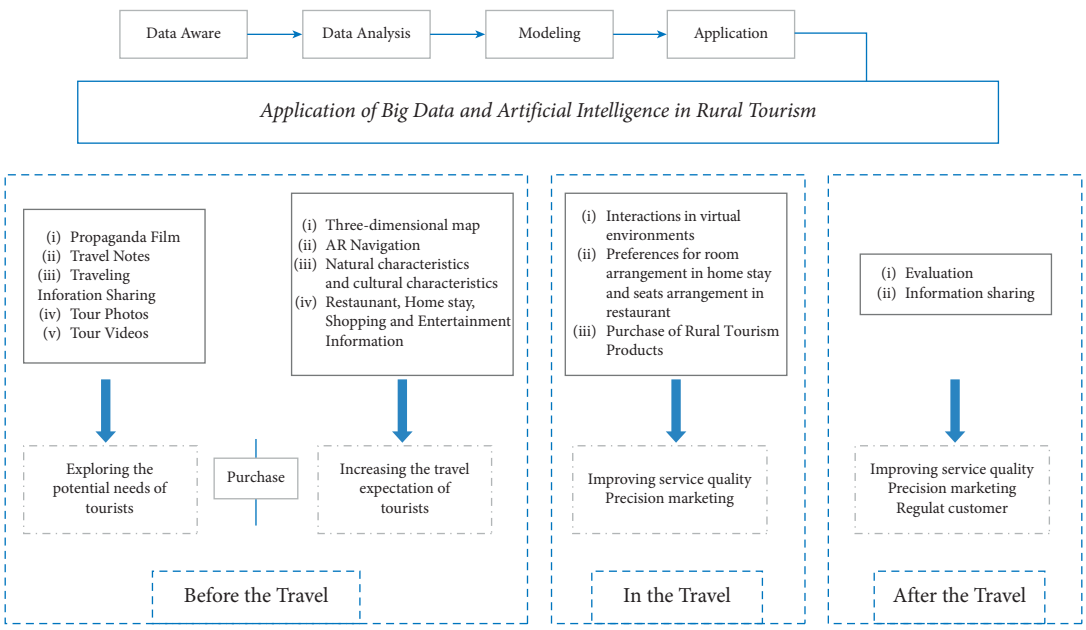


Figure 3: The fusion model of artificial intelligence, big data technology, and rural tourism marketing.

to tourists to attract them to go to, and through AR navigation technology, tourists can choose different rural tourism routes according to their actual needs.

4.4.2. In the Travel: Virtual Experience. With the help of artificial intelligence technology, it creates a wonderful virtual interactive tour experience for tourists. Through the data generated by tourists during the tour, such as the tour experience shared by WeChat, TikTok, and others, it makes accurate marketing to tourists [26]. By means of artificial intelligence and AR glasses, visitors can feel as if they are in the scenic spots when learning them from the tour guide. Artificial intelligence can also be used to analyze customer preferences in home stay. So personalized services and marketing can be carried out during the home stay service.

4.4.3. After the Travel: Collect Evaluation. After the tour, visitors are encouraged to fill in questionnaires or share their tour experience and comments on scenic spots, catering, transportation, accommodation, and shopping on the public network platform. Tourism operators can collect and analyze the real information through big data and artificial intelligence technology and constantly improve their services based on the analysis results. At the same time, tourism souvenirs or agricultural products can be promoted to tourists as per the analysis result.

5. Discussion

In the context of the Internet era, new media marketing affects all walks of life, and at the same time, it brings opportunities to rural tourism scenic spots. This paper explores

how the new marketing model can help the development of rural tourist attractions, and it gives the following suggestions:

5.1. Improve the Information Level of Smart Tourism. New media marketing has natural advantages unmatched by traditional media [27]. For example, rapid collection of travel big data, precision marketing, and labor cost saving, are all its advantages. New media can accurately target each target customer. New media has a lot of information about users and can better understand them, which greatly promotes its development [28]. In this way, we can better judge and analyze users' habits and other information. The interactivity of new media can shorten the distance between tourism operators and users. As is known to all, interaction is an important method of communication between the people. In the past, due to the poor continuity of the Internet, it was difficult to publish advertisements or news, and the communication between tourism operators and users was not very convenient. However, with the development of social networks, tourism operators fully interact with users through their own microblogs and websites, which can not only establish a good image of enterprises but also help users solve problems and get feedback in time. New media can enable tourism operators to obtain low-cost marketing power [29]. The cost of new media is generally low. If tourism operators can use it to establish a large low-cost marketing organization and improve their competitiveness, it is undoubtedly very good, which is incomparable to the traditional mode [30]. Scenic spot marketing has gradually abandoned the traditional methods of the past and turned to new media to promote the promotion of scenic spots, which is an inevitable step in the development of science and technology.

The government should increase the application of big data and artificial intelligence technology in the tourism industry, increase capital investment, give preferential policies, drive individual rural tourism operators, and link with meteorological, transportation, catering, accommodation, and other departments to establish an intelligent tourism information platform, and it should improve the quality of tourism service and tourism service experience.

5.2. More Sufficient Integration between Rural Tourism and Artificial Intelligence/Big Data. The development of "smart tourism" requires the construction of hardware equipment, the development and maintenance of software, and the establishment of databases. In order to meet the needs of the vast number of tourists, it is necessary to have abundant and complete service resources and, at the same time, to gain the trust of tourists. In the future, China's rural tourism scenic spots will surely develop into "smart tourism" scenic spots [31].

Every link should be deeply involved and supported by big data and artificial intelligence, from the awakening of intentions before travel to the analysis of behaviors and preferences during travel and the collection of evaluation after travel. Based on big data and artificial intelligence technology, rural tourism marketing can abandon the traditional B2B model and adopt the O2O model, analyze tourists' preferences and needs, dig into the potential will of tourists, implement precision marketing according to the real needs of tourists, and improve customer satisfaction and loyalty.

5.3. Explore Effective Mining Methods of Big Data Technology. At present, the structured or unstructured data related to tourism generally adopt cloud computing technology to collect and store data, but data mining and analysis levels are still need to be improved. Further exploration is needed to find more effective data mining methods to ensure the high efficiency and comprehensiveness of data mining.

6. Conclusions

To realize rural smart tourism and provide tourists with efficient tourism information services, the development of rural tourism under the background of big data and artificial intelligence contains huge opportunities. Big data technology can be integrated and developed in rural tourism, which has played a great role in promoting the development of rural tourism, especially the marketing of rural tourism. Marketing is an important part of the development of rural tourism. Big data is used as a technical tool to formulate a sound marketing strategy to help local rural tourism go out of the countryside, promote rural economic development, help local rural areas get rid of poverty and become rich, and truly solve the "three-rural" problems. This paper comprehensively describes the definition and content of big data and systematically sorts out the definition of domestic rural tourism and the research status of rural tourism marketing at home and abroad. And the relationship between the big data and the development of rural tourism is studied, and it is concluded that big data as a background is a very important opportunity for the development of rural tourism. Combined with the situation of rural tourism resources and rural tourism development, this paper explores the problems existing in rural tourism marketing with big data and artificial intelligence and formulates rural tourism marketing strategies under the background of "Internet +" according to local conditions, which further promotes the development of rural tourism in the region. Due to different research priorities, this research focuses on the rural tourism marketing strategy based on big data and artificial intelligence but does not measure and compare the contribution degree of different algorithms for the rural tourism marketing strategy. In the future, we will conduct more in-depth research on this aspect in order to support rural tourism marketing and rural revitalization strategy accurately.

Data Availability

All the data used are given in the paper.

Conflicts of Interest

The authors declare that they have no conflicts of interest.

References

[1] X. X. Li, "Innovation of tourism marketing mode under the background of big data era," *Tourism and Photography*, vol. 20, pp. 16-17, 2021.

[2] Z. Zhang, "Big data analysis with artificial intelligence technology based on machine learning algorithm," *Journal of Intelligent and Fuzzy Systems*, vol. 39, no. 5, pp. 1–8, 2020.

[3] S. Yao, Z. Zheng, W. Wang, and Guan, "An efficient joint compression and sparsity estimation matching pursuit algorithm for artificial intelligence application," *Future Generation Computer Systems*, vol. 86, no. SEP, pp. 603–613, 2018.

[4] H. Wen, "A new algorithm based on artificial intelligence to realize rapid detection and recognition of mass data abnormal point," *Boletin Tecnico/Technical Bulletin*, vol. 55, no. 6, pp. 364–371, 2017.

[5] J. M. Chen and S. L. Xu, "Construction of intelligent tourism big data analysis model based on artificial intelligence," *Computer Knowledge and Technology*, vol. 15, no. 11, pp. 189-190, 2019.

[6] M. N. Li, "Research on eco-agricultural tourism based on artificial intelligence technology," *China Southern Agricultural Machinery*, vol. 53, no. 4, pp. 112–115, 2022.

[7] J. T. Yu, "Analysis and application of intelligent tourism management system," *Journal of Jiamusi Vocational Institute*, vol. 38, no. 3, pp. 155–157, 2022.

[8] Y. Niu, "Application of big data analysis in the field of intelligent tourism," *Tourism Today*, vol. 20, no. 1, pp. 28–30, 2022.

[9] O. Koren, C. A. Hallin, N. Perel, and D. Bendet, "Decision-making enhancement in a big data environment: application of the K-means algorithm to mixed data," *Journal of Artificial Intelligence and Soft Computing Research*, vol. 9, no. 4, pp. 293–302, 2019.

[10] Z. Zhang, X. Wang, and J. Lu, "Multi-objective immune genetic algorithm solving nonlinear interval-valued programming," *Engineering Applications of Artificial Intelligence*, vol. 67, no. Jan, pp. 235–245, 2018.

[11] F. A. Baothman, "An intelligent big data management system using haar algorithm-based nao agent multisensory communication," *Wireless Communications and Mobile Computing*, vol. 2021, no. 13, Article ID 9977751, 15 pages, 2021.

[12] Q. Han, S. Huo, and R. Li, "Martial arts routine training method based on artificial intelligence and big data of lactate measurement," *Journal of Healthcare Engineering*, vol. 2021, no. 1, Article ID 5522899, 8 pages, 2021.

[13] H. Ponce, P. Souza, A. J. Guimaraes, and G. González-Mora, "Stochastic parallel extreme artificial hydrocarbon networks: an implementation for fast and robust supervised machine learning high-dimensional data," *Engineering Applications of Artificial Intelligence*, vol. 89, no. Mar, pp. 103427.1–103427.16, 2020.

[14] H. M. Zhang, J. Y. Liang, and J. Xu, "Innovation of smart tourism cloud service system under the background of "tourism + internet"," *Tourism Tribune*, vol. 31, no. 6, pp. 12–15, 2016.

[15] X. L. Liu, "Tourist perception and optimization of rural tourism image under the guidance of 5G technology," *Agricultural Economy*, vol. 1, no. 12, pp. 140–142, 2020.

[16] Y. P. Li, Z. Z. Hu, C. Huang, and L. Q. Duan, "The concept of smart tourism under the context of tourism information service," *Tourism Tribune*, vol. 29, no. 5, pp. 12–15, 2014.

[17] Z. Zhu and X. Zhang, "On the construction of smarter tourism perception system and management platform," *Journal of Jiangsu University (Natural Science Edition)*, vol. 13, no. 6, pp. 97–100, 2011.

[18] L. Pan, B. S. Lin, M. Fang, and M. Chen, "An empirical examination of continuance intention of tourism APP : based on the context of smart tourism," *Tourism Tribune*, vol. 31, no. 11, pp. 65–73, 2016.

[19] L. Y. Zhang, N. Li, and M. Liu, "On the basic concept of smarter tourism and its theoretical system," *Tourism Tribune*, vol. 27, no. 5, pp. 66–73, 2012.

[20] Z. C. Zhang, P. Huang, Y. Long, and Z. Z. Li, "Model construction of intelligent tourism integrated system based on artificial intelligence," *Science & Technology Vision*, vol. 1, no. 12, pp. 10–12, 2021.

[21] M. Yan, "Smart tourism and its development: taking nanjing as an example," *Chinese Economy and Business Herald*, vol. 20, pp. 75–77, 2012.

[22] K. Mo, "Discussion on security threats and countermeasures of smart tourism," *Tourism Overview*, vol. 2, pp. 302-303, 2013.

[23] J. L. Liu and Y. F. Fan, "The form, value and development trend of smart tourism," *Chongqing Social Science*, vol. 10, pp. 121–124, 2011.

[24] G. Z. Yao, "Analysis of smart tourism construction framework," *Nanjing University of Posts and Telecommunications(The Social Sciences Edition)*, vol. 14, no. 2, pp. 5–9, 2012.

[25] Y. Liu, J. G. Bao, and Y. L. Zhu, "Exploring emotion methods of tourism destination evaluation:A big-data approach," *Geographical Research*, vol. 36, no. 6, pp. 1091–1105, 2017.

[26] L. J. Zhang and X. Zhao, "Tourism management and service system based on big data," *Information & Communications*, vol. 11, pp. 232-233, 2014.

[27] C. Y. Liang, Y. C. Ma, and C. H. Lu, "Big data mining: the core of smart tourism," *Journal of Beijing University of Posts and Telecommunications*, vol. 180, no. 11, pp. 134–139, 2014.

[28] S. G. Kolte and J. W. Bakal, "Big data summarization using novel clustering algorithm and semantic feature approach," *International Journal of Rough Sets and Data Analysis*, vol. 4, no. 3, pp. 108–117, 2017.

[29] N. An and X. Wang, "Legal protection of artificial intelligence data and algorithms from the perspective of internet of things resource sharing," *Wireless Communications and Mobile Computing*, vol. 2021, no. 2, Article ID 8601425, 10 pages, 2021.

[30] S. Smys, H. Wang, and A. Basar, "5G network simulation in smart cities using neural network algorithm," *Journal of Artificial Intelligence and Capsule Networks*, vol. 3, no. 1, pp. 43–52, 2021.

[31] G. Qiu, Q. Kou, and T. Niu, "An improved clustering algorithm based on reverse learning in intelligent transportation," *AIP Conference Proceedings*, vol. 1839, no. 1, pp. 1–6, 2017.

Hindawi
Mobile Information Systems
Volume 2023, Article ID 9830407, 1 page
https://doi.org/10.1155/2023/9830407

Retraction

Retracted: Walking Position Data in Football Training Based on Embedded Action Recognition System

Mobile Information Systems

Received 1 August 2023; Accepted 1 August 2023; Published 2 August 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. Li, "Walking Position Data in Football Training Based on Embedded Action Recognition System," *Mobile Information Systems*, vol. 2022, Article ID 4094025, 13 pages, 2022.

Hindawi
Mobile Information Systems
Volume 2022, Article ID 4094025, 13 pages
https://doi.org/10.1155/2022/4094025

Research Article

Walking Position Data in Football Training Based on Embedded Action Recognition System

Li Li

Ministry of Sports, Shenyang Institute Engineering, Shenyang 110136, Liaoning, China

Correspondence should be addressed to Li Li; lili13897970597@sie.edu.cn

Received 16 March 2022; Revised 26 April 2022; Accepted 23 May 2022; Published 22 June 2022

Academic Editor: Liming Chen

With the development of image recognition and pattern recognition, action recognition has become a hot research direction in the field of computer actions. Because the embedded platform has the advantages of small size and low power consumption, it is a good choice to use the embedded platform for action recognition. These sensor data are used to overcome the drift error of the gyroscope when the positioning data are collected, and the accuracy and reliability of the data are improved. The system uses two data forwarding nodes to aggregate the data of each sensor and then transmit it to the host computer. The data aggregation node can communicate and upload data by means of Bluetooth or wire. In order to deeply study the relevance of the embedded action recognition system in collecting football training positioning data, this paper uses simulation model establishment method, data collection method, and theory and practice combination method to collect samples, analyzes the embedded action recognition system, and streamlines the algorithm. Using computer technology as a support when building a simulation model, the first thing you need to have is a certain computer technology because when building a simulation model, not all objects can be modeled. At this time, only computer technology can be used as a support to build a simulation model of some objects and create an action recognition system that can record the position data in football training. After establishing the human body simulation recognition model, use MATLAB to extract the K bone information. When collecting, the human body is facing the K device, the number of acquisition frames is 25, 55, 75, 95, 105, and 205, and each frame number is collected 10 times. Take the average. The delay time is 4s. The result shows that the 20 key bone point outputs by K come from the RGB camera on the same side. Further study the actual utility of the compensated model in the presence of occlusion. They are worn on the middle of the thigh and calf, respectively. In a sensor, the measured value of thigh length L1 is 0.6 m, and the value of calf length L2 is 0.4 m. Take the right knee as an example. When the leg is raised, the b-axis coordinate increases by 2%, and the c-axis coordinate decreases by 1.8%. When the leg is lowered, the opposite is true. It can be seen that the compensated coordinate is consistent with the action. It is basically realized that starting from the embedded action recognition system, a model that can support the analysis of football positioning data is designed.

1. Introduction

With the rapid innovation of football skills and tactics, the confrontation on the football field has intensified, and the offensive and defensive transitions have accelerated. Athletes have to do running, sprinting, emergency stop, jumping, and physical confrontation on nearly 8000 square meters of field for more than 90 minutes, and complete a series of technical actions in the fierce competition. The walking position data are the athlete's ability to react, dodge, and judge quickly, and the lower limb braking ability is the athlete's rapid deceleration and braking. In recent years, with the fierce development of football, football training for youth is also blooming everywhere. Junior high school students are in the golden period of physical development and the best period of football technology development. Physical education teachers and coaches should seize this best development period to fully develop their physical qualities such as strength, speed, agility, flexibility, and coordination [1]. The football technical and tactical training process is the process of reshaping and forming the team's technical and tactical play and characteristics. The complexity and variability of

this process and the variety of influencing factors determine the multiple possibilities for the development space of the team's technical and tactical play.

With the rapid development and spread of technology, how to make computers execute instructions issued by people faster and more accurately is a hot topic in this field. Human conversations have gradually evolved from traditional transmissions such as computers and strokes to new and faster interaction modes such as letters and bodies. To use a computer to diagnose human body language, first use sensors to collect human motion data, then add, subtract, multiply, and divide the human motion data through a series of algorithms, and finally realize the differentiation of targeted concepts of high-difficulty and high-content motions. The effective recognition of a casual small action has great difficulty in recognition, and the promotion of this related skill can greatly promote the depth of human beings in sports and other fields. Movement is a major research topic in the field of humans and machines, and the design of a flexible and comprehensive body movement library is a decisive factor in completing body language recognition.

Football is one of the most popular sports in the world. People have never given up data analysis of their movement and used various advanced technologies to achieve this goal. In 2019, *G* proposed a compact motion descriptor to describe the adjacent trajectory pattern of human action recognition. The proposed method introduces a strategy that models the local distribution of neighboring points by defining a process of spatial points around the motion trajectory. In particular, a two-level occurrence analysis was carried out to discover the movement pattern represented by the track points. First, calculate the locally occurring words on a circular grid layout centered on a fixed position of each track. Then, the regional occurrence description is realized by expressing the action as the most frequently occurring local word in a specific video. The second generation layer can be calculated for the entire video or each frame to achieve online recognition. This compact descriptor, with a local size of 72 and a sequence descriptor size of 400, is of great significance in real-time applications and environments with hardware limitations. The strategy he proposed was evaluated on the KTH and Weizmann data sets, and the average accuracy rates were 91.2% and 78%, respectively. In addition, by using only the first 25% of the video sequence, further online recognition was performed on UT interaction, achieving an accuracy of 67%. Although the modeling process is perfect, it is a pity that the accuracy of the algorithm is not high, and there is nothing to say [2]. In 2016, Qin L researched the positioning technology of the system to help drivers make judgments and improve driving safety. Therefore, the system has broad application prospects. The research content of this article can enrich and supplement the PNL visual positioning method and has the significance of theoretical research. An improved method for vehicle license plate measurement based on monocular vision is proposed. This method combines the characteristics of fast analytical solution and high positioning accuracy of iterative solution, has high robustness, and overcomes the multi-solution problem of P3P iterative method. Simulation experiments show that compared with the P4L method, the positioning accuracy of the improved positioning method has been greatly improved. At the same time, the real-time performance of the collision avoidance warning system with improved visual positioning method has been greatly improved, and the new positioning algorithm has a good performance in real-time performance, which greatly improves the processing capacity of the system. Although the processing power of the system has been improved, it is ultimately a wrong research direction and cannot be applied to football [3]. In 2020, based on the characteristics of athletes, Ma B developed and designed a C/S mode athlete training process monitoring system based on mobile artificial intelligence terminal technology. It uses GPS to obtain real-time position information of athletes and provides real-time guidance for athletes. In order to reveal the changing laws of various indicators in the training state of athletes, Ma B conducts simultaneous tracking and analysis from the characteristics of individual athletes sports function, coach training plan arrangement, brain function status, conventional physiological and biochemical indicators, nutrition, etc. The 16 athletes were randomly divided into experimental group and control group according to men and women and events. The basic situation of the experimental group and the control group is roughly the same. Before the experiment, the indexes of the experimental group and the control group were statistically tested. The results show that there is no significant difference between the two, which is in line with statistics. However, there are errors in his experimental process and data recording errors [4].

The innovations of this article are as follows: (1) summarize the current status and application of body language at home and abroad by means of references, and analyze and study the determining conditions of body language in the field of human-computer interaction; (2) without external interference under the condition of using electromagnet to realize the measurement and marking of the ground, the data set is used to collect the actions of the football players, and the calibration values of the walking position in the process of walking to standing, rolling, and falling are analyzed; (3) the completion of the database of the embedded system is completed. According to the requirements of products and development, on the basis of the normal startup and operation of the system, innovate and streamline the file system as much as possible. Through the above work, the embedded action recognition system can be accurately applied to the movement analysis of the athlete's training data, and the recognition efficiency is guaranteed.

2. Implementation Method of Moving Position Data Analysis in Football Training Based on Embedded Action Recognition

2.1. Football Training. "Training" is a pedagogical term, which is similar to the meaning of teaching. The purpose of training is to enable trainees to acquire a behavior or skill. Please rephrase the sentence for clarity and correctness.". "Xun," "Shuowen" is defined as preaching, Congyan,

Chuansheng [5]. "Training" in the sense of physical education refers to the planned and step-by-step mastery of certain skills through learning and counseling. It means that people consciously cause the trainees to have physiological reactions, such as building conditioned reflexes and strengthening muscles, thereby changing the training. The purpose of the activities of the quality and ability of the person is to cultivate and shape the person [6]. Dumping the ball: Do not hook up with your toes, and do not stand still under your feet. You can better adjust the center of gravity and control the ball when you move. Dribbling: Touch the ball as much as possible, preferably one step at a time. Stopping: Watch and move attention. Observe the situation of the incoming ball, quickly judge the landing point, and move in time. Shooting: It is roughly the same as passing the ball through the arch of the foot, but it increases the power and improves the accuracy.

Football is known as the "world's No. 1 sport" and is the most influential individual sport in the global sports world. With the summary of historical experience and the active orientation of national policies, the development of football mainly focuses on the concept of football training, youth football, campus football, football development model, football culture, etc.

To sum up, the research uses "football training" as the key word, and nearly 100 literature have been consulted in VIP. Scholars' research on training concepts is mostly based on the training concepts of different projects, the nature, and construction of training concepts. Today, when competitive sports are at its peak, the training concept urgently needs to cater to the international trend, combine the internal development law of the event, and innovate the training concept. In innovative training concept, the essence of innovation is the concept of reunification of subjective and objective in the process of sports training, which promotes the breakthrough and scientific development of the training concept of competitive sports with innovative thinking [7].

2.2. Data Analysis and Collection. In order for the network coordinator and network management to work properly, a high-performance controller needs to be selected. The high performance here has to do with the controllers used by end devices and routers in a Zigbee network. High performance and powerful processing power are important reference factors for the controller of the network coordinator. First consider the simplest case; that is, for the entire football field, a coordinator can cover the entire area. That is to say, all player points can be connected to the network created by co [8]. Players only need to wear segment points with sensors, and they can connect to the network normally in any corner of the field and transmit sensor data to co, which is responsible for identifying different terminal segment points and different types of sensor data. In the end, co will transmit the aggregated information with the identification of each athlete to the terminal through the serial port in real time for display [9]. On the contrary, the terminal can also send instructions to the co in real time, such as suspending the data transmission of a certain segment or speeding up the data transmission of a certain segment. But this method has a prerequisite; that is, the co must be able to support a large enough range; otherwise, for any segment of the football field, it may not find the network in a certain area and cause the system to malfunction. In order to make up for the shortcomings of this method, we can use the following improvement plan to increase the area covered by the router network in an increased way to reduce the pressure of co [10]. Figure 1 shows a structural simulation diagram of this improved method; with the development of the routing industry, router technology is constantly innovating and upgrading. From the first generation to the fifth generation, routing technology is moving toward intelligence step by step, and its role in the communication network is more important to achieve business flexibility and high-performance organic combination.

In Figure 1, it can be clearly seen that CO cannot cover the entire football field area, so we have added four routers around the field to increase the actual range of the network. As shown in the figure, each router can expand the range of the wireless network. In theory, four routers can be enough to cover the entire football field area, and the effective distance of each router only needs 55 meters. In this way, the terminal segment point on the field can find the nearby co or router at any position [11]. This structure is a complex topology.

2.3. Action Recognition. There are two main ways to obtain motion data: one is to use a black camera or other types of cameras to take pictures, and the other is to use an inertial sensor to cooperate with the equipment to collect the medium speed product and range speed change in the-process. More than 93% of the information in the process of people is transmitted by nonvoice, which is mainly by hands and feet. Hand and foot movements can generally be described as various forms and movements of the skeleton, head, and long bones in expressing people's attempts to pay attention or in the process. Movement classification is shown in Figure 2. Hand and foot movements can be divided into small movements and large movements according to the scale of movement. Small movements such as gestures and expressions, and large movements such as long bones and backbone movements are relatively easy to recognize [12]. In recent years, with the development of information technology and the popularization of intelligent technology, the global technological transformation is further advancing, and technologies such as cloud computing, Internet of Things, big data, and artificial intelligence are also developing rapidly. Among them, human motion recognition technology has begun to be used in computers widely used in vision-related fields.

As shown in picture 2, according to the difference in three-dimensional space and time, human hand and foot processing can be roughly divided into two categories: dynamic recognition and static recognition. Static recognition refers to the recognition of overall or partial information when the human body maintains a static posture,

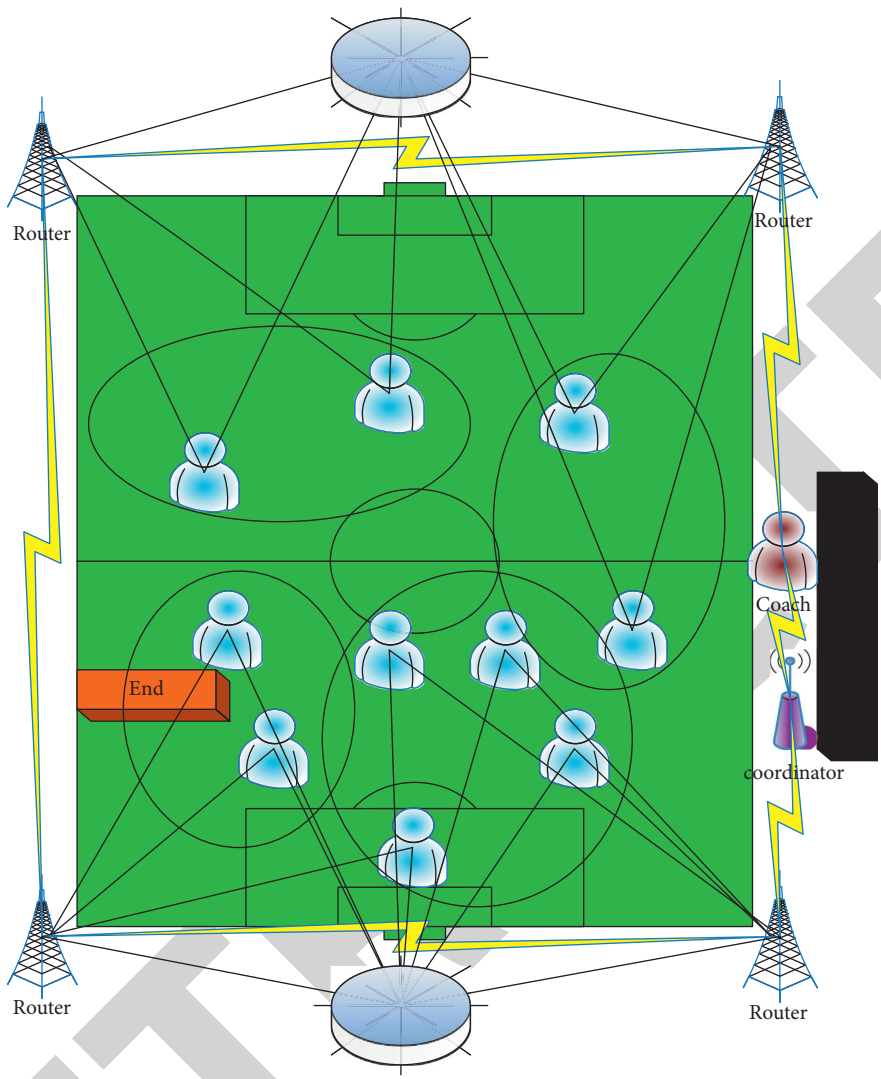


Figure 1: Improved model of data acquisition system.

such as body shape recognition [13]. Motion recognition refers to the recognition of the overall or partial motion content of the human body, such as limbs, hands, and feet [14].

Suppose two time series are m and z, and their lengths are o and n, respectively, one is the reference template, the other is the test template, and the value in the sequence is the characteristic value of each frame [15].

$$m = m_1, m_2, \ldots, m_o,$$
$$z = z_1, z_2, \ldots, z_o. \tag{1}$$

In order to pair the two sequences, first construct a distance matrix w of $o \times n$. The matrix element $w\ (u,\ l)$ represents the distance between the two template elements m_u and z_l. Here, the Euclidean distance $w(u,l) = (m_u - z_l)^2$ is used; that is, the sequences m and z are single similarity between frames [16].

$$w = \begin{bmatrix} w(m_1, z_1) & w(m_2, z_2) & \cdots & w(m_1, z_n) \\ w(m_2, z_1) & w(m_2, z_2) & \cdots & w(m_2, z_n) \\ \vdots & \vdots & \ddots & \vdots \\ w(m_o, z_1) & w(m_o, z_2) & \cdots & w(m_o, z_n) \end{bmatrix}. \tag{2}$$

The process of dynamic regularization is to find a path with several points in the distance matrix, so that the sequence of points that the path passes through has the smallest Euclidean distance and the highest similarity [17]. Define the regular road as d, where the g th element $d_g = (u, l)$ represents the mapping relationship between the sequences m and z:

$$d = \{d_1, d_2, \ldots, d_g\}, \quad \min(n, o) \le g \le n + o - 1. \tag{3}$$

When the constraints are met, choose the path with the lowest cost from many roads:

$$wsd = \max\left\{\frac{\sqrt{\sum_{g=1}^{g} d_g}}{g}\right\}. \tag{4}$$

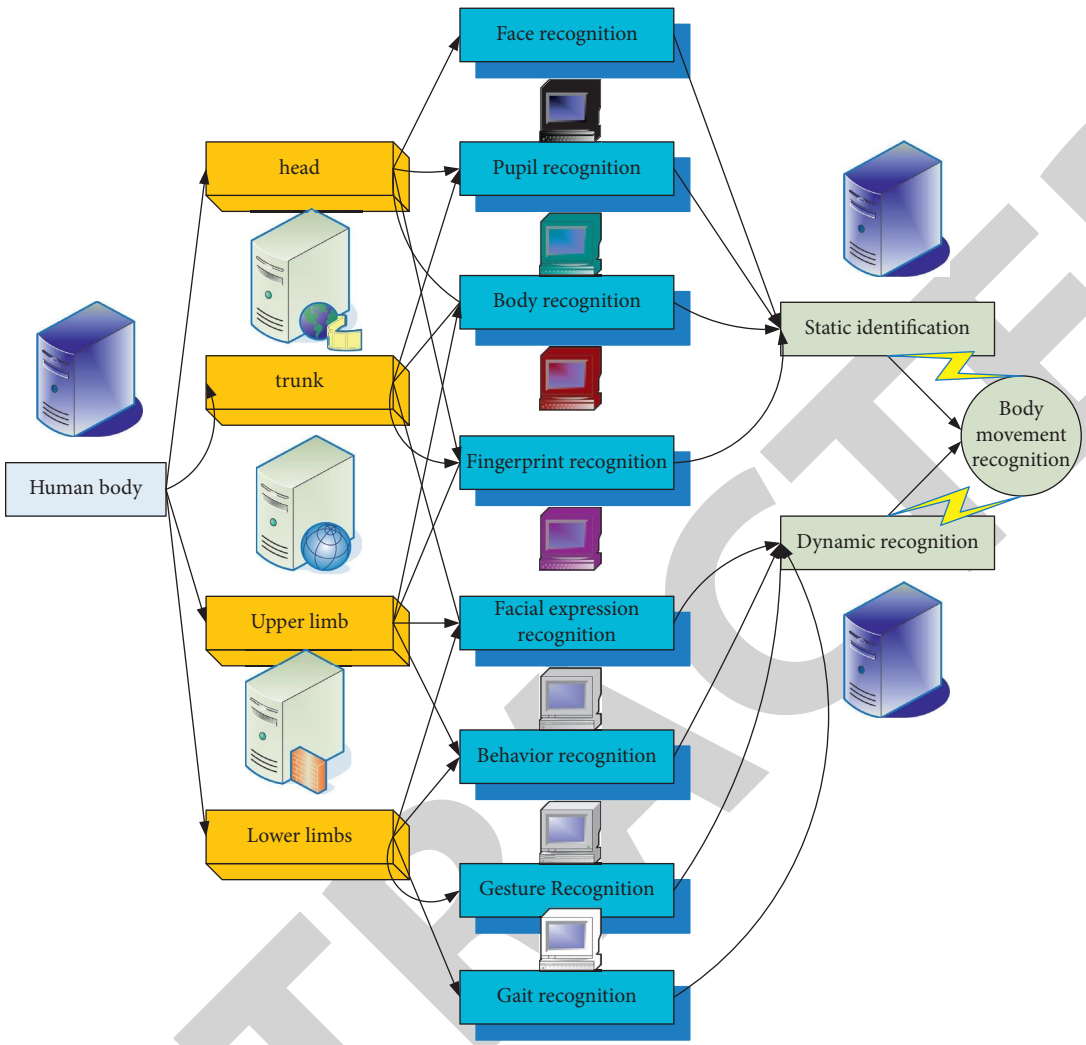


Figure 2: Body movement and recognition classification.

Among them, g is the path length corresponding to different paths [18].

The best distance is the road that minimizes the distance along the path, which can be easily determined according to the recognition algorithm. Define a cumulative distance $\alpha(u, l)$, as in (5). Match these two sequences m and z starting from the point (0, 0). When reaching a point, the distance calculated by all the previous points will be accumulated. After reaching the end point (o, n), this cumulative distance is the total distance, which is the similarity between the sequences m and z [19].

$$\alpha(u, l) = w(m_u, z_l) + \max\{\alpha(u-1, l-1), \alpha(u-1, l), \alpha(u, l-1)\}. \quad (5)$$

It is also critical to determine the character of a football player. Suppose we have o samples $\vec{a}_1, \vec{a}_2, \vec{a}_3, \ldots \vec{a}_o$. Project these o samples to a 0-dimensional vector $\vec{a}_o$, that is, a point, so that the sum of squares of the distance from this point $\vec{a}_0$ to these o samples is the smallest, as in (6), where $f_0(\vec{a}_0)$ represents the sum of squares of the distance [20].

$$f_0(\vec{a}_0) = \sum_{u=1}^{o} \|\vec{a}_0 - \vec{a}_u\|^2. \quad (6)$$

And the sample mean $\vec{n}$ can be expressed as $\vec{n} = 1/o \sum_{u=1}^{o} \vec{a}_u$; then for $f_0(\vec{a}_0)$, it can be expressed as follows:

$$f_0(\vec{a}_0) = \sum_{u=1}^{o} \|(\vec{a}_0 - \vec{n}) - (\vec{a}_u - \vec{n})\|^2. \quad (7)$$

Then, $f_0(\vec{a}_0)$ can be expressed as follows:

$$\vec{f}_0(\vec{a}_0) = \sum_{u=1}^{o} \|\vec{a}_0 - \vec{n}\|^2 + \sum_{u=1}^{o} \|\vec{a}_u - \vec{n}\|^2. \quad (8)$$

It can be seen from (8) that $f_0(\vec{a}_0)$ takes the minimum value at $\vec{a}_0 = \vec{n}$. In the case of 0 dimensions, the best projection of the sample in the sense of the smallest mean square error is the mean of the sample points [21].

Let $\vec{f}$ denote the unit direction vector passing through the sample mean line $\vec{n}$, then the line $\vec{a}$ can be expressed by $\vec{f}$ and $\vec{n}$ as follows:

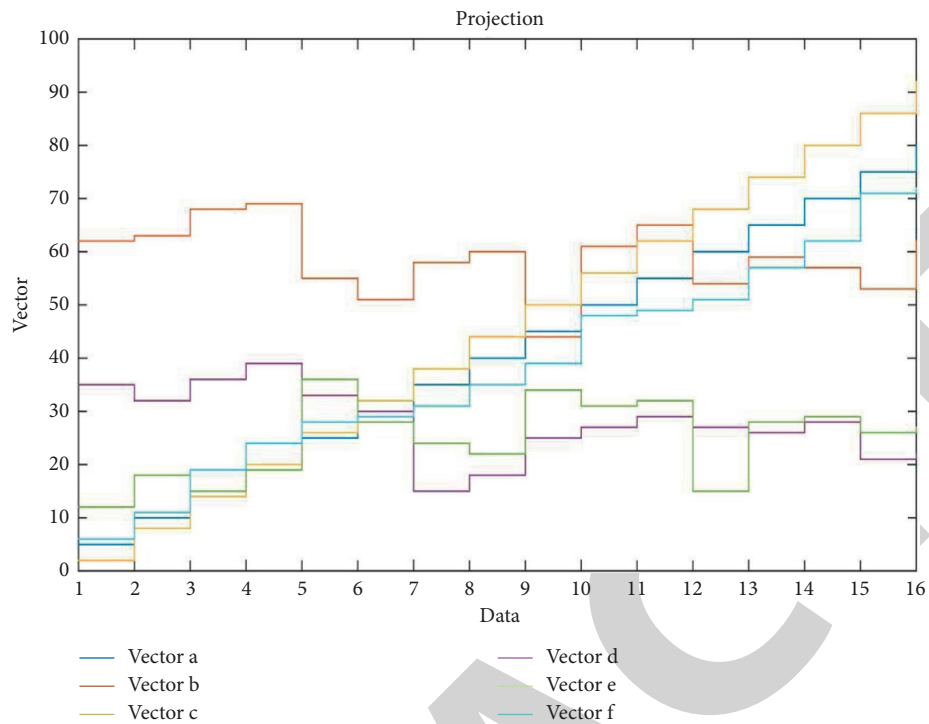


Figure 3: Schematic diagram of sample data mapping to one-dimensional.

$$\vec{a} = \vec{n} + x\vec{f} * \sum_{\exp}^{u=1} (u_a, u_b), \tag{9}$$

where x is a real number. The projection of the sample $\vec{a}_u$ in the $\vec{f}$ direction is shown in Figure 3.

As shown in Figure 3, $\vec{X}_u = |\vec{a}_u - \vec{n}| zpt(\varpi_u)$ can be obtained from the vertical relationship, where ϖ_u is the angle between the vector $\vec{f}$ and the vector $\vec{a}_u - \vec{n}$. Since $\vec{f}$ is a unit vector, the mean square error $f_1(\vec{f})$ can be expressed as [22]

$$f_1(\vec{f}) = \sum_{u=1}^{o} \left\| \left(\vec{n} + x_u \vec{f} \right) - \vec{a}_u \right\|^2. \tag{10}$$

Data acquisition is an application system that uses a wireless module and sensor to collect data from outside the system and input it into the system for data statistics. The nonelectricity or electric quantity signal is automatically collected from the digital unit under test and sent to the computer system for analysis. Combined with the expression of x_u, it can be derived that the mean square error $f_1(\vec{f})$ can be expressed as [23]

$$f_1(\vec{f}) = -\vec{f}^s \left(\sum_{u=1}^{o} \vec{a}_u - \vec{n} \right) \left(\vec{a}_u - \vec{n}^s \right) \vec{f} + \sum_{u=1}^{o} \left\| \vec{a}_u - \vec{n} \right\|^2. \tag{11}$$

Multiply both sides of the formula by $\vec{f}^s$ at the same time to get formula

$$\vec{f}^s t \vec{f} = \beta \vec{f}^s \vec{f} = \beta. \tag{12}$$

According to formula (12), when the sample data are projected to the direction of the eigenvector corresponding to the largest eigenvalue of the scatter matrix (defined as the β direction), $\vec{f}^s t \vec{f}$ takes the maximum value [24].

When the sample data are projected to the g dimension, the conclusion of 12 shows that the projection to the g dimension space can be expressed as $\vec{a} = \vec{n} + \sum_{j=1}^{g} x_j \vec{f}$, and the minimum mean square error is shown in the following formula:

$$f_g\left(\vec{f}_1, \vec{f}_2, \ldots\ldots \vec{f}_g\right) = \sum_{u=1}^{o} \left\| \left(\vec{n} + \sum_{j=1}^{g} x_{uj} \vec{f}_u \right) \right\|^2. \tag{13}$$

It can be proved that $f_g(\vec{f}_1, \vec{f}_2, \ldots\ldots \vec{f}_g)$ obtains the minimum value when the vector $\vec{f}_1, \vec{f}_2, \ldots\ldots \vec{f}_g$ is the eigenvector corresponding to the first g eigenvalues of the scatter matrix t [25]. All the quantities belonging to this g-dimensional space can be represented by $\vec{f}_1, \vec{f}_2, \ldots\ldots \vec{f}_g$, as shown in

$$\vec{a}'_u = \vec{n} + \sum_{u=1}^{g} x_{uj} \vec{f}_j. \tag{14}$$

Among them,

$$x_{uj} = \vec{f}_j \bullet (\vec{a}_u - \vec{n}) = \vec{f}_j^s \bullet (\vec{a}_u - \vec{n}). \tag{15}$$

Table 1: Distribution of male football training years in school.

Group	1–3 years	4–5 years	6–7 years	7 years or more	Total
Number of people	22	49	59	31	161
Proportion (%)	14.9	34.1	39.2	11.8	100.0
Eccentricity (100%)	96.6	94.8	95.8	96.3	100.0

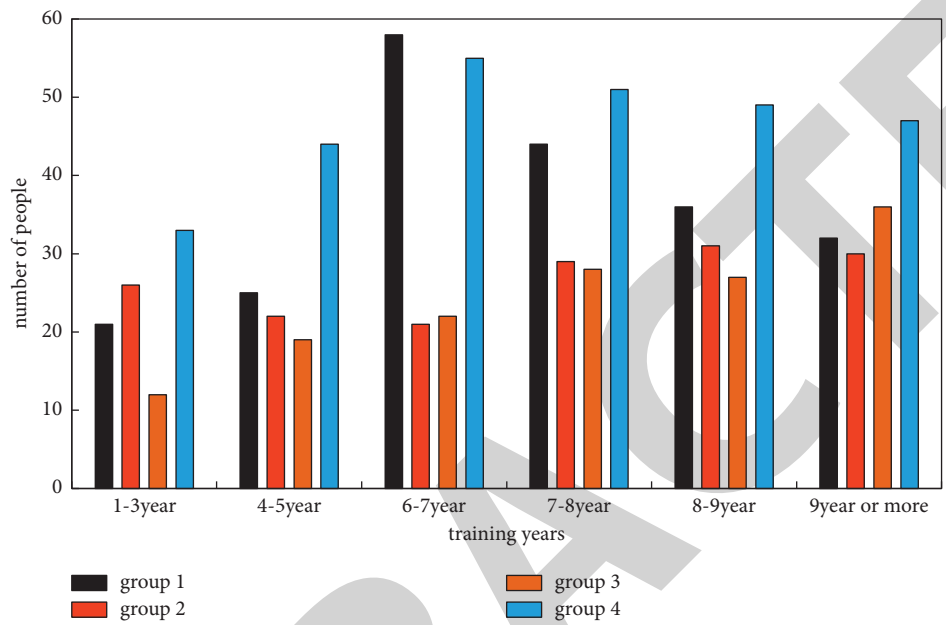


Figure 4: Distribution of male football training years in school.

$x_{u1}, x_{u2}, \ldots\ldots x_{ug}$ is the main component, and a lower dimension is used to represent the original sample data [26].

3. Experiments and Conclusions of the Design and Implementation Method of Moving Data Analysis in Football Training Based on Embedded Action Recognition

3.1. Subjects. The subjects of this study are 322 school boys in a certain city. We investigated 29 youth teams in a certain school with football training experience, 52 people from 14- to 15-year-old city clubs, 32 youth football teams in a certain school, 22 people in a middle school, and 26 people in a county second middle school football team, totaling 161 people in the city's 5th middle school without football training experience.

In order to study the influence of different football training years on the analysis of the city's school boy's position data, this study divided the school boys with football training experience according to different training years, which can be divided into 1–3 years, 4–5 years, four groups: 6–7 years, 7 years, or more. The distribution statistics of personnel in each group are shown in Table 1 and Figure 4.

It can be seen from Figure 4 that most of the school boys in the survey have more than 6 years of football training experience. This is because the city has a strong football culture atmosphere. With the encouragement of the school or the support of parents, many boys have been in elementary school, began to participate in football, and developed a strong interest in football, which prompted school boys to often participate in football. As the receiver of knowledge, athletes have great subjective initiative. A football team consists of more than 20 players. Sometimes, the number of training camps reaches more than 30 people. Each player has different growth and life experiences, and the characteristics of competitive ability are quite different. A comprehensive and accurate understanding of the players' competitive ability is characterized by the main basis for coaches to choose technical and tactical play for the team.

3.2. Design of Action Information Collection System. Inertial sensors are used as acceleration sensors and rotators, and the corresponding inertial values are speed increase and edge velocity; electromagnet is a resistive sensor, and the output value is magnetic field strength; the image sensor is a K sensor, and the output value is color image, depth image, and bone information [27–29]. The inertial sensors and magnetic sensors at the data collection end are collected by wearing on human limbs. For example, the sensor segment points can be fixed on the thigh, calf, and ankle in the gait motion collection experiment; the segment points can be fixed on the waist during the fall experiment, the head, etc.; segment points can be fixed on multiple parts of the human body in the human body's daily behavior and action experiment.

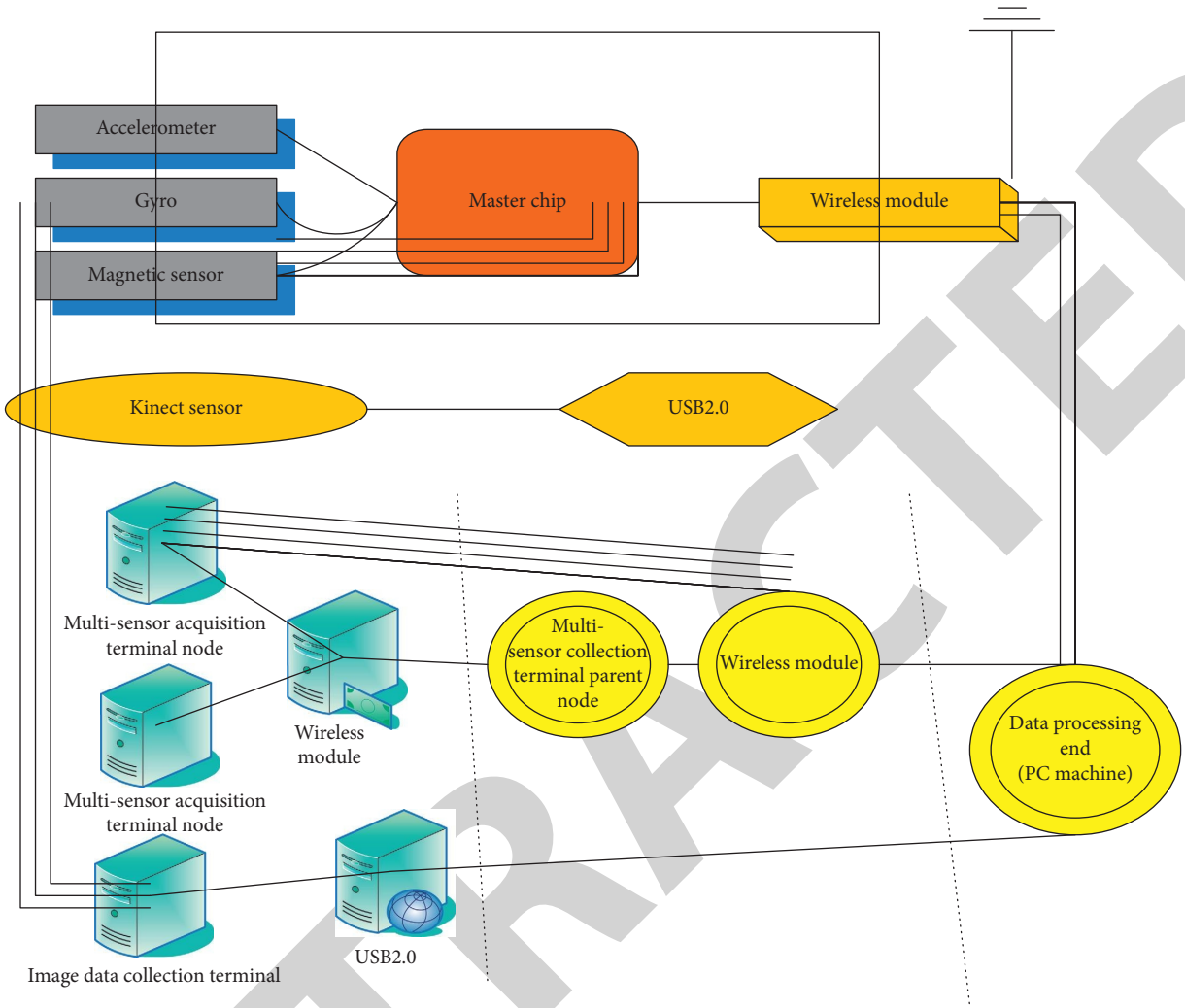


Figure 5: Block diagram of body movement data acquisition system.

The main functional requirements of the data collection terminal are as follows:

(1) Collecting segment points can accurately collect three-axis acceleration, three-axis angular velocity, and three-axis magnetic field data.

(2) Collecting segment points can perform simple processing on nine-axis data, such as setting thresholds and filtering.

(3) The number of acquisition segment points and the output rate are configurable.

(4) The collection point requires small equipment size and weight, low power consumption, status display, and easy control.

(5) Data transmission methods include wireless and wired.

According to the above-mentioned demand analysis, a data acquisition terminal based on inertial sensors, magnetic sensors, and image sensors is designed, and its structure diagram is shown in Figure 5.

As shown in Figure 5, the multi-sensor collection terminal can be used as a child segment point or as a parent segment point. When used as a parent segment point, the sensor collection function is turned off, and the polling method is used to collect the data of each sub-segment point; when a set of data is collected, it is uploaded to the data processing terminal through the wireless module.

3.3. Sensor Configuration. The important registers of MPU6112 are shown in Table 2.

The important registers of HMC5698 are shown in Table 3.

The initial configuration of HMC5698 is sampling rate configuration, 8 sampling data for one measurement data output, output rate configuration 28 Hz, measurement mode configuration, and range selection.

3.4. Human Model Establishment. To use a computer to collect movement information and recognize body movements, it is first necessary to establish a reasonable human body model based on the human body structure and kinematics theory. The human body is a very complex structural complex, including its own sensing system,

Table 2: Register configuration of MPU6112.

Register name	Register address	Description
SLA	$0.1 \times d1$	Register operation address
SMP	0.1×20	Sampling rate divider
PWR	$0.1 \times 5B$	Power management and clock configuration
CON	$0.1 \times 2a$	Low-pass filter configuration
CYR	$0.1 \times 2b$	Gyro self-test and range selection
ACC	$0.1 \times 2c$	Accelerometer self-test and range selection
INT	0.1×40	Interrupt configuration
GYO	$0.1 \times 42 \sim 0.1 \times 47$	Angular velocity data register group
ACO	$0.1 \times 2b \sim 0.1 \times 37$	Acceleration data register group

Table 3: Register configuration of HMC5698.

Register name	Register address	Description
SLA	$0.1 \times 2c$	Register operation address
CON	0.1×0.01	Selection of sampling times and output rate
CON	0.1×02	Range selection
MO	0.1×03	Measurement mode selection
DX	$0.1 \times 04 \sim 0.1 \times 05$	X-axis magnetic field data ($0 \times f800 \sim 0 \times 7ff$)
DY	$0.1 \times 08 \sim 0.1 \times 09$	Y-axis magnetic field data
DZ	$0.1 \times 06 \sim 0.1 \times 07$	Z-axis magnetic field data
STA	0.1×10	Data register status monitoring

processing system, and control execution system. Skeletonization and segmentation of the human body based on the bones of the human body can effectively reflect the state of the human body. From a spatial perspective, the recognition of two-dimensional models is relatively simple. The traditional skeleton extraction scheme is based on two-dimensional images. The algorithm is effective in processing the background environment, high contrast, and high camera accuracy. The three-dimensional human body model is compared with the two-dimensional, and the model has more depth data dimensions, contains the main information of the human body in space, and can accurately estimate the human body's spatial movement.

As shown in Figure 6, it is a diagram of the main segments of the human body. It can be seen from the figure that the segments of the human body are connected to the trunk, limbs, head, etc., including the finger, wrist, elbow, knee, and chest lock-off paragraph. The determination of these points also establishes the model foundation of the human body. The information of the three-dimensional human body model mainly includes the spatial positioning, connection relationship, and distance of the various points. The three-dimensional model used in this article is a 3D skeleton model of 20 main points. The 20 points are 1. hip center; 2. spine; 3. shoulder center; 4. head; 5. left shoulder; 6. left elbow; 7. left wrist; 8. left hand; 9 right shoulder; 10. right elbow; 11. right wrist; 12. right hand; 13. left hip; 14. left knee; 15. left ankle; 16. left foot; 17. right hip; 18. right knee; 19 right ankle; and 20 right foot. And each is connected to the sensor.

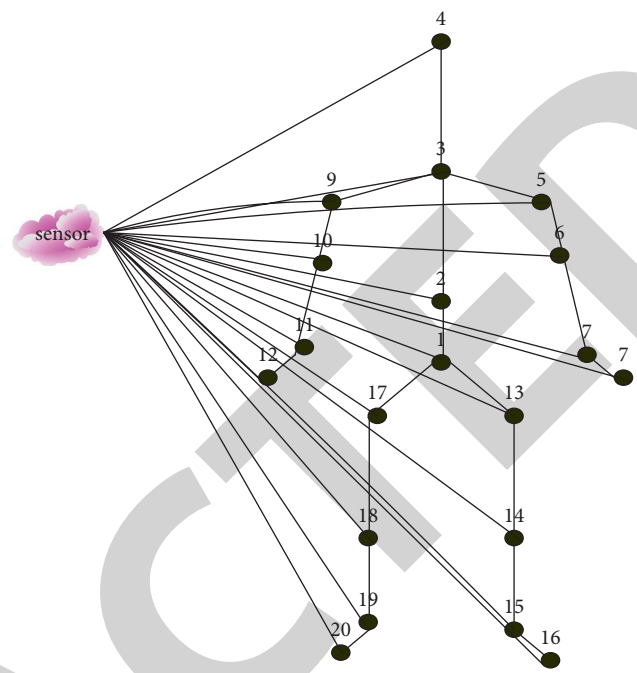


Figure 6: Human body joint map.

Table 4: Mean available start frame.

Number of acquisition frames	25	55	75	95	105	205
No delay	22	18	18	21	18	19
Delay 2 s	3	2	5	4	6	1
Delay 5 s	1	2	1	2	1	2

3.5. Survey Samples and Analysis. Use MATLAB to extract the K bone information, the human body is facing the K device when collecting, the number of acquisition frames is, respectively, selected as 25, 55, 75, 95, 105, and 205, and each frame number is collected 10 times and averaged. When the image and depth sensors are turned on and the data are collected immediately, the bones cannot be tracked in the first 20 frames of the image; while the data are collected after a few seconds of delay in turning on the sensor, there is basically no loss of bone frames, as shown in Table 4. The subsequent experiments are based on the acquisition after the startup delay, the delay time is 4s, and it can provide preparation time for the action at the same time.

Since the 20 key bone point outputs by K come from the RGB camera and infrared camera on the same side, the human skeleton is subject to color images and depth images in most cases, and is still affected by the environment, especially environmental occlusion and limbs. Severe distortion may occur in situations such as overlap.

In the experiment, the occlusion situation is the body's own occlusion and the partial occlusion of the environment.

Table 5: Tracking status and node status of different postures.

Action posture	Tracking status					Node status
	1	2	3	4	5	
Upright	1	1	1	1	1	Good
Oblique	1	1	1	1	1	Good
Side stand	0	0	0	0	0	No
Right arm pointing to the device	0	1	1	1	0	Poor
Behind the right arm	1	1	1	1	1	Bad
Right arm bent upward	1	1	1	1	1	Poor
Right leg environmental occlusion	1	1	0	1	1	Bad

Seven different static action poses are selected, and data are collected for each group of poses 5 times. The number of frames for each collection is 110 frames, and the bone state is obtained as shown in Table 5. 1 indicates tracking success, and 0 means tracking failure.

Except for standing upright and obliquely standing, good bone information can be obtained, and other occluded action postures have more or less bad and unrecognizable bone segment point information. Among them, the tracking state is all invalid in the side standing motion, and due to the lack of body and right body information, the bone information cannot be recognized; when the right arm is pointing to the device, there is 1 tracking failure, and when the right arm is pointing to the sensor, the image and depth sensor only recognizes the right-hand information. The obtained right wrist and right elbow information may be wrong; the partial occlusion of the right leg has 2 tracking failures; the middle axis segment point (head-shoulder center-spine-hip center) in the segment point information is good and poor The point state mainly appears on the segment points of the limbs. For example, the point information of the occlusion behind the arm and the partial occlusion of the body is severely shifted. It can be seen that when the main body of the torso is occluded or affected by environmental background factors, the bone information is prone to be unrecognizable; at the same time, the bone segment points under the occlusion of the right arm and right leg show that the data output by the device is largely dependent on image sensor.

3.6. Test Results after Compensation. Wear sensors are on the thigh and the middle of the calf, the measured value of the thigh length $L1$ is 0.6 m, and the value of the calf length $L2$ is 0.4 m. The right knee compensation data are based on the right hip data, and the right ankle is based on the compensated right knee data. A and b are the points of the skeleton before and after compensation. Relatively, there is a right-hand occlusion posture. This time the right ankle point is at coordinate compensation is performed on the basis of the right knee. When the environment is occluded, the right leg does a leg-raising exercise, first raising the leg and then lowering the leg to get the coordinates of the right knee and right ankle as shown in Figure 7.

It can be seen from Figure 7 that the motion basically keeps moving in the bc plane, the a-axis coordinate should be changed less, and the bc-axis data should be changed more. Take the right knee as an example. When the leg is raised, the b-axis coordinate increases, and the c-axis coordinate decreases. When the leg is dropped, the opposite is true. It can be seen that the compensated coordinates are consistent with the action.

4. Discussion

4.1. Article Context Analysis. First introduce the deep learning tool Caffe, and then introduce the principle and implementation of each layer of the deep convolutional neural network. Finally, an 11-layer convolutional neural network was designed for the embedded platform, and the network was implemented using Caffe. The training model and network are deployed on the embedded platform and tested on different action data sets, and analyzed the reasons that affect the recognition accuracy. In view of the fact that the embedded platform has limited computing power compared with the advanced graphics cards and server clusters on the PC side, and the data set is noisier, the test results basically met the initial requirements.

4.2. Summary Analysis. To sum up, although the concept of sensors has been proposed for ten years, as a data integration technology with considerable benefits and performance, whether from books or engineering research levels, it still requires a lot of development by scholars and workers to truly mature. In terms of book copying, however there are many attractive features when it is proposed, such as the high efficiency of the network and strong research. However, there are still big deficiencies in the research of contracts, such as how to make reasonable plans for the modules of each segment in an extremely complex network structure, and try to increase the duration of the entire network. Also in terms of research engineering, there are now many universities and research institutes doing experiments in this area, and many companies have already produced some powerful transmission components and methods, but in general, wireless sensors. The network has not yet fully entered the large-scale practical development process. However, it can be expected that in the next few years, with the innovation and development of theories and the endless supply of new methods, those related network projects that are still in fading will leave the laboratory and enter every aspect of our lives again and again.

4.3. Model Analysis. So far, the design of the sports data acquisition system suitable for football stadiums has been completed. Although this system is still in the experimental debugging stage, it can be seen that the basic functions of the system have been realized. This system is mainly based on the theory of wireless sensor network, the single-chip microcomputer plus wireless transmission module is the hardware, and the interface program and protocol are the software. In this article, from the initial selection of this application, to the design of two hardware solutions, to the design of the final graphical interface, a more detailed

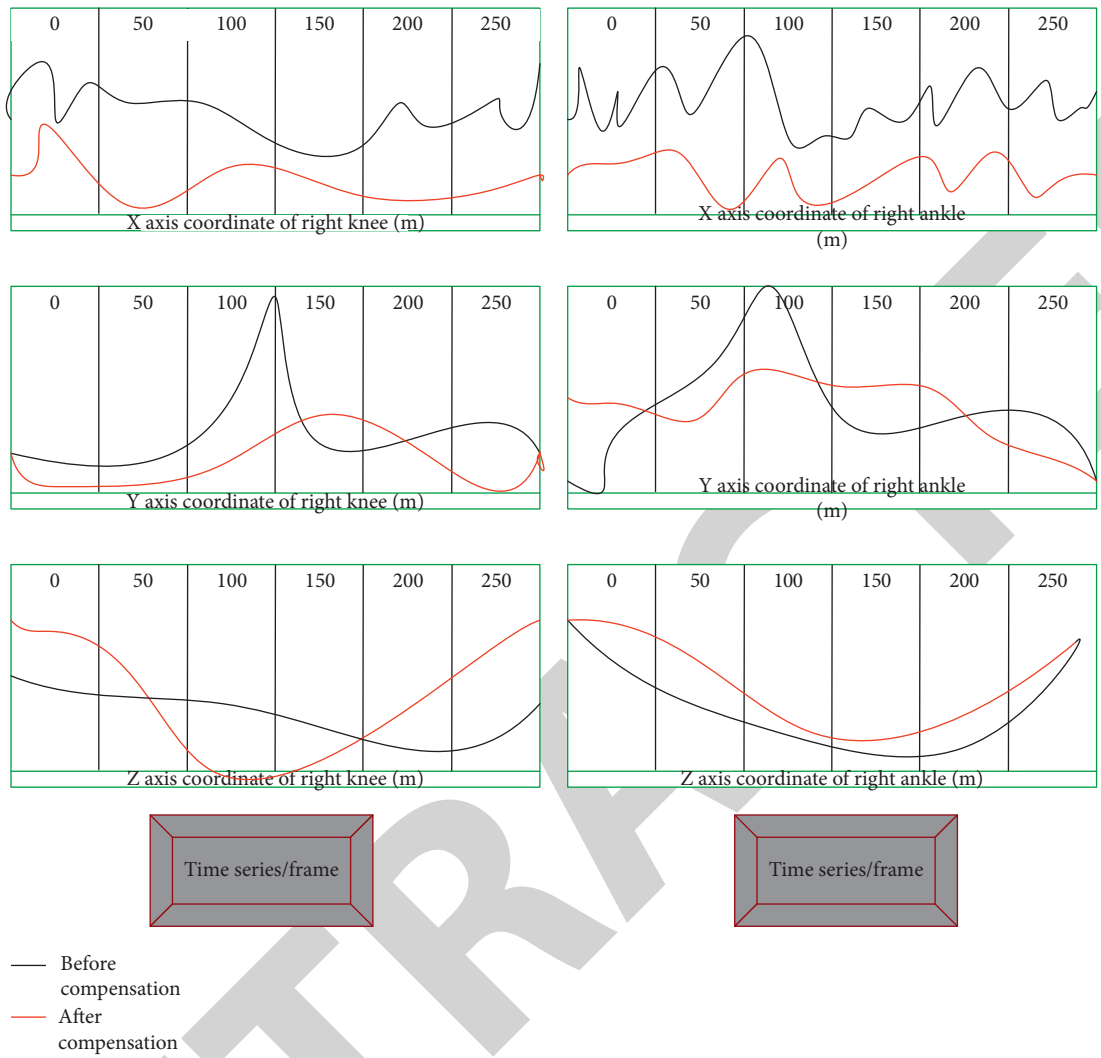


Figure 7: Right knee and right ankle space coordinate.

description is carried out. In the next step, I will test and evaluate this system to determine the final realization scheme.

5. Conclusions

The corresponding process of hand and foot movement is one of the advanced methods in the field of humans and machines. This technology can be developed in the fields of medicine, development process, surveillance, sports, and football recognition. In order to deeply study the relevance of the embedded action recognition system in collecting football training positioning data, this paper uses simulation model establishment method, data collection method, and theory and practice combination method to collect samples, analyzes the embedded action recognition system, and streamlines the algorithm. The initial configuration of HMC5698 is sampling rate configuration, 8 sampling data for one measurement data output, output rate configuration 28 Hz, measurement mode configuration, and range selection and creates an action recognition system that can record the position data in football training. After establishing the human body simulation recognition model, use MATLAB to extract the K bone information. When collecting, the human body is facing the K device, and the number of acquisition frames is 25, 55, 75, 95, 105, and 205, and each frame number is collected 10 times. Take the average. The delay time is 4s. The result shows that the 20 key bone point outputs by K come from the RGB camera on the same side. Further study the actual utility of the compensated model in the presence of occlusion. They are worn on the middle of the thigh and calf, respectively. In a sensor, the measured value of thigh length L1 is 0.6 m, and the value of calf length L2 is 0.4 m. Take the right knee as an example. When the leg is raised, the b-axis coordinate increases by 2%, and the c-axis coordinate decreases by 1.8%. When the leg is lowered, the opposite is true. It can be seen that the compensated coordinate is consistent with the action. The shortcomings of this paper are as follows: first of all, large-scale wireless sensor networks need to be researched and tested, because when the number of network segments increases, the network communication performance will drop sharply. This point has been fully

demonstrated in the 5 g network; secondly, the segment energy design of the segment point needs further research; after all, it seems that its energy consumption is still too large. Therefore, in further research, the network performance should also be targeted to improve, and lithium battery supply should be selected in terms of power consumption to reduce energy consumption, so that more football fields can be applied to this action recognition system.

Data Availability

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

Disclosure

The author received no financial support for the research, authorship, and/or publication of this article.

Conflicts of Interest

The author declared no potential conflicts of interest with respect to the research, authorship, and/or publication of this article.

References

[1] N. Man, K. Wang, and L. Liu, "Using computer cognitive atlas to improve students' divergent thinking ability," *Journal of Organizational and End User Computing*, vol. 33, no. 6, pp. 1–16, 2021.

[2] G. G. Villamizar, F. Martínez, and F. Garzón, "A fast action recognition strategy based on motion trajectory occurrences," *Pattern Recognition and Image Analysis*, vol. 29, no. 3, pp. 447–456, 2019.

[3] L. Qin, T. Wang, Y. Hu, and C. Yao, "Improved position and attitude determination method for monocular vision in vehicle collision warning system," *International Journal of Pattern Recognition and Artificial Intelligence*, vol. 30, no. 07, Article ID 1655019, 2016.

[4] B. Ma, S. Nie, M. Ji, J. Song, and W. Wang, "Research and analysis of sports training real-time monitoring system based on mobile artificial intelligence terminal," *Wireless Communications and Mobile Computing*, vol. 2020, no. 6, pp. 1–10, Article ID 8879616, 2020.

[5] L. Liu, "Moving object detection technology of line dancing based on machine vision," *Mobile Information Systems*, vol. 2021, no. 2, pp. 1–9, Article ID 9995980, 2021.

[6] H. Hei, X. Jian, and E. Xiao, "Sample weights determination based on cosine similarity method as an extension to infrared action recognition," *Journal of Intelligent and Fuzzy Systems*, vol. 40, no. 3, pp. 3919–3930, 2021.

[7] P. Wang, "Research on sports training action recognition based on deep learning," *Scientific Programming*, vol. 2021, no. 7, pp. 1–8, Article ID 3396878, 2021.

[8] Y. Du, Y. Fu, and L. Wang, "Representation learning of temporal dynamics for skeleton-based action recognition," *IEEE Transactions on Image Processing*, vol. 25, no. 7, pp. 3010–3022, 2016.

[9] Y. Ji and S. Ma, "Remote evaluation system of tennis batting action standard based on acceleration sensor," *Security and Communication Networks*, vol. 2021, no. 6, pp. 1–11, Article ID 9930084, 2021.

[10] L. Qi, "Volleyball action extraction and dynamic recognition based on gait tactile sensor," *Journal of Sensors*, vol. 2021, no. 12, pp. 1–11, Article ID 9204123, 2021.

[11] Y. Chen, "Sports sequence images based on convolutional neural network," *Mathematical Problems in Engineering*, vol. 2021, no. 4, pp. 1–14, Article ID 3326847, 2021.

[12] X. Hu, X. Huang, T. Hu, and Z. Shi, "A minimal dataset construction method based on similar training for capture position recognition of space robot," *Wireless Personal Communications*, vol. 102, no. 2, pp. 1935–1948, 2018.

[13] G. Zhao, "Feature recognition of human motion behavior based on depth sequence analysis," *Complexity*, vol. 2021, no. 4, pp. 1–10, Article ID 4104716, 2021.

[14] F. Husain, B. Dellen, and C. Torras, "Action recognition based on efficient deep feature learning in the spatio-temporal domain," *IEEE Robotics and Automation Letters*, vol. 1, no. 2, pp. 984–991, 2016.

[15] N. Singh and S. A. Mthuli, "The big picture of non-profit organisational sustainability: a qualitative system dynamics approach," *Systemic Practice and Action Research*, vol. 34, no. 3, pp. 229–249, 2021.

[16] H. Abe, H. B. Rijal, K. Bogaki, M. Shukuya, and A. Mikami, "Study on modeling of the consciousness, behavior and desired information of occupants in relation to energy saving," *Journal of Environmental Engineering*, vol. 84, no. 755, pp. 93–101, 2019.

[17] M. Alhammami, S. Hammami, C. P. Ooi, and W. H Tan, "Optimised ML-based system model for adult-child actions recognition," *KSII Transactions on Internet and Information Systems*, vol. 13, no. 2, pp. 929–944, 2019.

[18] 宏 黄, S. Gao, and Y. Yu, "Visual obstacle avoidance system based on optical flow method," *Journal of Image and Signal Processing*, vol. 05, no. 02, pp. 66–72, 2016.

[19] J. Ryu, J. Seo, H. Jebelli, and S. Lee, "Automated action recognition using an accelerometer-embedded wristband-type Activity tracker," *Journal of Construction Engineering and Management*, vol. 145, no. 1, Article ID 04018114, 2019.

[20] L. Cavigelli and L. Benini, "Origami: a 803-GOp/s/W convolutional network accelerator," *IEEE Transactions on Circuits and Systems for Video Technology*, vol. 27, no. 11, pp. 2461–2475, 2017.

[21] R. C. Hespanhol, "The expression of mannose receptors in skin fibroblast and their involvement in leishmania (L.) amazonensis invasion," *Journal of Histochemistry and Cytochemistry*, vol. 53, no. 1, pp. 35–44, 2005.

[22] J. Lei, G. Li, J. Zhang, Q. Guo, and D. Tu, "Continuous action segmentation and recognition using hybrid convolutional neural network-hidden Markov model model," *IET Computer Vision*, vol. 10, no. 6, pp. 537–544, 2016.

[23] A. J. Mayan, B. Bharathi, C. Vishal, and C.V. V Subrahmanyam, "Smart gloves for hand gesture recognition using sign language to speech conversion system," *International Journal of Pure and Applied Mathematics*, vol. 119, no. 12, Article ID 14111, 2018.

[24] T. Liu, K. Chen, X. Dai, and J Luo, "Action recognition fused with RGB-D multi-modal features and radius-margin bounded extreme learning," *Moshi Shibie yu Rengong Zhineng/Pattern Recognition and Artificial Intelligence*, vol. 31, no. 10, pp. 958–964, 2018.

[25] H. Tann, H. Zhao, and S. Reda, "A resource-efficient embedded Iris recognition system using fully convolutional

Hindawi
Mobile Information Systems
Volume 2022, Article ID 4964894, 9 pages
https://doi.org/10.1155/2022/4964894

Research Article

Practicability of Sports Goods in the Sports Field Based on Artificial Intelligence Technology

Huaibo Zhang[1] and Jianghua Zhu[2]

[1]*Department of Physical Education, East China University of Political Science and Law, Shanghai 201620, China*
[2]*Department of Physical Education, Donghua University, Shanghai 201620, China*

Correspondence should be addressed to Jianghua Zhu; zhujh@dhu.edu.cn

Received 2 April 2022; Revised 20 May 2022; Accepted 7 June 2022; Published 21 June 2022

Academic Editor: Liming Chen

People are in the intellectual age. The use of technologies such as smart search engines, machine translation, fingerprint analysis, facial scanning, and self-driving makes people's social and work lives happier. The intersection of artificial intelligence and other projects has also become the focus of research in the new era. This article uses comparative experimental methods and sampling methods, puts forward the evaluation method of association rules in the recommendation of sports goods, and compares the selection of sensors used by the five types of sports companies in the sports experiments. In the experiment part, according to the minimum confidence level, the two rules are met. Minimum confidence is a threshold defined by users or experts to measure confidence, which represents the lowest reliability of association rules. The conclusion is that 30% of users have bought running shoes and hiking shoes at the same time and 66.6% of users have also purchased sports suits; there are also sports suits purchased at the same time. All mountain bike users have bought sports gloves. The weight of Freescale is 0.2530, the weight of Bosch is 0.4457, the weight of ST is 0.0946, the weight of VTI is 0.0953, and the weight of Konix is 0.1114. The experimental results show that the selection result of the three-axis acceleration sensor is the SMB380 model of Bosch.

1. Introduction

Artificial intelligence technology started late in China, but it started early in foreign countries. In these years, artificial intelligence research has risen again. Artificial intelligence is being used in more and more industries [1, 2]. Automated driving has brought a shift to the transportation sector. Smart robots are expected to control the pharmaceutical industry using an identification algorithm to help police arrest suspects. In allocating technological resources, artificial intelligence has advanced in all areas and will cause a huge change for society in the future [3–5]. In addition, the United States, Japan, the United Kingdom, China, and other global scientific and technological powers have joined forces to explore artificial intelligence and present relevant strategic plans to improve artificial intelligence nationwide. Artificial intelligence is currently evolving rapidly. Scientists hope to develop an agent that can think independently to simulate human intelligence and hope to realize further research on human intelligence through the study of intelligent machines.

The development trend of modern sensor technology can be analyzed and summarized from four forces: first, the development of new materials, new processes, and new sensors. Second, realize the multifunction, high precision, integration, and intelligence of the sensor. Third, realize the miniaturization of sensing technology hardware system and components. Fourth, realize wireless networking through the cross integration of sensors and other disciplines.

From a practical point of view, it is easier to see the moral issues of people related to the rapid development of artificial intelligence technology. Artificial intelligence technology includes disciplines such as an AIS system in medicine, the application of mechanical design, the practice of war, and space travel. The real goal of artificial intelligence research at this stage is to increase the potential of computers so that

computers can mimic the human brain and perform various functions on machines, thus producing robots. But as we often say that technology is a double-edged sword, the problem of technological alienation will not be completely eliminated, but it must be covered and improved through continuous technological progress. Therefore, at the practical level, we must correctly treat humans in the development process. The ethical problems brought about by smart technology must be avoided, and appropriate corrective measures must be taken at the appropriate time. Only by combining practical and theoretical foundations can we develop better, which means we must always do well. Take preventive measures and preventive mechanisms before serious problems arising in the application of artificial intelligence and recognize the dual problems of technology and rationality, which is of great practical significance to the progress of human life, science and technology, and civilization.

Khatib and Ahmed put forward nine major factors that have caused digital disruption in the domain of the sports, including the impact of AIS on athletes, competition rules, training quality, and training results. But his research did not propose a strategy for sports media people to respond to the above changes [6]. In April 2018, Naslund et al. conducted a comprehensive analysis on the concept, design, and studies and advances in AIS; its beneficial and adverse effects on life, medical care, finance, and other fields; and how to shape the future of artificial intelligence. But his research did not compare the policy layout measures [7]. Of course, the ethical issues designed at the artificial intelligence level are also considered at the level. In their research, Cheng and Mitomo pointed out that humans need artificial intelligence and cannot be afraid of the destruction of the science fiction plot. They put forward a "Turing test" on morality and explore some questions about the ethics of robots, describing the establishment of moral robots. However, their research did not provide constructive opinions on feasible solutions [8].

The innovations in this article are as follows. (1) The methodological description of research policy simplifies the whole process of the genetic algorithm, explains the purpose of the operation of the genetic algorithm, and explains the whole text theoretically. (2) The technical risks of artificial intelligence are analyzed and an ethical discussion and explanation of the industry are conducted. (3) The packaging was taken into account in the selection process, and the table was explained twice. The research on the practicability of sporting goods in the field of sports based on artificial intelligence technology designed in this paper is better than the traditional research on the practicability of sporting goods in terms of algorithm accuracy and experimental methods.

2. Method of Practicability of Sports Goods in the Sports Field Based on Artificial Intelligence Technology

2.1. Definition. The emergence of artificial intelligence stems from people's demand for upgraded manufacturing and use of tools. In recent years, "artificial intelligence" applications have been springing up like rain, permeating all aspects of our lives [9] and people have more and more channels to understand it. From the conceptual description in Hollywood sci-fi movies to the production model of real manufacturing [10] to the use of products in life, its development once led the trend of electronic intelligence in this era [11], such as robots, expert intelligence, unmanned vehicles, and the integrated combination of smart home appliances and smart phones, affecting our daily behavior. The rapid evolution of science and innovation has allowed us to enter the era of synthetic engineering. So, how is artificial intelligence defined [12]?

A general reference to AI is the technical sciences that study and develop methods, techniques, and operation for the simulation of the system, expanding and improving mankind wisdom [13]. Computer science is also at the forefront of computer science and technology. Although it is a computer science subject, it also covers the sciences [14], psychology, linguistics, logic, cognitive science, behavioral and mathematical sciences, computer science, and management. Domainology [15] can be said to be a multidisciplinary subject [16]. According to many experts, they all hope for a uniform interpretation of the concept of "artificial intelligence" [17], but the meaning is not the same from the perspective of technological evolution [18]. "Father of artificial intelligence", Dr. John McCarthy, has examined artificial intelligence to determine the behavior of machines based on human behavior [19]. MIT's Professor Winston believes that AI is the study of how you can use a computer to perform logical tasks that only people from the past can perform [20]. Toyoaki Nishiten, the former president of the Japanese Society for Artificial Intelligence and a professor at Kyoto University, uses "intelligent devices" or "mind devices" to define artificial intelligence. Japan's top artificial intelligence expert, Professor Song Wei Feng of the University of Tokyo, believes that artificial intelligence is human-like computer with discovery and perception functions made by artificial methods and its manufacturing technology. The opinions of experts generally reflect the basic functions and content of artificial intelligence technology, and its emergence is of epoch-making significance.

In different ways of thinking [21], most of us have a rather vague understanding of artificial intelligence. When we talk about artificial intelligence, we are referring to representative high-tech devices similar to robots [22, 23]. However, the biggest difference between the two lies in artificial intelligence. It is equivalent to the brain of a robot and is not limited to its brain. Therefore, in essence, artificial intelligence is an artificially constructed intelligent human device that simulates human thought and consciousness. After experiencing the trough, artificial intelligence has now entered a new stage. As humans demand for intelligent applications in the future, more uses of artificial intelligence will be introduced to humans [24]. Table 1 is the policy documents and main content related to artificial intelligence.

Table 1: AI-related policy documents and their main contents.

Year	Documents	Important content
2015	The state department on the active advancement of the "Guiding Opinions of the Internet" operation	List AI as one of the point actions
2016	"National Economic and Social Development Plan of the People's Republic of China"	Focus on breakthroughs in major big data and critical cloud computing skills
2016	Internet + AI three-year action implementation plan	Speed up the growth of AI sector
2017	Technological Innovation 2030-Major Project	The term artificial intelligence first appeared in government reports
2017	New generation artificial intelligence development plan	Layout of artificial intelligence at the national level
2017	Promote the new generation of AI industry to push the development of the 3-year plan of action	Push the integrated growth of AI and the real economy

2.2. Physical Training in Sports Scientific Surveillance. At present, the way of surveillance athletes' body function can be broadly classified into three types: one is through the observation of coaches or participants' own voluntary assessments, e.g., conscious exercise vigor meter. The second is to evaluate the functional status according to the changes in athletes' physical functions through exercise load experiments. The third is to quantitatively assess the physical condition of athletes through the analysis and detection of physiological and biochemical indicators such as blood, urine, and sweat and determine exercise intensity according to changes in blood lactic acid, urine protein, and other markers [25]. According to blood sugar, changes in blood fatty acids, blood ammonia, and other markers are used to understand energy usage, and changes in some factors are used to judge the body's adaptability. Training load assesses an athlete's ability to function with immune-measuring devices such as lymphocytes, proteins, serum, and saliva. The third approach is accurate, objective, and quantitative and reflects the athlete's physical activity. Nevertheless, the outcomes of these metrics are not the same across movements [26]. Traditional and standardized control methods such as haemoglobin, glycaemia, breast acid, and immunoassays are complex and expensive and are only available in the laboratory or with little detail. Of particular importance for the science of sports training is the development of control methods with high sensitivity, high performance, and ease of use. Life sensor is highly flexible, very professional, and easy to use. It is capable of controling various characters properly during sports training. You can also constantly monitor the direct movement of the sensor. Thus, the use of life sensors in motion tracking is widely viewed [27, 28]. The clustering hypothesis usually means that the samples in the same cluster are more likely to have the same sample category label. According to the definition of the clustering hypothesis, the decision boundary of the sample category should be passed in the area with relatively sparse data as much as possible; otherwise, the sample points in the dense area of the cluster may be divided into both sides of the category decision boundary. This is the mark for distinguishing the sample category. Under the setting of the clustering hypothesis, the function of a large number of unlabeled samples in the training sample set is to divide the boundary between the dense and sparse regions of the data distribution in the sample space. Cases with a higher chance of ranking than this level were considered positive with double classification as well as those with a chance of being classified as negative below this level. Similarly, if different threshold values are selected, different pairs (FPR, TPR) are generated to obtain the operating curve (0.0), (1.1), which is the binary ROC curve classification [29].

2.3. Strategy and Methodological Description. The first is the general approach and background and after that data mining technology and algorithm research. Explain in detail the basic concepts and algorithms of data mining in data mining technology, association rules, and cluster analysis. Enter the web data mining and suggestion system, for example, the basic concepts and classifications of network mining, as well as a detailed description of each category, and link analysis and link library link analysis algorithms in network mining technology. An online recommendation system is designed for sports products. For example, the network uses a mining architecture to collect network data and preprocess the data. The knowledge discovery department uses cluster analysis and network analysis. SOLAP analyzes and visualizes the results, which is convenient for users to understand. Online proposal combines clustering algorithm and association rules and analyzes and proposes based on URL process. The functional structure and mining process of the online bidding system are proposed, cluster analysis and correlation analysis on the market behavior and browsing behavior of online shop users are adopted, and corresponding suggestions are given. Finally, a summary is made. The analysis block diagram is shown in Figure 1.

Next, the genetic algorithm is explained and simplified.

In a transaction database, an item set is a collection of items that appear together in certain transactions. A data set containing i elements is defined as a set of i series objects. In this data set, by adding the frequency of certain elements to the rule, the frequency of other transactions can be derived.

Assumption $I = \{i_1, i_2, \ldots, i_m\}$: DB is a collection of transactions, and transaction T represents a single transaction in DB. Suppose X is an item set, and the association rules are as follows:

$$X \Rightarrow Y. \tag{1}$$

Sometimes recommendations based on association rules are not as good as randomly generated recommendations.

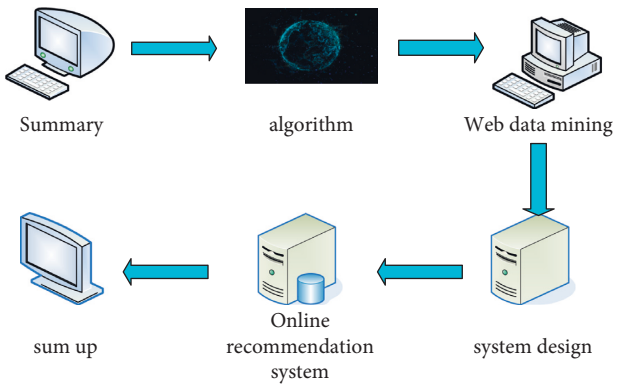


Figure 1: System flow chart.

For this reason, this article introduces a measure called lift, which compares the lift value of different rules to measure whether the rule is meaningful and judge the meaning of the rule and its magnitude. It is calculated as follows:

$$\begin{aligned} \mathrm{Lift}(X \Rightarrow Y) &= c(X \Rightarrow Y)/s(Y), \\ &= (s(X \Rightarrow Y))/(s(X) * s(Y)). \end{aligned} \tag{2}$$

Frequent item sets refer to the sets whose support is greater than or equal to the minimum support (min_sup). Support refers to the frequency of a set in all transactions. Based on the frequent item sets generated in the first step, then studying the association rules between each item, at this stage, if the rules are

$$\{x_1, x_2, x_3\} \longrightarrow x_4. \tag{3}$$

Then, the rule confidence is in the following formula:

$$c = s(x_1, x_2, x_3, x_4)/s(x_1, x_2, x_3). \tag{4}$$

Therefore, it can be defined that a strong association rule is a rule with a confidence c greater than a given threshold. We can get

$$S_j' \in A_k^b. \tag{5}$$

Therefore, it can be considered that the best point is likely to fall into the string, which is used as the optimization space for the next generation, and the corresponding variables are

$$\begin{cases} x_i \in \begin{cases} \left[x_i^L, x_i^U\right] & i \neq k \\ \left[x_i'^L, x_i'^U\right] & i = k \end{cases}, \\ \left[x_i'^L, x_i'^U\right] = \begin{cases} \left[x_i^L, x_i^U\right] & b = 0 \\ \left[x_i'^L, x_i'^U\right] & b = 1 \end{cases}. \end{cases} \tag{6}$$

Supplement

$$x_k^m = \frac{1}{2}\left(x_k^l + x_k^u\right). \tag{7}$$

Move the optimization space: in order to avoid losing the optimal solution in the process of reducing the optimal space, the driving distance can be taken as $2d_k$, where d_k is the distance between two adjacent different points in the x_k direction:

$$d_k = \frac{x_k^u - x_k^l}{2^{n_k} - 1}. \tag{8}$$

The moving method is to adjust the boundary:

$$\left[x_i^L, x_i^u\right] = \begin{cases} x_k^L - 2d_k, x_k^U - 2d_k & b = 0 \\ x_k^L + 2d_k, x_k^U - 2d_k & b = 1 \end{cases}. \tag{9}$$

The fitness function is directly converted from the objective formula:

$$F[f(x)] = \begin{cases} f(x) \\ -f(x) \end{cases}. \tag{10}$$

In the boundary construction method, the following transformations are made for the problem of finding the minimum value:

$$F[f(x)] = \begin{cases} C_{\max} - f(x) & f(x) < C_{\max} \\ 0 & f(x) \geq C_{\max} \end{cases}. \tag{11}$$

Change to the maximum value algorithm:

$$F[f(x)] = \begin{cases} C_{\max} + f(x) & f(x) > C_{\min} \\ 0 & f(x) \leq C_{\min} \end{cases}. \tag{12}$$

Thus, this essay uses a hereditary method to generate different k values through genetic selection, crossover, and mutation algorithms. The ultimate goal is to obtain meaningful frequent sets of order $n+1$ that can form relevant rules. This article aims to eliminate weaknesses. Large association rules can be supported to a certain extent. Here the objective function of genetic algorithm is

$$s(A, B) - s(A *) > D. \tag{13}$$

3. Experiment and Analysis

3.1. Realization of Association Rules in Sports Goods Recommendation. YAAHP is an auxiliary software of analytic hierarchy process and fuzzy comprehensive evaluation method. It provides help in model construction, calculation, and analysis for the decision-making process using analytic hierarchy process and fuzzy comprehensive evaluation method.

Take, for example, ten products in an online sporting goods store. Each purchase of the user is regarded as a transaction, and a specific time period is set. By using YAAHP software, the calculation results are output in PDF format. Take ten goods in online sporting goods stores as an example. Each purchase by the user is regarded as a transaction and a specific time period is set. If the market behavior is marked as 1, then if there is no market in this time period, it is marked as 0. Table 2 lists ten selected products and their respective codes.

Table 2: Sporting goods list.

Number	Kinds	Code
1	Sneakers	A1
2	Hiking shoes	A2
3	Sports suits	A3
4	Treadmill	A4
5	Mountain bike	A5
6	Ridding gloves	A6
7	Fishing rod	A7
8	Camping tent	A8
9	Rowing machine	A9
10	Dumbbells	A10

The transaction data set is established for the purchase behavior of the above-mentioned commodities, and the association rules are mined according to the association rule algorithm a priori. In order to dig out valuable information, the minimum support is set to 30%, and the minimum confidence is 60%. If the minimum support is set too high, there will be fewer effective association rules; if the minimum support is set too low, there will be too many effective association rules. Frequent counting can record the maximum number of objects contained in an object group in a rule. The first mining: the frequent count of any product purchase is greater than 3, and the obtained frequent item set 1 is shown in Table 3.

Second mining: the frequent counts of two item sets are greater than 3, and the obtained frequent item sets 2 are shown in Table 4.

The third mining: the frequent counts of the three item sets are greater than 3, and the frequent item sets 3 obtained are shown in Table 5.

According to the minimum trust level, these two rules are consistent. The conclusion is that 30% of users bought running shoes and hiking shoes at the same time, 66.6% of users also bought sportswear, sports uniforms, and mountain bikes. Simultaneously, they bought sports gloves from users. According to similar calculation results, if a user purchases or browses a sports suit, the user can be provided with sports shoes, running shoes, hiking boots, mountain bikes, and sports gloves. In recent years, sporting goods market has developed rapidly. In particular, the sales of famous foreign sporting goods companies in China have maintained double-digit growth every year. The Chinese market has become the second largest market for these large companies outside the United States. Generally, the higher the market share, the stronger the competitiveness. The representative ones are Nike and Adidas. Table 6 shows the market share of China's sporting goods.

In the comparison of different models of the same brand, in the selection of BMA020, BMA150, and SMB380, the indicators for comparing BMA020 and SMB380 are shown in Table 7.

SMB380 is better by comparison of the products of five manufacturers as shown in Table 8.

3.2. Artificial Intelligence and Application Examples. Table 9 shows the current types of AI.

Table 3: Frequent set item 1.

Number	Code	Frequent count
1	A1	9
2	A2	11
3	A3	8
4	A5	4
5	A6	15
6	A7	6
7	A8	5
8	A10	16

Table 4: Frequent set item 2.

Number	Code A	Code B	Frequent count
1	A1	A3	6
2	A5	A6	4
3	A7	A8	4
4	A1	A2	7
5	A2	A3	6
6	A3	A10	6
...	...	...	...

Table 5: Frequent set item 2.

Number	Code A	Code B	Code C	Frequent count
1	A1	A2	A3	2
2	A3	A5	A6	3

Table 6: China sports products market share list.

Company	Market share (%)	Rank
Nike	22	1
Adidas	21	2
Lining	16	3
Anta	12	4
Puma	7	5
Kappa	6	6
Converse	4	7
Reebok	2	8

3.3. Comparison of Decision Consistency. The target layer-criterion layer judgment matrix constructed based on expert information is input into the YAAHP software. Figure 2 is a comparison of the importance of the decision-making target acceleration sensor. It is the result of the operation in PDF format after inputting the complete judgment matrix between each layer. Because $CR = 0.0800 < 0.10$, the judgment matrix has acceptable consistency. In the acceleration process, the sensor obtains the acceleration value by measuring the inertial force on the mass and using Newton's second law.

Next, the sensitivity of Freescale, Bosch, St, VTT, and Konix is tested. The relative size of the displacement rate of the detection sensitivity indicator relative to the measured change. The detection sensitivity is a sign to measure the physical instrument. The sensitivity is shown in Figure 3.

Table 7: Index comparison of BMA020 and SMB380.

Type	Application field	Precision	Offset (mg)	Free fall detection	Support application expansion
BMA020	Pedometer	Poor	220	Negative	Negative
SMB380	Navigation	Better	60	Positive	Positive

Table 8: Comparison of five manufacturers' products.

Brand	Bosch	Freescale	Konix	ST	VTI
Sensitive	64LSB/g	64LSB/g	125 mg/count	1024LSB/g 360LSB/g	1000count/g 1333count/g
Range	2/4/8 g	2/4/8 g	2 g	2/6 g	2 g
Encapsulation	3.0 ∗ 3.0 ∗ 0.9	3.0 ∗ 5.0 ∗ 1.0	5.0 ∗ 5.0 ∗ 1.2	4.4 ∗ 7.5 ∗ 1.0	7.0 ∗ 7.0 ∗ 1.8
VDD (V)	3.3	2.8	2.8	3.3	2.5
IDD (mA)	0.20	0.40	0.75	0.65	0.20

Table 9: Typical cases.

Company name	Products	Skills	Application
Automated Insights	Wordsmith	Natural language processing, deep knowledge, and content identification	Used by AP to assemble and disburse business reports
Give Me Sports	Give me sports	Deep knowledge, content identification	Spider mail and sports news writing
Washington Post	Heliograf	Deep knowledge, content identification	Coverage of digital-focused news in the field of sports
Narrative Science	Quill	Natural language processing, deep knowledge, content identification	Machine automatic narrative
The New York Times	Visual API tool	Graphic identity recognition	Detect picture features and compare text messages
The Guardian	#Open001	Deep knowledge, content identification	Gather, organize and publish messages within technical support networks

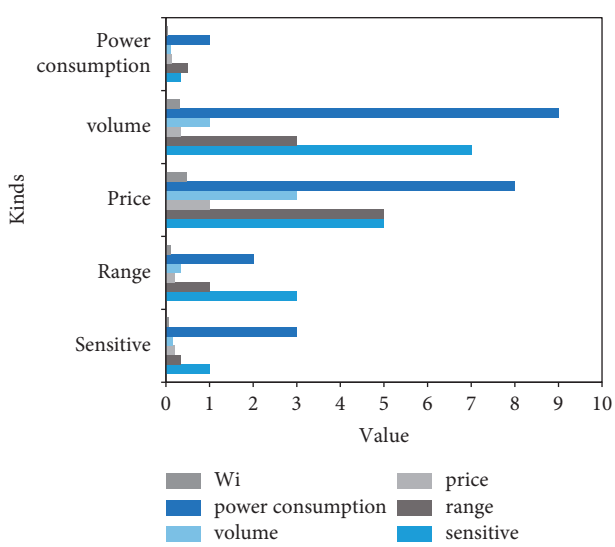


Figure 2: G-C judgment matrix for the selection of acceleration sensor.

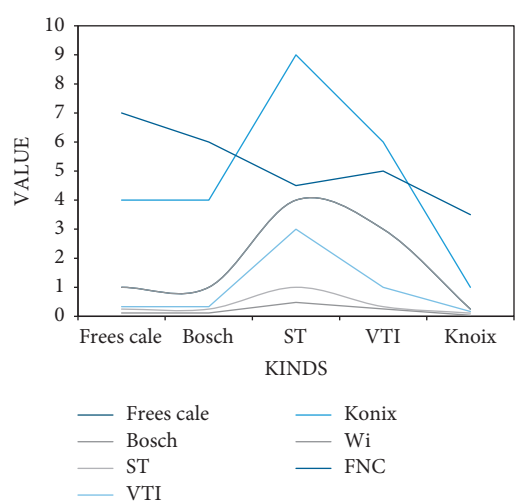


Figure 3: Judgement matrix for the relative importance of the sensitivity of the criterion level at the scheme level.

Decision goal refers to the goal that the decision-maker wants to achieve. The decision-making objectives must be clear, specific, and realistic. If the goal is not clear, marketing activities will lose the direction of efforts, resulting in ineffective operation. Combining the comparison of the index system and according to the comparison results of the product manufacturers of the five manufacturers in the table, analyze the relative advantages of each brand product in the design level relative to the sensitivity of the decision-making target, and determine a sensitivity level crisis table. The range and price in the table are shown in Figure 4.

The power consumption is shown in Figure 5.

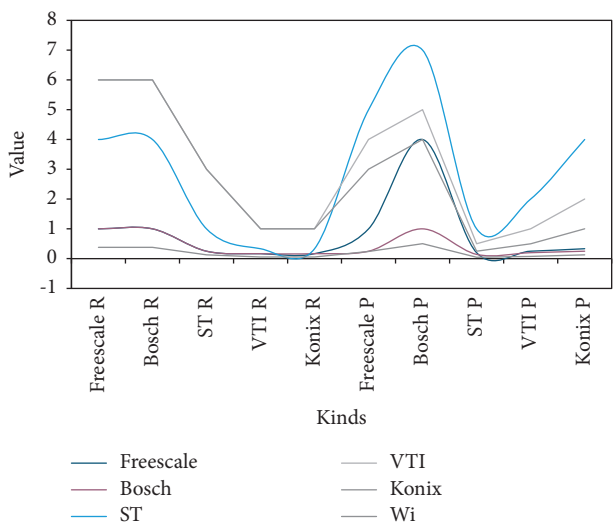


Figure 4: Judgment matrix for the relative importance of price and range at the criterion level at the scheme level.

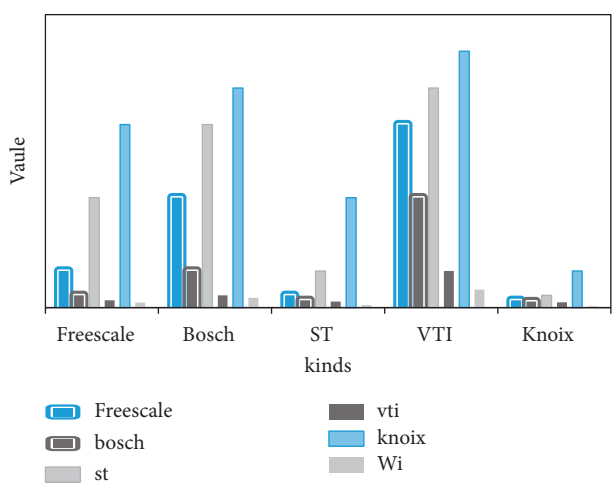


Figure 5: Judgement matrix for the relative importance of the power consumption of the criterion layer.

4. Discussion of Practicability of Sports Goods in the Sports Field Based on Artificial Intelligence Technology

4.1. Relationship between Artificial Intelligence and Technological Paradigm. It must start with a technical example. Since this concept comes from an "example," then we have to start with an example. Technological paradigm refers to a mode to solve the selected technological and economic problems, and these solutions are based on the principles of natural science. When Kuhn proposed the concept of "example," the definition of the concept itself was not clear. Kuhn has tried to correct this defect many times, but they have not gotten good results. Therefore, let us temporarily regard this example as "the research tradition that dominates or dominates a particular discipline." That is, the example is the core content of the community to supervise researchers in a certain field, and it is also a theoretical method to maintain the discipline as an independent scientific field. In fact, it is the inherent quality specification of a discipline. The technology example is a reference for the development of example technology. Therefore, technical examples can be regarded as the guiding existence of specific technologies in the development process. It not only retains the experience content accumulated in the development process, but also applies to the latter. Growth provides direction. In short, the technical example is the basic technical theory for the technical community to maintain the content of technical production in the process of technological development.

From the point of view of characteristics, the characteristics of examples are universal, scientific, historical, regional, and subjective. Because the technical paradigm is the development of paradigms in the field of economics and technology, the characteristics of paradigms also apply to technical paradigms, but the conditions for this formation still require the following points: independent subject areas and foundation of a technical community. The introduction of disciplines is also a subject introduction of basic theory.

4.2. Thinking Changes under the Evolution of Technological Paradigm. The so-called rational thinking is the way people use logic and judgment in the process of observing the inner essence and objective laws of things. It is based on human's perceptual knowledge of objective things, and through certain methods, it can be processed reasonably. It is an abstract process of searching for internal causes. This way of thinking not only exists for a long time, but also includes all aspects of human life.

With the widespread use of machines, the release of human resources has been realized, and the next step in development is the release of human thought. The study of human thought can be traced back to the seventeenth century. Starting from the British philosopher Hobbes, he proposed that "thoughts are calculable." In the 19th century, the German philosopher Leibniz introduced "universal language" and "thought calculation" under the influence of industrial society and culture, indicating that the way of thinking can be expressed through symbolic behavior. Their use of symbols for calculation has become a form of thought expression that can solve one or more problems. By establishing specific rules, through logical rigor, they can avoid semantic misunderstandings and make this rule more rigorous. From the internal domination of logical thinking to the wide application of external, this process led not only to the birth of computers, but also to a process that made people more rational.

4.3. Thinking about the Risks of Artificial Intelligence Technology. Threats to social order include unemployment, threats to public security, and threats to militarization. Threats to social morality include inequality in life, threats to the future survival and development of mankind, and threats to the condition of human subjects. The rupture of technical rationality and social rationality in external causes and the influence of social groups on risk perception both are technical dangers of artificial intelligence. Due to the rupture

of technology and culture, the development of modern technology has always lacked humanitarian reflection. Therefore, when developing technology, we must also consider the human factor and regard people as the bottom line of technological development. An example of new cars based on artificial intelligence are driverless cars that need to be able to adapt to unusual light conditions, unusual weather conditions, unusual road debris, unusual traffic patterns, unusual actions, and gestures made by humans.

Enhancing the exchanges between humanities and science and technology can be carried out in the following ways: First, when formulating science and technology policies, we must combine the suggestions of people in different fields, such as those in the humanities field. Technicians may expect to use technology more to bring about social changes or gain some power through technology, while ignoring the dangers that technology may bring to society. Humanities practitioners can analyze technology in advance before researching and developing it. For example, philosophers discussed the philosophical aspects of the dangers of artificial intelligence technology, providing a reference for the research. Secondly, by enhancing the humanitarian influence of technical personnel, artificial intelligence personnel can impart humanitarian knowledge in the research, enhance humanitarian thinking, and help reduce technical personnel's development of products that pose a huge risk to humans. Although the power of these proposals to change this reality may be limited, the role of humans in artificial intelligence technology will guide the development of artificial intelligence technology.

5. Conclusions

Experimental results show that the study of the suitability of sports equipment in sports based on artificial intelligence technology proposed in this article has a better statistical effect and more comprehensive statistical indicators than traditional technology. New information on artificial intelligence has been added. It is a relevant content of thinking about technological risks. In terms of interpretation and simplification of genetic algorithm, the simplified algorithm makes the integration rate of artificial intelligence technology and sporting goods good, and the objective function of the genetic algorithm is obtained. This document uses a collaborative laboratory approach and the sample collection method to make a comparative explanation of the consistency of decision-making. Compare the five manufacturers' products such as sensitivity, packaging, span and other indicators. The experimental results show that: according to the minimum confidence level, the two rules are in line, and the conclusion is that 30% of users have bought running shoes and hiking shoes at the same time, and 66.6% of users have also purchased sports suits; and also purchased sports at the same time. Users of suits and mountain bikes have bought sports gloves. The weight of Freescale is 0.2530, the weight of Bosch is 0.4457, the weight of ST is 0.0946, the weight of VTI is 0.0953, and the weight of Konix is 0.1114. Therefore, the selection result of the three-axis acceleration sensor is Bosch's SMB380 model product. The shortcomings of this article are: (1) The sample company only selects five product varieties, and the sample volume is not enough. In future studies, more sample sizes can be added for better selection and comparison. (2) The genetic algorithms designed in this article do not have separate control variables in the algorithm adaptation process. Although the actual experimental results have no effect, the reliability of the algorithm should be further investigated in future studies.

Data Availability

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

Conflicts of Interest

The authors declare no conflicts of interest.

References

[1] H. Chen, Y. Shang, and K. Sun, "Multiple Fault condition Recognition of Gearbox with Sequential hypothesis test," *Mechanical Systems and Signal Processing*, vol. 40, no. 2, pp. 469–482, 2013.

[2] L. Qiao, Y. Li, D. Chen, S. Serikawa, M. Guizani, and Z. Lv, "A survey on 5G/6G, AI, and Robotics," *Computers & Electrical Engineering*, vol. 95, no. 2021, Article ID 107372, 2021.

[3] Z. Lv, Y. Li, H. Feng, and H. Lv, "Deep learning for security in digital Twins of Cooperative intelligent transportation systems," *IEEE Transactions on Intelligent Transportation Systems*, pp. 1–10, 2021.

[4] C. H. Chen, "A Cell Probe-based method for vehicle speed Estimation," *IEICE - Transactions on Fundamentals of Electronics, Communications and Computer Sciences*, vol. E103.A, no. 1, pp. 265–267, 2020.

[5] C.-H. Chen, F.-J. Hwang, and H.-Y. Kung, "Travel time Prediction system based on data clustering for Waste collection vehicles," *IEICE - Transactions on Info and Systems*, vol. E102.D, no. 7, pp. 1374–1383, 2019.

[6] M. Khatib and G. Ahmed, "Management of artificial intelligence Enabled smart wearable devices for early Diagnosis and continuous monitoring of CVDS," *International Journal of Innovative Technology and Exploring Engineering*, vol. 9, no. 1, pp. 1211–1215, 2019.

[7] J. A. Naslund, K. A. Aschbrenner, and S. J. Bartels, "Wearable devices and Smartphones for activity tracking Among people with serious mental Illness," *Mental Health and Physical Activity*, vol. 10, no. 8, pp. 10–17, 2016.

[8] J. W. Cheng and H. Mitomo, "The underlying factors of the perceived usefulness of using smart wearable devices for disaster applications," *Telematics and Informatics*, vol. 34, no. 2, pp. 528–539, 2017.

[9] M. Choi and J. Kim, "Electrical characteristics and signal transmission characteristics of hybrid structure yarns for smart wearable devices," *Fibers and Polymers*, vol. 17, no. 12, pp. 2055–2061, 2016.

[10] H. Thapliyal, V. Khalus, and C. Labrado, "Stress detection and management: a survey of wearable smart health devices," *IEEE Consumer Electronics Magazine*, vol. 6, no. 4, pp. 64–69, 2017.

[11] Y. Chang, J. Zuo, H. Zhang, and X. au, "State-of-the-art and recent developments in micro/nanoscale pressure sensors for smart wearable devices and health monitoring systems,"

Nanotechnology and Precision Engineering, vol. 3, no. 1, pp. 43–52, 2020.

[12] V. Dhar, "The Future of artificial intelligence," *Big Data*, vol. 4, no. 1, pp. 5–9, 2016.

[13] S. P. Leo Kumar, "State of the art-Intense Review on artificial intelligence systems application in process Planning and manufacturing," *Engineering Applications of Artificial Intelligence*, vol. 65, no. 1, pp. 294–329, 2017.

[14] W. U. Zhao-Hui, "Research on the application of internet of things technology to digital Museum construction," *Acta Geoscientia Sinica*, vol. 38, no. 2, pp. 293–298, 2017.

[15] Y. Yang and K. Yu, "Construction of distance education Classroom in architecture Specialty based on internet of things technology," *International Journal of Emerging Technologies in Learning (iJET)*, vol. 11, no. 05, p. 56, 2016.

[16] N. Gnotthivongsa, Huangdongjun, and K. Non Alinsavath, "Real-time corresponding and Safety system to monitor home appliances based on the internet of things technology," *International Journal of Modern Education and Computer Science*, vol. 12, no. 2, pp. 1–9, 2020.

[17] R. Atiqur, "Automated smart car parking system for smart cities demand employs internet of things technology," *International Journal of Informatics and Communication Technology*, vol. 10, no. 1, p. 46, 2021.

[18] Z. Gao, D. Wang, and H. Zhou, "Intelligent circulation system modeling using bilateral matching theory under Internet of Things technology," *The Journal of Supercomputing*, vol. 77, no. 11, pp. 13514–13531, 2021.

[19] W. Li, "Design of smart campus management system based on internet of things technology," *Journal of Intelligent and Fuzzy Systems*, vol. 40, no. 2, pp. 3159–3168, 2021.

[20] X. Bai, Q. Wang, and S. Cao, "Application of Infusion control system based on internet of things technology in Joint Orthopedics Nursing work," *Journal of Healthcare Engineering*, vol. 2021, no. 4, pp. 1–11, 2021.

[21] Y. Cao, "Research on application of the Internet of things technology in financial leasing of intelligent manufacturing enterprises," *International Journal of Advanced Manufacturing Technology*, vol. 107, no. 3-4, pp. 1061–1070, 2020.

[22] M. Pan, Y. Liu, J. Cao, Y. Li, C. Li, and C. H. Chen, "Visual Recognition based on Deep learning for Navigation mark classification," *IEEE Access*, vol. 8, pp. 32767–32775, 2020.

[23] Q. Wang, Z. Mu, and L. Jin, "Control method of robot detour obstacle based on eeg," *Neural Computing & Applications*, vol. 34, no. 9, pp. 6745–6752, 2021.

[24] L. Wang and W. Deng, "A research-Oriented Teaching model for public physical education in Colleges based on Extenics theory," *International Journal of Emerging Technologies in Learning (iJET)*, vol. 16, no. 01, p. 247, 2021.

[25] G. Liu, "Research on the status Quo of the Curriculum of public physical education in high Schools," *Journal of Contemporary Educational Research*, vol. 4, no. 2, pp. 50–53, 2020.

[26] R. C. Oliveira, "Saúde Coletiva e Educação Física: um convite ao diálogo," *Ciência & Saúde Coletiva*, vol. 23, no. 10, p. 3465, 2018.

[27] H. Gao, "Research on the Reform and development of public physical education in Colleges and Universities under the background of "Healthy China" strategy," *Advances in Higher Education*, vol. 3, no. 2, p. 55, 2019.

[28] D. Fu, L. Chen, and C. Zhou, "Integration of wearable smart devices and internet of things technology into public physical education," *Mobile Information Systems*, vol. 2021, Article ID 6740987, 2021.

[29] X. Wang, C. Liu, and Y. Qi, "Research on new media content production based on artificial intelligence technology," *Journal of Physics: Conference Series*, vol. 1757, no. 1, Article ID 012062, 2021.

Hindawi
Mobile Information Systems
Volume 2023, Article ID 9769768, 1 page
https://doi.org/10.1155/2023/9769768

Retraction

Retracted: Multimedia Technology Based on Cloud Computing in Aerobics Teaching

Mobile Information Systems

Received 1 August 2023; Accepted 1 August 2023; Published 2 August 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] X. Guo, "Multimedia Technology Based on Cloud Computing in Aerobics Teaching," *Mobile Information Systems*, vol. 2022, Article ID 4157042, 7 pages, 2022.

Hindawi
Mobile Information Systems
Volume 2022, Article ID 4157042, 7 pages
https://doi.org/10.1155/2022/4157042

Research Article

Multimedia Technology Based on Cloud Computing in Aerobics Teaching

Xiuqing Guo

Zhejiang Industry & Trade Vocational College, Wenzhou 325800, Zhejiang, China

Correspondence should be addressed to Xiuqing Guo; soess@hnu.edu.cn

Received 26 March 2022; Revised 11 May 2022; Accepted 27 May 2022; Published 20 June 2022

Academic Editor: Liming Chen

Multimedia teaching has been widely introduced in college education and has become an important teaching aid. Cloud computing has relatively few applications in China's education field, but it has developed rapidly in recent years. The main feature of cloud computing lies in the use of virtualization technology to integrate various software and hardware resources and provide them to users via the Internet. In recent years, the application of multimedia technology has expanded from professional courses and cultural courses to the courses of sound, body, and beauty, which greatly enriched the teaching content, activated the classroom atmosphere, and improved the teaching efficiency. Multimedia teaching can be based on clear learning objectives, rational selection, and use of modern digital media, targeted for students' new aerobics education. Applying multimedia technology to college aerobics teaching is an important opportunity for the reform of aerobics education. Aerobics is a well-loved and widely popular sports event that integrates group gymnastics, dance, music, fitness, and entertainment. This paper introduces the difficulties of current multimedia technology and explains how to effectively carry out aerobics teaching, focusing on how to combine multimedia technology with aerobics teaching to promote the vigorous development of aerobics education. Taking the aerobics teaching in colleges and universities as an example, this paper mainly analyzes the shortcomings of current aerobics teaching in colleges and universities in China. Applying the strategy can bring certain enlightenment to the aerobics teaching in colleges.

1. Introduction

After entering the search keywords "multimedia" and "aerobics" in CNKI, it is found that the experimental and theoretical research of multimedia technology in aerobics has achieved certain results. However, there is still insufficient research on the use of network resources for teaching and the use of modern media tools. Therefore, the research on the application of multimedia technology in aerobics teaching needs to be further improved.

With the emergence of network technology media and platforms, the transmission of teaching information is no longer limited to classrooms and teachers' oral teaching methods. At the same time, the development and updation of multimedia technology have broken the tradition and routine of education and teaching, which is of great significance for realizing the modernization of teaching methods.

Cloud computing has shown great advantages in the field of education. This advanced computer technology has improved the learning methods of learners and transformed the learning environment. This technology has promoted the reform of the teaching field. Multimedia technology is used in teaching and has immeasurable value [1–3]. Multimedia technology uses images to convey teaching signals to students [4]. Multimedia is the integration of various forms of traditional media, including pictures, images, text, and audio [5–9]. The characteristic of multimedia is that the amount of information transmitted per unit time is extremely large [10–14], which is 4~5 times the amount of information transmitted by traditional media. People use this special new mode of obtaining information to greatly promote the efficiency of information acquisition [15]. In today's society, the field of multimedia application is very extensive. Especially in the field of teaching, multimedia technology can change the quality of teaching, teaching efficiency, and

teaching environment and promote differentiated and personalized teaching [16]. Because of the individual factors of teachers and the different learning and acceptance ability of students, the teaching effect is often not uniform. Teachers must make unified arrangements for student progress, and the teaching efficiency is very low [17–19]. The traditional teaching steps generally include the following: the teacher conducts the complete teaching demonstration, explains the action essentials and precautions, and provides detailed steps to disassemble; the students follow the essentials and perform step-by-step exercises; layered teaching is conducted to correct mistakes of the students; and teachers collectively explain the key and difficult actions [20]. The teaching and learning efficiency of this traditional teaching mode is very poor. Since there are individual students, the learning effect is uneven. If multimedia technology is applied in the teaching process, the above problems can be avoided and the quality and efficiency of teaching can be greatly improved. This will be beneficial for students' self-learning and promote characteristic education.

Building a cloud computing platform to achieve high availability is not only conducive to saving and utilization of hardware resources but also conducive to the optimization and overall construction of cloud computing architecture based on college-intensive customers. This paper puts forward the strategy of optimizing the application of multimedia technology, builds a multimedia aerobics teaching platform, and strives to promote the gradual deepening of aerobics teaching reform, ensuring that the role of aerobics teaching in improving students' physical quality and enhancing students' artistic conservation can be fully exerted.

The innovations of this paper are as follows: (1) The shortcomings of traditional aerobics teaching and the application characteristics of multimedia technology in aerobics teaching in colleges and universities are introduced. (2) The feasibility of applying multimedia technology in aerobics teaching is analyzed. (3) The design of the experiment and the analysis on the difficulty of the realization of the platform are carried out.

2. Defects in Traditional Aerobics Teaching and the Application Characteristics of Multimedia Technology in College Aerobics Teaching

Aerobics is a sport with the accompaniment of music, using physical exercises as the basic means and aerobic exercise as the basis to achieve the purpose of improving health, shaping body, and entertainment. It originated from the traditional aerobic fitness exercise and is a kind of aerobic exercise. There are many kinds of hand shapes in aerobics, which are absorbed and developed from ballet, modern dance, disco, and martial arts. The hand shape is the extension and performance of arm movements. If used well, aerobics movements will be more colorful, lively, and more appealing.

There are some shortcomings in its traditional method of teaching: (1) It is nothing more than a demonstration by teachers. The students imitate the practice, and finally, the teachers organize the students to cooperate with group training. The content of the traditional aerobics teaching class is to repeat several movements, the course is boring and lack of changes, and some aerobics movements are taught very slowly, and students may not be able to learn a complete set of aerobics in one semester. In this process, students learn mechanically and the subject status is difficult to play. (2) There is an emphasis on imitation training of basic ability, ignoring the ability of autonomous movements. Aerobics is a practical sports skill that not only contains artistic performance components but also improves students' aesthetic ability and physical expression ability; teaching efficacy promotes the coordination of students' physical body and improves the physical quality of students. However, the survey shows that the aerobics teaching carried out in Chinese universities, especially aerobics teaching as an elective course, is rarely professional. Most of them only focus on the imitation training of students on basic movements, but not the aerobics of students. This results in students being too dependent on teachers when learning aerobics. Without the help and tutoring of teachers, students become "loose sand" and are rarely able to organize training and programming independently. (3) The technical means are backward, and the classroom teaching materials are not updated. The aerobics movement is a regular and new movement. Only by constantly excavating new movements and adopting new arrangement techniques can we ensure the continuous progress of the students. Therefore, the teaching materials are scarce and the teaching hardware facilities are not complete. This leads to the backward technical methods of the classroom, the lack of timely updation of classroom teaching materials, and insufficient teaching aids. Relying on teachers "single fights alone," the knowledge imparted to students is very limited. (4) There is a lack of professional aerobics teachers, and the teacher's team urgently needs to build the current aerobics teaching method in colleges. On the one hand, the number of excellent teachers from aerobics majors is quite a few, and the demand exceeds supply. On the other hand, the professional quality of existing aerobics teachers is not high, and the problem of insufficient teaching ability is significant, coupled with the lack of professional teacher training mechanism, which has led to the development of aerobics courses in Chinese universities difficult. Completing a set of aerobics movements at the same time often requires the joint participation of all joints and parts of the body. This puts forward certain requirements on the physical coordination, music rhythm, and memory of aerobics practitioners.

By realizing the virtualization of IT infrastructure, IT costs can be reduced while improving the efficiency, utilization, and flexibility of existing assets. Many media CDs burn a lot of media CD burning (1) integration can be multichannel unified acquisition, storage, organization, and synthesis of information.

3. The Feasibility of Using Multimedia Technology in Aerobics Teaching

Multimedia technology is the product of advanced high-tech development. It has been used in teaching since the 1990s. It combines intuitive text, pictures, and audios and videos to

create fresh stimulation and stimulate interest in learning. Multimedia teaching refers to the selection and use of reasonable modern teaching media according to the teaching objectives and teaching objects of different characteristics in the teaching process, which includes designing the teaching process, combining with traditional teaching methods, participating in the whole process of teaching, using a variety of media information to interact with students, and constructing a reasonable teaching process. In practice, it can be concluded that the integration of multimedia technology with aerobics teaching is effective. Through multimedia technology teaching demonstration, videos can be used to slow down the movement so that students can clearly perceive the series of movements and form a correct movement image in the brain, which is easy to imitate and master. (1) Lively classroom atmosphere reflects the sense of the times the accelerated progress of the Internet era has enabled many teaching resources to be shared through the Internet. In the classroom, students can see many classic aerobics teaching videos through video materials. The combination of animation and music, multiangle looping, and lively classroom atmosphere can stimulate students' innovative thinking. Instead of simply imitating the teacher's actions and behaviors, they can realize their own thinking through just the right guidance. The use of multimedia networks to achieve international synchronization can further promote the pace of aerobics teaching in China to keep up with the times and renew its vitality. (2) Targeted teaching makes education more scientific, and multimedia technology applied to classroom teaching integrates educators, students, and Internet media into one. Multimedia courseware is simply a tool used to assist teachers in teaching. In the design, it needs to be designed according to the characteristics of the teaching content and the different needs of the learners. First, information on the whole is classified and organized, and then, text, graphics, images, sounds, animations, and other media materials are integrated in both in time and space, to integrate them and give them interactivity, so as to design and produce auxiliary teaching courseware.. The selection and use of courseware are aimed at the interest and cognition of modern college students. More targeted teaching keeps students interested and helps them take the initiative in learning. The scientific teaching content and standardized terminology allow students to understand the basic theoretical knowledge while standardizing the action. From understanding the music beat to familiarizing with the pace of gestures, from easy to difficult levels, step by step, aerobics teaching is on the track of scientific norms. (3) It can stimulate students' unique aesthetic inclination towards creative and vivid multimedia courseware and improve students' ability of composition and color coordination and students' artistic aesthetic level. The specific dynamic teaching scenarios guide students to consciously enter the learning mode, explore the creativity in the depths of thinking, and turn ordinary imitation into active exploration. This form of teaching not only enriches the teaching resources but also intuitively meets the reform trend of physical education. Combining the shape, sound, and color of the clip configuration, the unique aesthetic trend perfectly integrates the classroom and life, which greatly stimulates the creativity of the students.

Multimedia teaching usually refers to computer multimedia teaching, which is a combination of various media realized by the computer, which has the characteristics of interactivity, integration, and controllability. It is just one of the many media. Compared with ordinary teaching, the advantages of multimedia teaching include intuitive perception, breaking through the limitations of vision, observing objects from multiple angles, and highlighting key points, which are helpful for understanding concepts and mastering methods. The pictures, texts, audios, and videos are combined to mobilize the students' emotions, attention, and interest from multiple angles.

4. Design and Implementation Platform

In order to cultivate high-level technical talents, make colleges and universities adapt to more fierce competition, and make professional courses more acceptable to students, Wuchang Institute of Technology tries to establish a multimedia interactive teaching platform to assist the original teaching model. A complete multimedia computer system is composed of hardware and software. Its core is a computer, and its periphery is mainly audio-visual and other media devices. The hardware type of the multimedia system is a computer host and various input/output devices that can receive and play multimedia information, and its software is a multimedia operating system and various multimedia tool software and application software packages. The multimedia interactive teaching platform adopts the three-layer structure of the dynamic Web database application system, namely, the B/S distributed architecture mode composed of a browser, a web server, and a database server. The system has an open API interface and can exchange information with a variety of scheduling systems, exchange resources with the course center, support Blackboard (digital teaching platform) and Moodle (open-source course management system), generate SCORM1.2 standard courseware package and LMS Linkless connection to support mega resource applications, provide direct support for Flash10-based live broadcast, on-demand and recording, without installation of plug-ins, and support cross-platform applications. The platform deploys HD codec host, HD camera, large-screen display, and other equipment to the training classrooms as hardware to complete the live broadcast and recording of the training process. A multimedia interactive practice training system platform and server are deployed in the central computer room to facilitate the collection of teaching resources and application and storage of audio and video courseware in each training classroom. The application of the above devices and technologies can realize the integration of user management, resource management, data management, and instrument management and organically integrate the laboratory, the service object, and the external environment to ensure the automated operation and advanced development of the laboratory system. The multimedia interactive teaching platform consists of 5 modules,

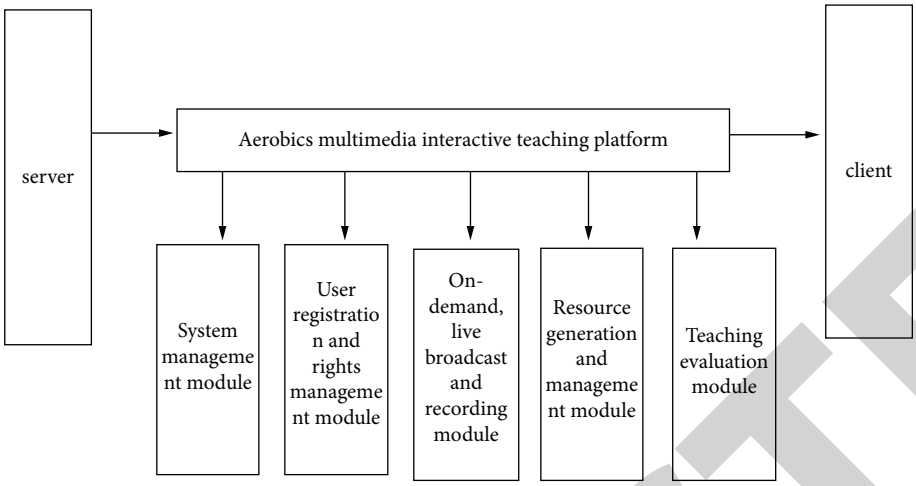


Figure 1: System structure.

namely, system management module; user registration and rights management module; on-demand, live broadcast, and recording module; resource generation and management module; and teaching evaluation module. The overall architecture of the platform is shown in Figure 1.

The system management module includes configuration of basic parameters, configuration of the central server, recording configuration, and upgrade and database management. This module is mainly configured and maintained by the platform administrator. In the user registration and rights management module, the platform defines five different types of users according to different usage rights: visitors and members are two nondeletable roles configured by default, and system administrators, teachers, and students are added as three custom users. Among them, the system administrator has the highest authority, and the administrator can grant appropriate operation rights to other four types of users. User registration function: the user has the status of a visitor when browsing the homepage of the platform and has the permission of "visitor." The user should click "Register" to enter the registration page and fill in the registration page information. After the registration is successful, the page automatically jumps to the personal center page. At this time, the user will be assigned the "Membership" role and the system administrator can also apply for the role change. User rights function: first, the system administrator user, mainly responsible for the daily maintenance and management of the entire system platform, with the highest authority, can control all modules of the system. Daily main responsibility for user management is experimental resource management, video recording, quality course production, and sharing approval. Second, the teacher user is mainly responsible for the input of resource information, including the upload of courseware or videos and student information interaction. Third, student users can study the resources online or download the resources needed, and they can visit the teacher online and ask the teacher what they need to solve. Recording function: the recording function is generally used by the system administrator. The administrator enters the background. In the recording management, manual recording, quick scheduled recording, or recording according to the schedule can be performed separately according to the requirements. Resource generation and management module: users can record and upload videos, edit videos, create microcourses and other resources through the platform, and classify, modify, and delete resources in the management module. The resource library supports a quick search function for classification, which can be quickly searched and sorted according to the education category, course name, grade level, and so on. Teaching evaluation module: the system administrator needs to create a good teaching evaluation activity in advance in the background and then inform the relevant personnel of the corresponding event name, start time, and invitation code. After the assessment personnel log in to the front desk, they will be able to enter the teaching evaluation page. They can view the current status by checking the status of the list. The activity status is divided into three types: "already in progress," "not started," and "completed."

The users of the multimedia online education platform are roughly divided into three dimensions, namely, the teacher dimension, the student dimension, and the system management. From the perspective of teachers, the recorded panoramic video teaching and classroom homework, quizzes, and related teaching materials should be synchronized to the multimedia online platform. This is the most basic component of the platform content and the minimum resource to ensure student learning. At the same time, teachers should also be able to access the teaching resources of other teachers. Each teacher's teaching resources are seamlessly connected and can be viewed by each other. The evaluation of the scores should also be implemented in the platform. The biggest advantage of the platform is that it can break the limitation of time and space, so that the students' test papers can be scanned in the platform for pipeline review and then the system can automatically approve the score uploading teaching management-related system. At the same time, the platform should also be able to add a communication module between teachers and parents. This module is only open to teachers, so that teachers and parents

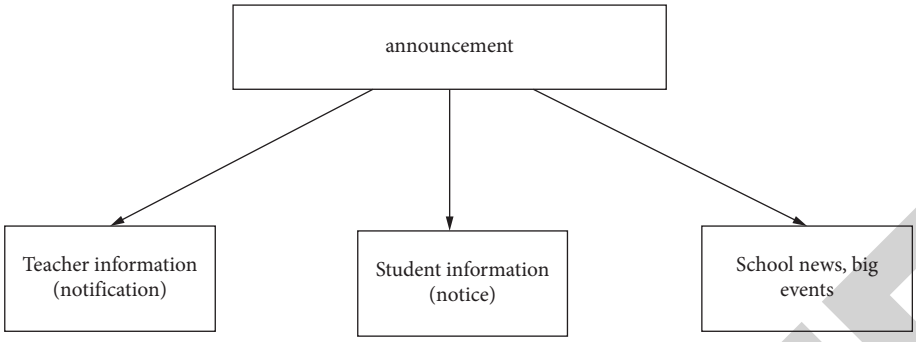


Figure 2: Notification management.

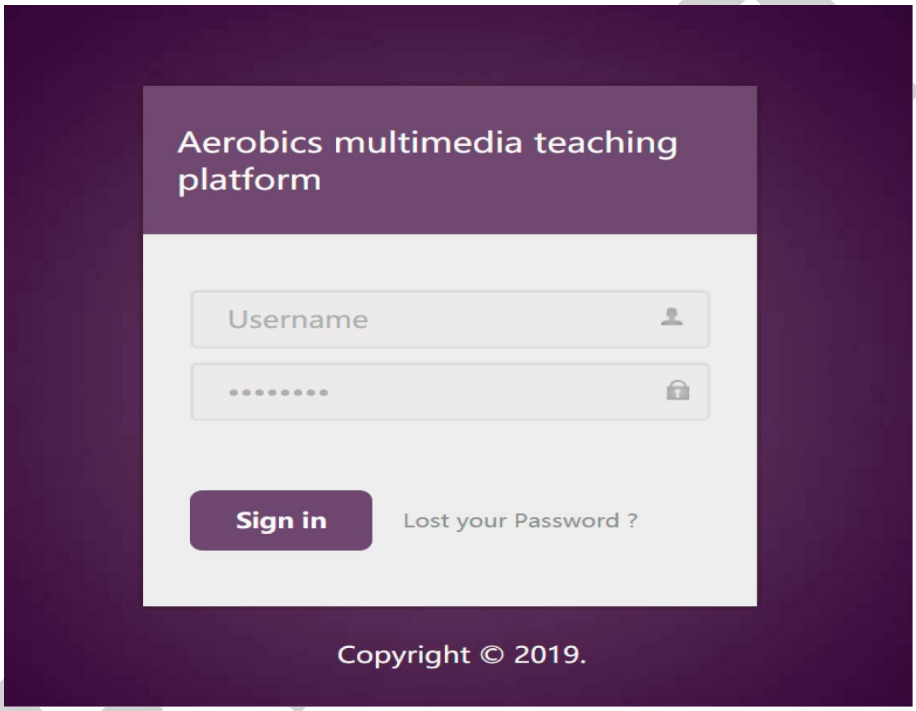


Figure 3: Multimedia platform login.

can communicate and guide together to help college students establish good study habits. This includes a simple operation process. Simply put, students can enter the platform by entering the student number and password, and they can acquire education through the platform. The process of acquiring education should also consider the integration of students' learning goals, design different teaching contents for different students, and propose reasonable evaluation methods. Based on this simple operation, it is also necessary to have the highest level of convenience. It is convenient for students to understand their progress in a timely manner. According to the different learning progress, the prestudy and after-class review will be carried out according to the resources provided by the platform. In addition to the above factors, the platform must have a reasonable assessment system to facilitate students to test their own learning outcomes. Online communication is also the main factor. This communication is not a simple language exchange. It should include the download of related materials, such as teacher's lectures and PPT. Teaching resources, such as student's study notes and other relevant learning materials, can be exchanged online. The system management dimension mainly includes two aspects of content. The first aspect is to ensure the good operation of the platform and ensure the integrity of the system and identification of the teaching materials.

The second aspect of system management is the management of notification announcements. This is not a notification notice in the traditional sense. The platform design should consider campus information, teacher information, new school initiatives, etc., as shown in Figure 2.

The core and fundamental function of the multimedia online education platform is to realize the management and platform maintenance in the process of teaching through the Internet. The above aspects mainly include multimedia teaching process, multimedia online interaction, and

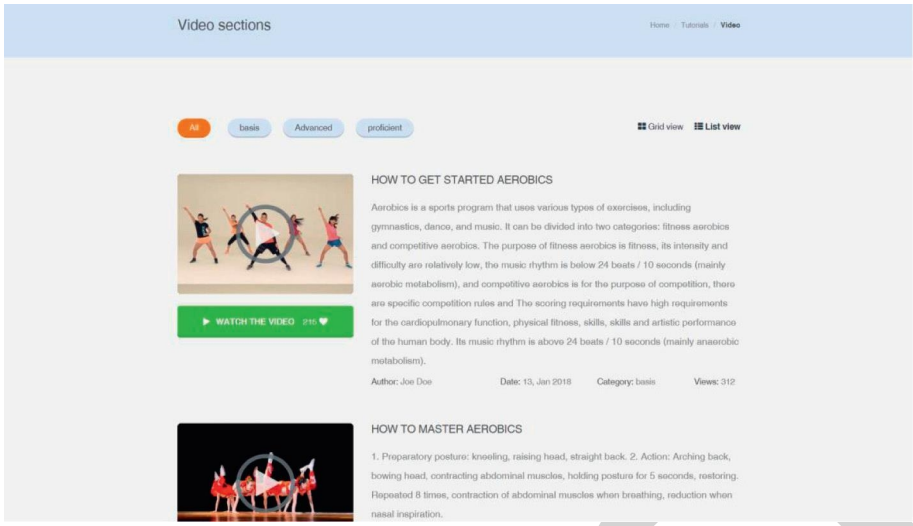


Figure 4: Aerobics multimedia teaching video list.

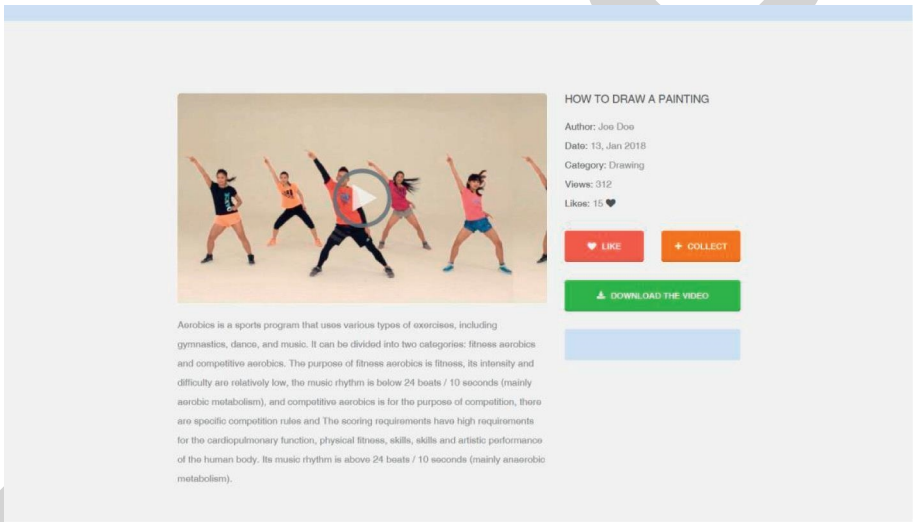


Figure 5: Aerobics multimedia teaching video details.

scientific and reasonable assessment methods. The system login interface is given in Figure 3.

After logging in through the system, users can choose different levels of instructional videos for aerobics to watch and learn. They have basic, advanced, and proficient videos of all levels. The video also has related introductions including teachers, video dates, views, and more (Figure 4).

After selecting the corresponding multimedia learning video, the user can directly click on the video to view it, as shown in Figure 5.

The use of multimedia teaching methods has improved the teaching quality of aerobics, and the research indicators have basically achieved the expected results. Therefore, the implementation of the experiment is feasible and superior, and this teaching mode can be applied in the teaching of aerobics in physical education. It is worth noting that multimedia technology is only a teaching method, which is a beneficial supplement to traditional teaching. In teaching, on the basis of giving full play to the advantages of traditional aerobics teaching methods, we should absorb the essence of multimedia teaching and combine the two organically, so that they can develop their own strengths and complement each other, in order to achieve better results.

5. Conclusion

The main feature of cloud computing lies in the use of virtualization technology to integrate various software and hardware resources and provide them to users via the Internet. At present, major universities are very concerned about the changes brought about by cloud computing and are beginning to put relevant research results into practical applications. Platforms can fully share many excellent courseware resources, and the platform can automatically generate a large amount of courseware, which can make the teacher's ability develop in a balanced manner. Students can

Hindawi
Mobile Information Systems
Volume 2022, Article ID 5615101, 13 pages
https://doi.org/10.1155/2022/5615101

Research Article

Visual Analysis of Audience and Information Interaction of Brand Communication Data Based on Computer Vision

Fuyin Zhang,[1] **Xinmiao Liu**,[1] **and Qing Zhou**[2]

[1]*School of Literature and Media, Suihua College, Suihua, Heilongjiang 152001, China*
[2]*Faculty of Humanities and Arts, Macau University of Science and Technology, Macau 999078, China*

Correspondence should be addressed to Fuyin Zhang; 2111602012@e.gzhu.edu.cn

Received 4 March 2022; Revised 6 May 2022; Accepted 30 May 2022; Published 18 June 2022

Academic Editor: Liming Chen

With the rapid development of mass media, especially the rapid development of new media represented by the computer Internet in the world, the audience is no longer a reader, and the audience transmitted through the media is not simply the recipient of information but is paid more attention by academic researchers in various fields, and the concept of audience can be extended to many fields. With the advancement of media, the way of brand communication is also changing. The traditional research perspective believes that brand positioning is aimed at consumers, but from the perspectives of both sides, brand positioning should broaden its horizons and cover all audiences who receive brand information. The article takes the integration of "cold land black soil" agricultural product brands as the research core. First, the relevant concepts of "cold land black soil" and "agricultural product brand integration" are given the normative definition of the article research, and qualitative analysis is used to analyze the "cold land black soil." The status quo of the integration of "Black Earth" agricultural product brands is summarized from the aspects of integration positioning, existing products, base construction, business projects, and sales network construction. The main problems are relatively weak, imperfect marketing strategies, and loopholes in quality supervision; secondly, the analytic hierarchy process (AHP) is used to make a comprehensive quantitative analysis of the related factors affecting the brand integration of "black soil cold" agricultural products, and determine the brand awareness and consumer awareness.

1. Introduction

With the continuous development of media technology, the continuous upgrading of network infrastructure and application technology facilities, and the widespread use of mobile devices, these provide conditions for the transfer of information production and dissemination to mobile terminals. The Internet is experiencing a new revolution from PC to mobile. The communication environment of mobile Internet has brought profound changes to the communication itself, and the emergence of new communication paradigms and the relationship between transmission and reception have become an important topic of concern in academia and industry. The change in the communication environment is not only reflected in the fact that mobile media reconstructs the audience's lifetime and life scene, but also makes the keywords such as "traffic, portal, platform, user" in the previous PC era gradually replaced by "computer vision." The current scene is regarded as a tool and is widely used in media integration, press and publication, urban management, and other fields. In the field of brand communication, computer vision advertising, computer vision marketing and computer vision communication, and so on have repeatedly appeared in brand communication practice. Computer vision is not only a tool, but also gradually evolved into a kind of thinking, which affects the current brand communication. Therefore, based on the current practice of brand communication, this paper discusses the use of scene elements in brand communication in the context of the mobile Internet era, focusing on the core issue of the current situation, problems, and feasible and effective strategies of brand use of computer vision in the mobile Internet era.

Survival and business growth are inseparable from timely and effective brand communication. However, there

were conceptual or methodological misunderstandings in these early-growing Internet education initiatives when it came to understanding branding and brand communication. They believe that brands are limited to well-known, large, and mature companies. In fact, a brand is an asset of a company and a relationship between products and consumers. Companies at any stage of development need to invest in building and spreading their brands.

Through literature research, it can be seen that most of the research objects or case studies of local brands are based on large and mature businesses, and there are very few studies on small- and medium-sized business companies. In view of the development of Internet companies in recent years, there are few studies on the brand communication of Internet companies. Here, the article takes the corporate brand as the research purpose, which can play a supplementary role in the research on brand communication of this type of enterprises and has certain reference and practical significance for the brand communication of later enterprises.

2. Related Work

Experts at home and abroad have also conducted a lot of research on the visual analysis of information interaction between computer vision and brand communication data. Liu et al. examine the influence of luxury hotel brand, brand loyalty, brand awareness, perceived quality, and brand image on consumers' brand attitude and purchase intention, with brand performance as a background factor [1]. The purpose of Fritz et al.'s research is to establish links with previous authenticity research so as to gain a deeper understanding of the influencing factors of brand authenticity and the results of consumer surveys [2]. According to Barbu et al.'s research, many computer vision and medical imaging problems face the status quo of learning from large-scale datasets of observed features from millions of samples [3]. Kash et al. have made significant investments to support health information exchange (HIE) technologies that can be used to reduce readmission rates for patients in many community hospitals [4]. Ng et al. believe that in order to adapt to the era of information exchange through social networks, the orthopaedic community should incorporate social media communication into its approach to patient education [5]. Chen and Ye believe that with the increasing popularity of mobile social media among Chinese consumers, Western luxury brands are trying to connect with the Chinese market through popular social media [6]. However, due to the lack of relevant data and the methods used in these studies, there are some controversies, resulting in the relevant results not being recognized by the public.

3. Visual Analysis System Construction Design

3.1. System Requirements Analysis. Through the summary of visual analysis technology and the study of heuristic analysis methods, a basic framework for assisting users in data analysis and visualization model construction is obtained. Based on the research, this paper designs and implements an analysis platform using heuristic data visualization analysis method, which is used to verify the practical value of the analysis method and practice some basic data analysis problems with the help of the platform. System design should give full play to the driving position of people in the data analysis process and use computer data analysis and visual analysis methods to simplify the operation process of data analysis, improve the efficiency of data analysis, and improve the effectiveness of data analysis results and lower the threshold limit for data analysts to use. It focuses on solving the difficulties in model selection, data screening, and information cognition in the process of visual analysis.

During the analysis process, the analysis results can be dynamically provided with the data changes. The process allows the analyst to focus the algorithm processing on the subdata set of interest, allows the analyst to ignore the subdata set that is not relevant to the problem, and reduces the interference of the data information in the visualization part, especially the interactive part. The new conclusions obtained in the calculation and analysis process are effectively displayed to the analysts, and the next possible operations are prompted. It supports dynamic interaction, parameter setting, and reasonably arranges the interaction form of the user interface [7].

In order to deal with the problems existing in the data visualization analysis process, the basic process of the heuristic data visualization analysis method can be decomposed into the following steps, as shown in Figure 1.

3.2. The Practice of Heuristic Analysis. The system combines the idea of heuristic analysis method with the construction of visual analysis system and focuses on the process of using heuristic analysis method for data exploration and data discovery. The main process of heuristic analysis can be applied to a specific practice by using a mapping method, as shown in Table 1. The heuristic analysis method is based on the EDA model in the main process of data exploration. Analysts select, filter, regroup, and view details of data in the visual image, which inspires the cognition of data and obtains information. The heuristic analysis method uses the recommendation function of the system to select appropriate visual display methods to display the excavated data information. The functional-level division of the system is combined with the system analysis function and interaction mode for comprehensive design [8].

3.3. System Business Process. According to the design idea of heuristic visualization analysis method, the system adopts the main business processing model of user binding, construction of analysis project, and analysis records stored in the result sharing display in the business process design. At the same time, it is necessary to fit the key business process of heuristic analysis method into the process of system analysis. The business process of the whole system can be mainly embodied in the mode of Figure 2. The background server is mainly responsible for data parsing, data analysis, model recommendation, and related data persistence operations. The browser side is

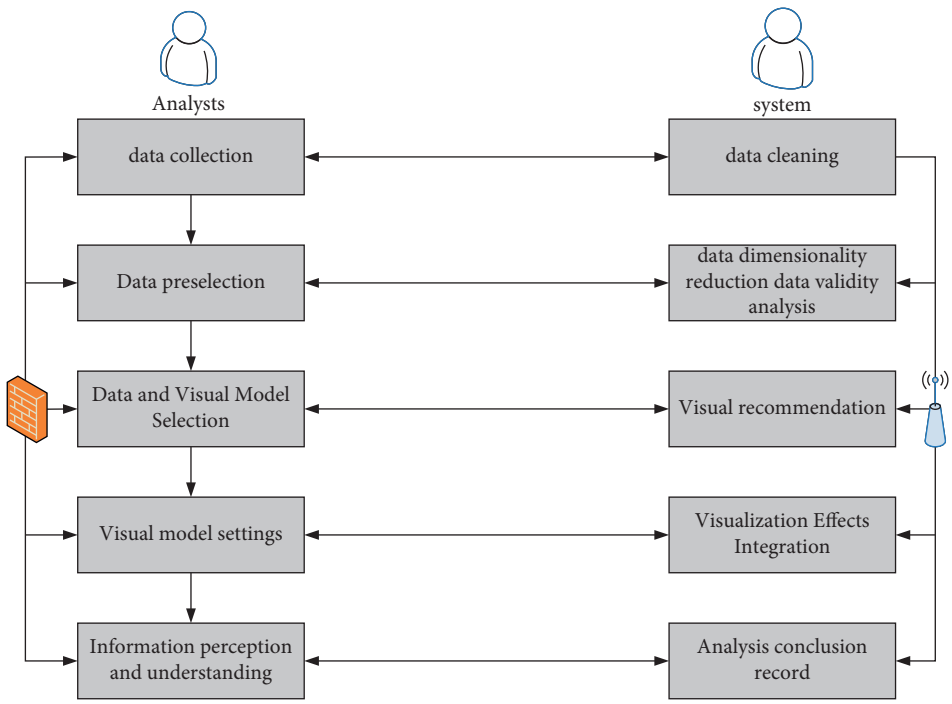


Figure 1: The basic process of heuristic analysis method.

Table 1: One way of mapping heuristic analysis to practice.

Analysis process	User action	System operation	Interactive mode	Numerical value
Data preparation	Data set selection and import	Data analysis, data persistence, data cleaning and display	Take data file upload and database connection as the main model	0.561
Data preselection	Specify data ranges and dimensions	High-dimensional data dimensionality reduction, data attribute discrimination, feature analysis, validity analysis, etc.	The user performs data screening and analysis interface to display the data quality report	1.563
Data analysis	Analyze data quality, multiattribute association analysis	Data attribute correlation analysis and display	Select different data attributes to build visual icons and observe the relationship	0.132
Visual model recommendation		Data visualization coding recommendations, visual model example construction	Displays properties suitable for visual encoding in a sorted list	1.163
Visual model building	Interactively perform data attribute and visual variable coding mapping, and adjust graphics parameters	Dynamically build graphics	Use drag-and-drop, association, etc. to build the model, and adjust the parameter meter to complete the detail adjustment	1.874

mainly responsible for sending the user' s operation request to the background system in the form of HTTP request and accepting the data information generated by the background system. Then, there is a need to build a visual display model effect in the front end and perform interactive operations with the user [9].

The gray box part of the flowchart is the part that the user can cycle through. In this process, the user continuously adjusts the visualization model, analyzes the effective information in the data, and realizes the abstract extraction of the core data information by gradually focusing on the data range.

The server-side data analysis system is an important basis for realizing the heuristic analysis method. The system will perform operations such as parsing, formatting, and data analysis on the original data and store the results of the operations and feed back the analysis results to the front end in an appropriate form. It can be seen that the functions of each module are cohesive, and there is information correlation, and some complex function modules can use the intermediate result information generated by other modules. Here, in the whole analysis process, each module calls each other through abstract business entities and transmits information. Figure 3 is a system frame diagram [10].

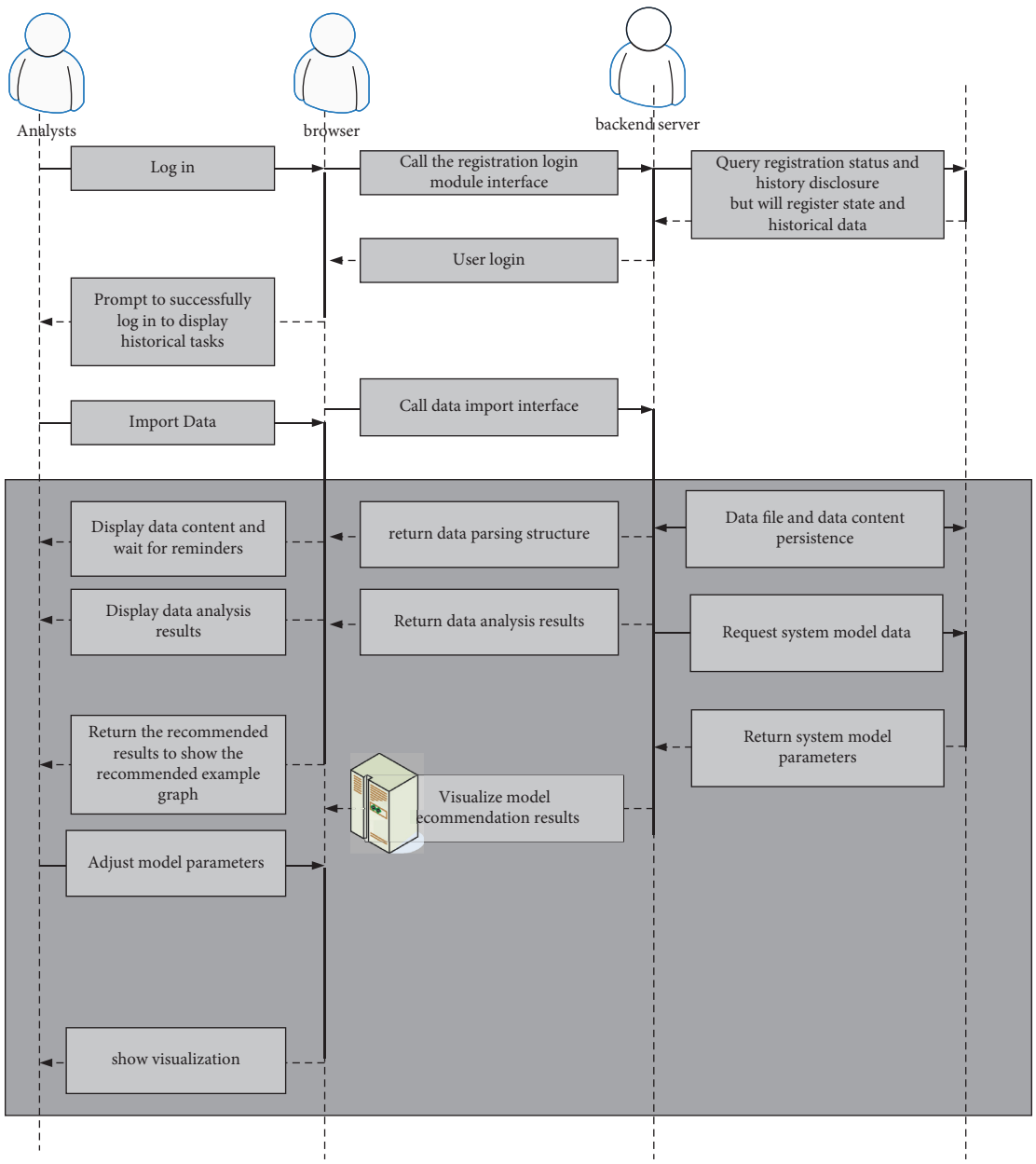


Figure 2: The main operation flow of the system.

In the front end, the Web-based visual model building function is the core module, and the data import module and the information display module together constitute the main part of the front-end system. The visualization model building module mainly integrates several visualization models that have been analyzed. It can be extended on this basis under the same calling interface framework. Figure 4 depicts the modular division of the front-end design of the system [11].

The process design of data parsing is shown in Figure 5, and each type of data file corresponds to a parser. All parsers implement the abstract parser interface, which ensures that the parsing control logic does not need to specifically analyze different types of files and only needs to call the parser factory method and parse the file by the specific parser. In the end, different types of parsers need to convert each piece of data information in the data file into unified JSON format data and finally return a JSON data list containing all data information for other functional modules to access the data information [12].

In the scenario of big data processing, massive data information often lacks sorting and cleaning, for example, a large amount of behavior and log information; although the amount of information is rich, it is difficult for analysts to understand. Generally speaking, it is necessary to integrate and extract a large amount of data, organize the original data into a secondary data table with certain significance, and then carry out visual analysis processing. This process first transforms the characteristics of the data attributes and reduces the amount of data that needs to be

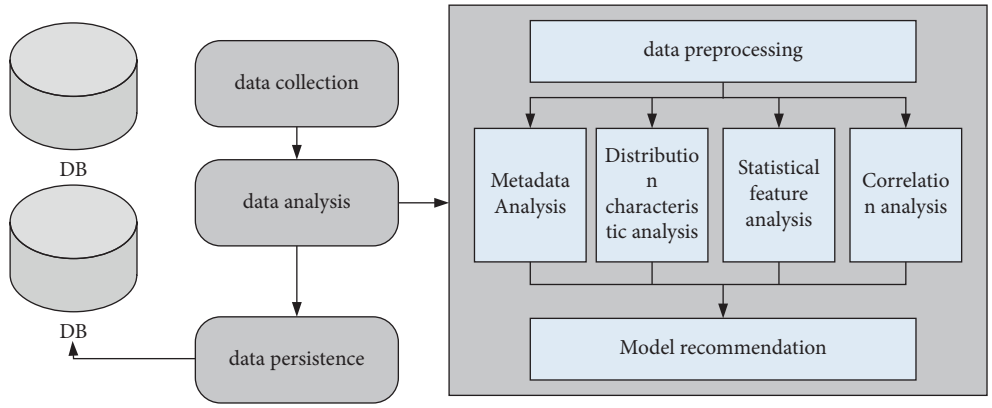


Figure 3: System frame diagram.

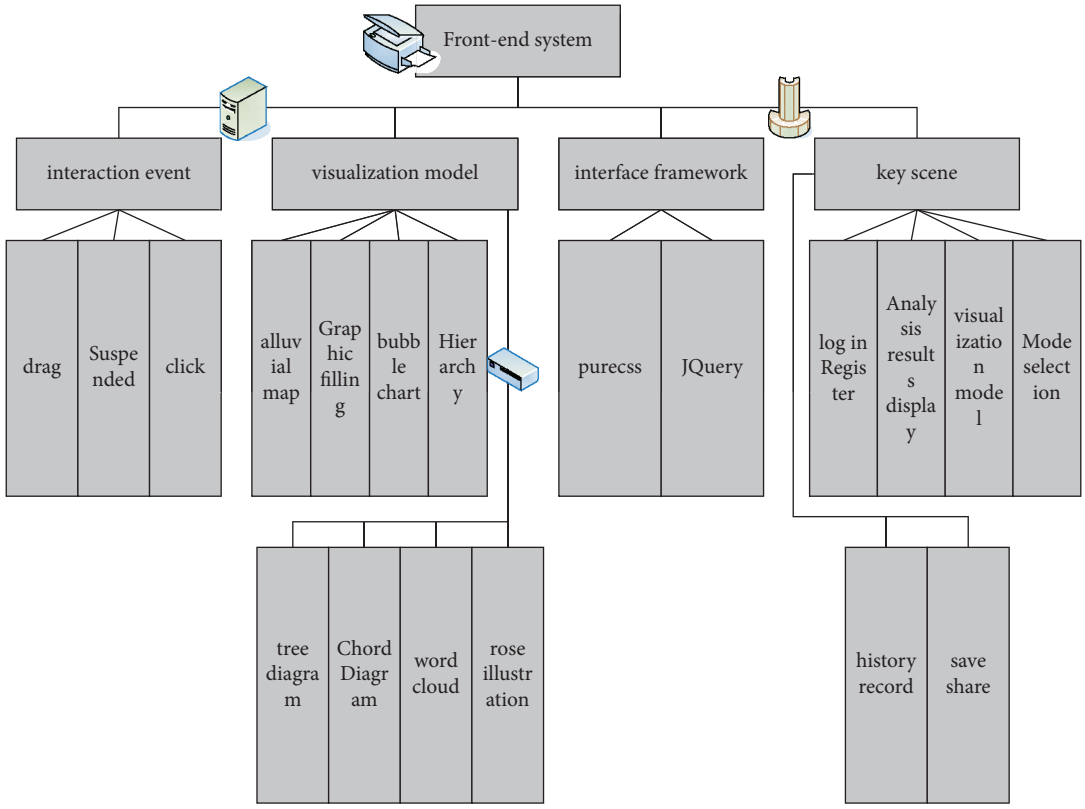


Figure 4: Front-end module division.

processed. In order to connect the process of processing primary data to secondary data, the system is designed to use a Hadoop-based data processing module to achieve the requirements. It realizes the ability to process such data information by reserving an interface for connecting with MapReduce to process data for analysts. Here, the distributed file system of Hadoop can be used to store the acquired massive data in HDFS, and it performs data processing through MapReduce according to the needs of data analysis and stores the results in HBase. Finally, the data to be analyzed is obtained by the system data acquisition and analysis module. The configuration of this environment mainly completes the process of installing Java virtual machine, configuring and installing Hadoop, and realizing the data import interface of system expansion. Its main data processing process is centered on MapReduce; the output results processed by MapReduce can be saved to HDFS files or output to HBase for storage, and after the final integration, the original data table before visual analysis is obtained. After the data is segmented on

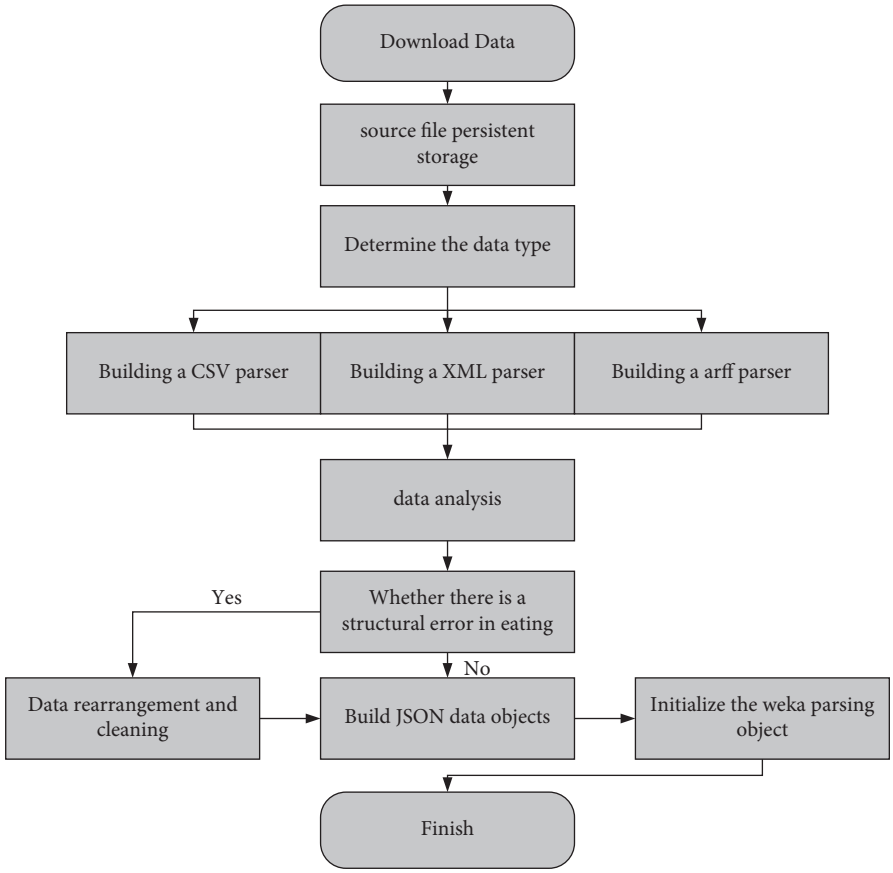


Figure 5: Data parsing flowchart.

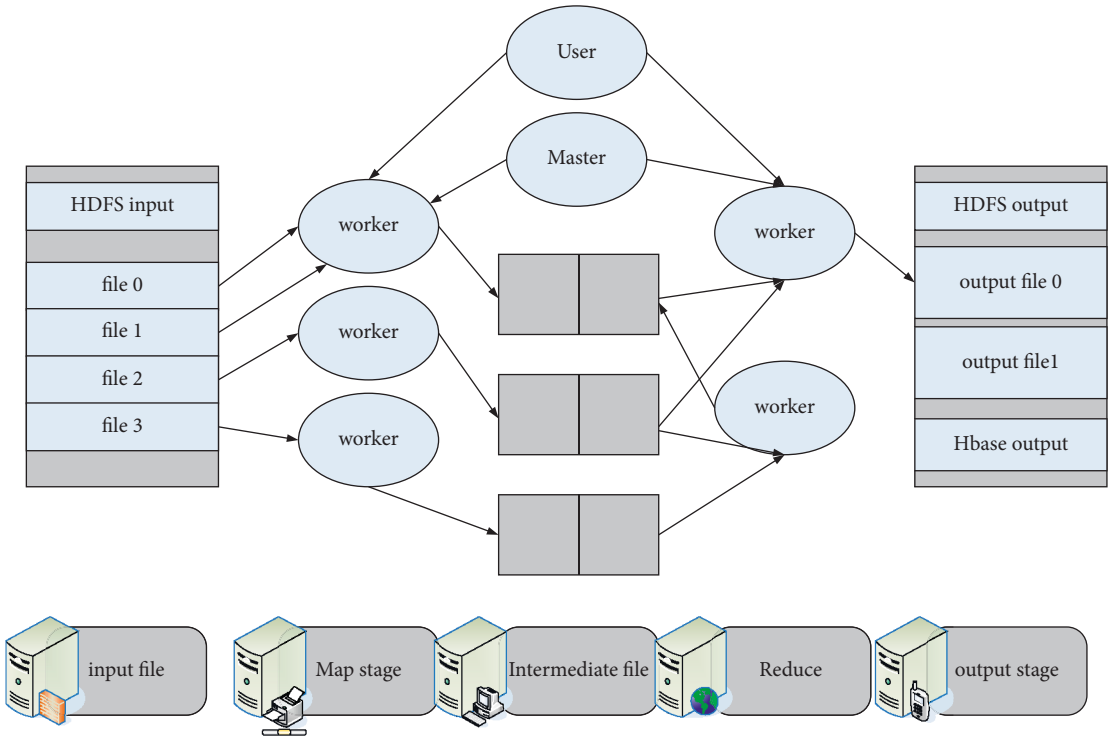


Figure 6: Native data processing flowchart.

the basis of the core feature attributes, the subsequent related functions of the analysis system can be used for the practice of visual analysis. The general process of MapReduce can be shown in Figure 6 [13].

Data Type Matching Degree. The data type matching score consists of two parts: the type matching degree and the uniqueness degree of the attribute. The type matching degree scores are shown in Table 2. The degree of uniqueness of an attribute is used for comparisons between numeric attributes. In the case of mapping categorical visual variables, attributes with a low degree of uniqueness can show the classification characteristics of the data to a certain extent, so the score in this matching situation can be improved. At present, the system compares the unique ratio with the average ratio, and the higher percentage is added to the existing weight as a new weight [14].

Statistical characteristic analysis helps analysts to grasp the whole picture of the data and make in-depth reasoning and judgment according to it. The visual analysis process can use the combination of numerical calculation and image display to realize the study of statistical characteristics and distribution characteristics of data, which is its significant advantage. In order to reflect the centralization trend, separation trend, and distribution trend of statistical data, this part of the function will measure a number of statistical characteristics of the data and display the results of the measurement to the analysts in the form of a visual interactive report for processing. The judgment of data types is mentioned in the section of metadata analysis, and the statistical characteristics of different data types are not completely consistent. The main statistics used in the measurement are the mean, median, and mode of the data, as well as the weighted average of the data obtained by the analyst's self-adjustment of the weight. The following formulas are used to calculate the arithmetic mean and weighted mean, respectively [15].

$$\overline{x} = \frac{1}{n}\sum_{i=1}^{n} x_i, \qquad \overline{x} = \frac{\sum_{i=1}^{n} w_i x_i}{\sum_{i=1}^{n} w_i}. \tag{1}$$

The general calculation formula of each calculation amount is as follows:

$$\sigma = \sqrt{\frac{1}{n}\sum_{i=1}^{n}(xi-\overline{x})^2}, \qquad Vx = \frac{\sigma x}{\overline{x}}. \tag{2}$$

The system not only calculates the skewness coefficient and kurtosis coefficient of the data, but also draws the intuitive distribution in combination with graphics. The formula used in the calculation is as follows:

$$SK = \frac{n\sum_{i=1}^{n}(x_i-\overline{x})^3}{(n-1)(n-2)\sigma^3}, \qquad K = \frac{n(n+1)\sum_{i=1}^{n}(x_i-\overline{x})^4 - 3\left(\sum_{i=1}^{n}(xi-\overline{x})^2\right)^2(n-1)}{(n-1)(n-2)(n-3)\sigma^4}. \tag{3}$$

When exploring the relationship between data, it is often necessary to compare the similarity between the attributes of each dimension of the data. The higher the similarity, the higher the possibility of potential logical associations among them. Due to the different types of data attributes, the measurement methods for calculating the similarity between different categories of attributes are also different. The system mainly considers the processing of the relationship between the three types of data similarity: categorical attribute, numerical attribute, and ordinal attribute. The main characteristics of categorical attributes are the total amount of data, the number of categories, and the frequency of each category. In a set of high-dimensional data, there are generally many categorical attributes. The similarity of two data objects can be described by the Jaccard distance, and the calculation formula of its anisotropy is as follows [16]:

$$d(X,Y) = \frac{q}{q+p}. \tag{4}$$

The normalized value is

$$\frac{N_t - N_0}{N}. \tag{5}$$

The formula for calculating the Euclidean distance is

$$d(X,Y) = \sqrt{\sum_{i=1}^{n}(x_i-y_i)2}. \tag{6}$$

The correlation between numerical attributes can be expressed by calculating the correlation coefficient of random variables. The value range of the correlation coefficient is [−1, 1]; the value of the correlation coefficient reflects the degree of linear correlation between two attribute random variables and its basis is defined as

$$Pxy = \frac{Cov(X,Y)}{\sqrt{D(X)}\sqrt{D(Y)}}. \tag{7}$$

Representing the evolutionary pattern of the entire sequence:

$$h_{enc} = \text{encoder}(X). \tag{8}$$

We feed z into each layer of the RNN to estimate the probability distribution of the occurrence of events on the corresponding time slice. Its process is defined as follows:

$$X' = \text{decoder}(z). \tag{9}$$

This optimization objective can be defined as minimizing the following loss function:

Table 2: Type matching score table.

		Property type		
		Numerical	Ordinal	Category type
But the variable type	Numerical	1	0.5	0.3
	Ordinal	0.6	1	0.2
	Category type	0.4	0.8	1

$$L = L_r + w_{kl} \cdot L_{kl},$$
$$L_r = -\frac{1}{n}\sum_{i=1}^{n}\sum_{j=1}^{|E|}\left(w_{ej}x_{ij}\log\left(x'_{ij}\right) + \left(1 - x_{ij}\right)\log\left(1 - x'_{ij}\right)\right),$$
$$L_{kl} = -\frac{1}{M_z}\sum_{i=1}^{Mz}\left(1 + \log\left(\sigma_i^2\right) - \mu_i^2 - \sigma_i^2\right). \tag{10}$$

After the model training is completed, using the learned latent feature vector z of each sequence to detect abnormal sequences ($R2$) in the dataset and using the local divergence factor of the vector in the feature space to evaluate the anomaly degree of each sequence, which is defined as follows:

$$LOF(z) = \frac{\sum_{y\in N_k(z)} D_k(y)}{\left|N_k(z)\right| D_k(z)},$$
$$D_k(z) = \frac{\left|N_k(z)\right|}{\sum_{y\in N_k(z)}\left(\left(d_k(y), d(z, y)\right)\right)}. \tag{11}$$

On this basis, calculating the outliers for each event at each time node

$$\text{anomaly}\left(x^{\text{mis}}\right) = \Pr\left(X = x^{\text{mis}}\right),$$
$$\text{anomaly}\left(x^{\text{red}}\right) = 1 - \Pr\left(X = x^{\text{red}}\right),$$
$$\text{dec} = t\frac{i - n}{i + n} + (1 - t)\frac{j - n}{j + n}. \tag{12}$$

4. Audience Analysis of Brand Communication Data under Computer Vision Communication Takes D City as an Example

Through the analysis of the current situation and existing problems of the brand integration of "cold black soil" agricultural products, it can be seen that there are many agricultural products with "cold black soil" as the trademark or promotion point. The brand goal of "ground black soil" is really and effectively brought into place. Eliminate fake and shoddy products in the market, expand the competitive advantage of the brand in the market, enhance the market recognition of black soil resources in cold regions, improve the market influence and occupancy of the brand, and make the brand integration effect truly manifest. It is the basis for the concept of "cold land black soil" agricultural product brand integration to clarify the various relevant factors that affect the integration of agricultural products brands. Therefore, this chapter uses mathematical models to analyze the mastered brands quantitatively and qualitatively. The factors of integration effect are decomposed, evaluated, and analyzed layer by layer, which provides decision-making reference for the actual integration direction of relevant enterprises and managers and provides quantitative basis for putting forward the concept of "cold land black soil" agricultural product brand integration and the countermeasures and suggestions for improving the integration of agricultural product brands, as shown in Figure 7.

The main body of integration is the main operator of the "cold land black soil" agricultural product brand operation and the main executor of brand integration. The main body of brand integration needs to accurately grasp the different needs of consumers under the condition of clear and objective analysis of the market environment. The procedure conforms to the standardization regulations, supervises the quality of agricultural products in the process of processing, expands the sales network of agricultural products in the sales process, and actively promotes the brand, leading the whole process of brand integration. At present, in the process of brand integration of "Handi Heitu," the Handi Heitu Property Group, as the only operating entity, is obviously not enough to control the promotion of the entire brand integration in terms of scale and resource acquisition. Therefore, diversification is required. The main body of integration has become an important prerequisite for brand integration, and from the perspective of domestic and foreign experience and the status quo of brand integration, those agricultural production enterprises, processing enterprises, and marketing enterprises with advanced agricultural production technology, strong capital turnover capacity, and modern management concepts or comprehensive farmers' professional cooperatives are more suitable main body of brand integration. Develop and expand agricultural leading enterprises, improve their processing and production capacity with modern management methods, establish agricultural associations, build bases, leading enterprises, comprehensive cooperatives, and other multi-integrated agricultural product brands, and promote the main business projects and brands. In the cross-regional development of the whole province or even the whole country, the diversified integration main body can digest internally, cooperate internally, and cooperate in the division of labor in terms of production, processing, storage and transportation, and sales. The integration of various factors, integrated management of relevant links, and jointly promote the development of the "cold black soil" agricultural product brand integration. Figure 8 and Table 3 are the output of various agricultural products.

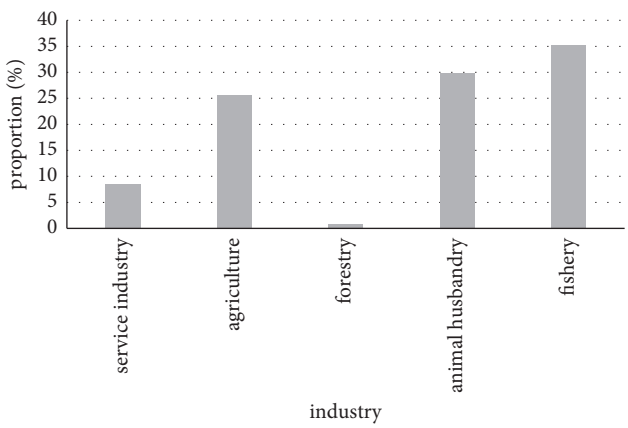


Figure 7: Distribution of the share of agricultural output.

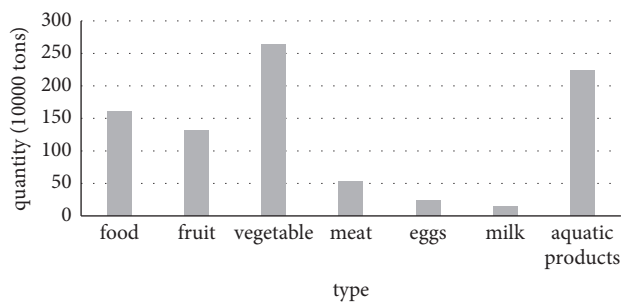


Figure 8: Output of various agricultural products in city D.

In the market environment where food safety has become a hot topic in the world, the quality and safety of agricultural products has become the focus of consumers' attention. All the global production enterprises strictly put quality supervision in the first place in the production process and use standardized procedures to control the quality of the production process. As analyzed above, the United States and France have adopted very strict quality control systems and have also legally made strict regulations on the production process of agricultural products, carried out quality certification of agricultural products, and standardized the management of brand logos, while Japan is relatively more, it is very strict, from quality certification to origin traceability. Combined with the development status of agricultural product brands in "cold land and black soil," and learning from foreign experience, in the integration and development of agricultural product brands, we should pay more attention to using standardized procedures to create standardized production so as to ensure and gradually improve the quality of agricultural products. From the government's point of view, it is necessary to establish a unified national certification standard, regulate and supervise relevant certification agencies, enrich the types of certification standards, improve the quality assurance of "cold land black soil" agricultural products, and gradually integrate with the international certification system; from the perspective of the enterprise, establish its own standard procedures and provide corresponding quality inspection reports for each batch of agricultural products entering the supermarket so as to truly realize the quality control in all aspects of production, processing and sales, and form its own quality certification standards for black soil.

Table 3: Production of agricultural products in some districts and counties in city D.

District name	Types of agricultural products produced	Quantity
Zone J	Fruit big cherry, yellow peach, vegetable, flower, sea cucumber	12.5
Zone G	Seafood prawns, scallops, abalone, etc., fruit apples, large cherries, yellow peaches, etc., meat	21.6
Zone L	Vegetables, flowers, fruits, cherries, pears, etc., seafood, fish, shrimp, shellfish, sea urchins, algae, etc.	52.3
City W	Fruits, apples, cherries, grapes, livestock and poultry, cattle, sheep, broilers, aquatic products, sea salt, fish and shrimp, sea cucumbers, shellfish	24.6
City P	Grain, fruits, apples, cherries, grasses, vegetables, livestock broilers, beef cattle	23.1
City Z	Livestock, poultry, chicken, pig, cattle, sheep, fruit, apple, strawberry, grape, kiwi, etc., vegetables, aquatic products, fish, shrimp, crab, shellfish	36.5
County C	Mainly seafood, such as shellfish, fish, shrimp, crab, algae and shellfish, especially rich in sea cucumber and abalone	51.7

The "three-product certification" of agricultural products has developed rapidly. The so-called "three products" refer to pollution-free food, green food, and organic food. The certification standard of "three products" is to ensure the quality and safety of agricultural products and promote the standardized production of agricultural products. Among them, pollution-free products and green food are the foundation, and organic food is the highest. Level of certification. According to statistics from the Green Food Development Center, as of April 2018, a total of 506 agricultural products have been certified by the Agricultural Products Quality and Safety Center of the Ministry of Agriculture, the China Green Food Development Center and the China Green Huaxia Organic Food Certification Center. The total number of enterprises is 217. Table 4 shows the certification of "three products" of agricultural products.

SWOT is an analysis method of marketing, which is mainly used to analyze the company's own competitive advantages, disadvantages, opportunities, and threats so as to formulate the development strategy of the company and promote the better development of the company. The article uses SWOT to analyze the advantages, disadvantages, opportunities, and threats of cold land black soil agricultural products so as to "prescribe the right medicine" in the process of brand building and dissemination, promote strengths and avoid weaknesses, and enhance the overall image of agricultural products brands. Figure 9 shows the SWOT analysis of agricultural products.

Table 4: "Three-grade" certification of agricultural products in city D.

Type of certification	Number of certified agricultural products	Number of certified companies
Pollution-free food	210	130
Green food	251	72
Organic food	45	15
Total	506	217

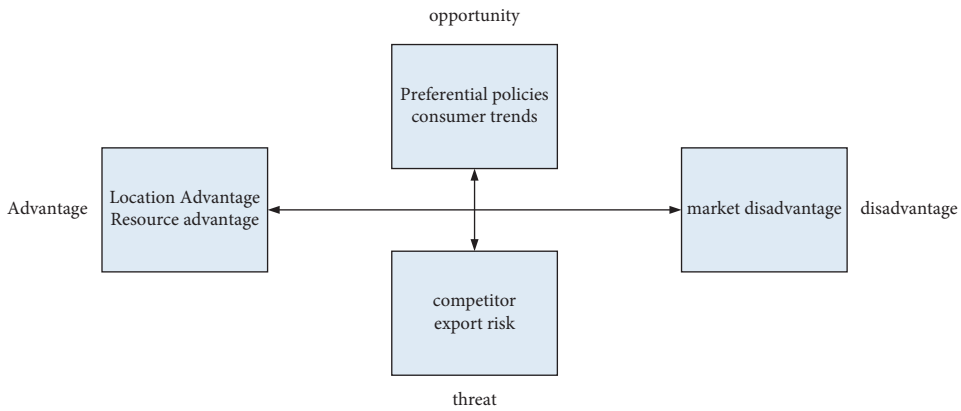


Figure 9: SWOT analysis of agricultural products in city D.

Integrated marketing is the key to the development of brand integration. In the final analysis, brand integration is the continuous change of marketing methods. It is easy to launch from the integrated marketing of many agricultural product brands in France and the United States. The diversification of marketing strategies can effectively improve the competitiveness of brands in the market. For example, the Japanese brand "Hakata Universal Onion" invites advertising companies to design a marketing strategy for a specific market on the premise of market promotion and create a brand name for a specific market, from production to sales. The company is tailor-made. In addition, the promotion of French wine tasting culture is a good way to promote French culture to the world. In the development of the "cold black soil" agricultural product brand, the advertising investment, especially the advertising investment of TV media, is relatively small, and the special "cold black soil" agricultural products advertisements that people can see on TV are mostly concentrated in small areas. However, there are very few agricultural products advertisements that can actually be broadcast on various satellite channels. On the one hand, "cold land and black soil" agricultural product operating enterprises should increase their advertising and publicity and plan or carry out a series of market promotion activities to improve the popularity of regional agricultural product brands and market awareness of the brand. The company should be more involved in the promotion of agricultural products, make full use of various resource platforms, and use diversified media methods as the basis to promote the brand image of regional agricultural products for all-round shaping and publicity so as to improve brand market awareness, as shown in Table 5.

Table 5: Brand name industry distribution.

Category of the brand	Number	Name example
Aquatic products	14	Zhangzidao, Haiyantang, Xiaoqin
Fruit	42	Mountain climbing, golden state red, hump
Vegetable	12	Lvchen, Fuqiao, Jinke
Animal husbandry	6	One hundred years of Phoenix, Xue Long, Chu Ming
Dairy industry	5	Jiuyang, Sanhuan, Xiaoniu Pavilion
Eggs	5	Cuckoo, Hong family, Hei Dao
Rice industry	8	Uncle Mi, Hongguo
Other	8	Lingjing, Huibao, Maihua
Total	100	

In the process of integrating foreign agricultural product brands, leading enterprises, professional cooperative organizations, and relevant government agencies have played an active role in supporting and promoting the large-scale development of brands. From abroad, Japan has used the power of the agricultural association in the development of brand integration, forming a multisubject brand integration body and improving the degree of organization. The French government also actively provides financial support and promotion support for agricultural product brand integration. Therefore, in the integrated development of "cold black soil" agricultural product brands, the government should regard the integration of "cold black soil" agricultural product brands as a global strategy, formulate a complete brand support system, and provide financial subsidies and

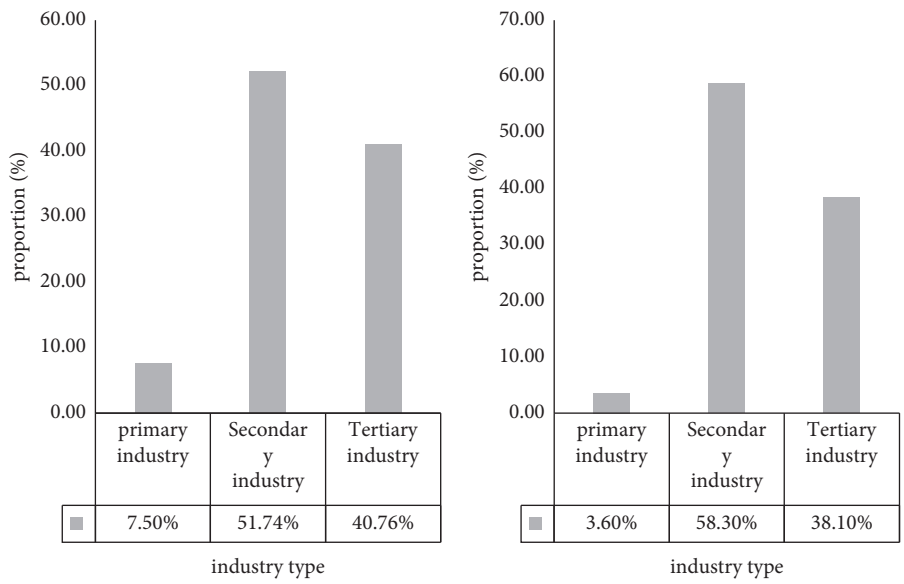


Figure 10: The composition ratio of the three industries in city D and the contribution rate of the three industries to the economic growth of city D.

infrastructure improvements required for brand certification. Strengthen the guidance and support to the regional brand, set up the correct brand concept, excavate the cultural connotation of the regional brand, and strengthen the cooperation between leading enterprises, cooperative institutions, and governments. Leading enterprises should continuously optimize their own resources and drive the coordinated development of various resource entities with modern organizational development so as to adapt to the changing market competition environment and farmers' cooperative organizations. It is necessary to continue to integrate scattered small households, take the interests of farmers as the fundamental starting point, and exert collective strength in brand promotion and other aspects. The contribution rate of agriculture to economic growth is only 3.6%, less than 1/16 of the secondary industry and 1/10 of the tertiary industry, as shown in Figure 10.

The brand of agricultural products is one of the national strategies to participate in the global agricultural competition, and now every modern agricultural country treats brand agriculture as a national strategy. Through the analysis of the relevant experience of the United States, Japan, and France in the integration of agricultural product brands, this chapter summarizes some experiences that can be used for reference in the integration and development of agricultural product brands in "cold land and black soil": first, strengthen the control of the standard system and formulate standardized brands, certification system, and quality management system; secondly, expand media marketing channels, strengthen brand innovation and publicity protection; lastly, increase government policy support and improve the social service system.

5. Discussion

Through the qualitative analysis of the current situation, existing problems, and the quantitative analysis of many factors affecting the integration effect of "cold black soil" agricultural product brand integration, this chapter's conception of the "cold black soil" agricultural product brand integration mainly starts from the following aspects: (1) Accurately grasp the principle of brand integration of "Cold Land and Black Earth," adhere to the principles of market orientation, unified quality standards, resource utilization, and protection, and strictly follow these principles to grasp each link and each influencing factor. The goal of brand integration of "Black Earth," all integration methods and methods are based on the ultimate goal; (2) the concept of brand integration of "Cold Earth Black Earth" mainly includes three aspects: the integration of production and processing, the integration of brand management, and the integration of product sales. From a theoretical point of view, it provides a method that can improve the brand integration effect and market competitiveness of "cold black soil" agricultural products.

Mobile TV includes city bus TV, train TV, passenger transport, and TV on the plane. Urban bus routes are fixed, so the audience of bus TV is relatively fixed, which is conducive to the continuous dissemination of brand information. People take the same bus every day and see the same advertisement, and they will naturally remember it. China's railways transport hundreds of millions of passengers every year, and these passengers come from all over the country, so the scope of information dissemination is very wide. When people take trains, especially long-distance

trains, they often feel bored. Train TV provides them with an opportunity to relax so that people no longer have to do nothing during the long journey, so people's attention resources are more concentrated at this time, and the dissemination effect will be very good. Brand owners can choose trains covered by train TVs to promote agricultural products in trains or other trains between city D and other cities. It is also possible to directly put the special agricultural products of D city on the train for sale so that people can actually taste it, because food is a must for every passenger on the way, and agricultural products with food as the main form of expression are useful at this time. In addition, televisions on long-distance buses and planes can also be used as a position for brand promotion of agricultural products. LCD TV advertisements in buildings and supermarkets are outdoor advertisements.

Building TV fills the waiting time of office workers and makes waiting no longer boring. The audience of building TV is mainly urban white-collar workers. They pay more attention to the quality of life and have higher requirements on diet. Therefore, video advertisements on building TV have strong pertinence. Supermarkets are important sales terminals for agricultural products. The audience of supermarket videos are consumers who are shopping, many of whom are housewives who prepare meals for the whole family. Video advertisements in supermarkets can play a role as a shopping guide and may even directly arouse consumers' attention. The desire to buy motivates them to implement the buying behavior. The outdoor screen is huge, the picture is clear, the color is bright, and the expression is vivid; it is easy to attract people's attention, and the location is generally located in the more prosperous business district in the center of the city; the flow of people is large, so the contact rate and arrival rate are high, and the dissemination effect is good. In fact, no matter it is interpersonal communication, mass communication, or new media communication, any kind of communication method is not enough to have a decisive influence on the brand, and not all brands are suitable for these communication methods. Therefore, when choosing the communication method of agricultural products brand, one or several communication methods should be determined according to product characteristics, target positioning, promotion budget, and so on so as to maximize the role of brand communication.

6. Conclusion

The significance of exploring the consumer psychology of brand audiences is to guide people to pay attention to brand audiences from the perspective of consumer psychology and to establish, maintain, and develop the relationship between brands and audiences through activities or efforts. This includes internal and external audiences and ensures value through long-term interactions, exchanges, and communication, fulfills these commitments, and continues to develop trust, dependence, satisfaction, and commitment to this good brand-audience relationship. Only by aiming at the emotional needs of consumers can the audience finally have a desire and appreciation for the brand. The formation of the audience's positive emotions can prompt the audience to maintain a long-term stable relationship with the company in order to pursue this good emotional state again. The homogenization and supercompetition of products in the market are becoming more and more common, and the traditional marketing strategies to enhance the competitive advantage are more and more powerless. Whether for internal or external audiences, brands should endow the audience with an emotional commitment so that the audience can establish a deep, lasting, and intimate emotional connection with the brand. This principle applies to all audiences. But a major limitation of the article is the complexity of the research object itself. Audiences are complex and elusive, although behavioral decisions rest with the audiences themselves due to the involvement of a variety of peripheral factors when participating in communication activities, and when these influences act on the audience, there will be differentiated changes again, and the prediction and summary of the rules are not necessarily all-in-one. Therefore, the article is limited to the analysis of the scope and typical manifestations of the brand audience's active behavior. Brands such as agricultural product enterprises, agricultural associations, farmers, and the government are mainly taking active actions to design scientifically, plan rationally, and comprehensively use a variety of methods to carry out brand communication and promotion activities on the basis of in-depth understanding of products so as to create more internationally renowned agricultural product brands.

Data Availability

No data were used to support this study.

Conflicts of Interest

The authors declare that there are no conflicts of interest regarding the publication of this article.

Acknowledgments

The basic research project of Basic Scientific Research Business Expenses of Universities in Heilongjiang Province: Research Results of the Research on the Brand Communication Strategy of "Cold Black Soil" in Suihua City (Project no. YWK10236200118).

References

[1] M. T. Liu, I. A. Wong, T.-H. Tseng, and A. W.-Y. Chang, "Applying consumer-based brand equity in luxury hotel branding," *Journal of Business Research*, vol. 81, no. dec, pp. 192–202, 2017.

[2] K. Fritz, V. Schoenmueller, and M. Bruhn, "Authenticity in branding - exploring antecedents and consequences of brand authenticity," *European Journal of Marketing*, vol. 51, no. 2, pp. 324–348, 2017.

[3] A. Barbu, Y. She, and L. Ding, "Feature selection with annealing for computer vision and big data learning," *IEEE Transactions on Pattern Analysis and Machine Intelligence*, vol. 39, no. 2, pp. 272–286, 2017.

[4] B. A. Kash, J. Baek, and E. Davis, "Review of successful hospital readmission reduction strategies and the role of health information exchange," *International Journal of Medical Informatics*, vol. 104, no. aug, pp. 97–104, 2017.

[5] J. P. Ng, N. Tarazi, D. P. Byrne, J. F. Baker, and J. P. McCabe, "Scoliosis and the social media: facebook as a means of information exchange," *Spine Deformity*, vol. 5, no. 2, pp. 102–108, 2017.

[6] H. Chen and W. Ye, "Huan Chen is the wrong person. Same name but different persons. Connecting or disconnecting: luxury branding on social media and affluent Chinese female consumers interpretations," *Social Science Electronic Publishing*, vol. 24, no. 1, pp. 1–13, 2017.

[7] B. Merrilees, "Nation branding: concepts, issues, practice," *Place Branding and Public Diplomacy*, vol. 131, pp. 96-97, second edition, 2017.

[8] S. S. Alwi, S. M. Ali, and B. Nguyen, "The importance of ethics in branding: mediating effects of ethical branding on company reputation and brand loyalty," *Business Ethics Quarterly*, vol. 27, no. 3, pp. 393–422, 2017.

[9] V. Branding, "Correction to: the heat flow for the full bosonic string," *Annals of Global Analysis and Geometry*, vol. 53, no. 2, pp. 283–286, 2018.

[10] V. Branding, "On semi-biharmonic maps between riemannian manifolds," *Journal of Geometric Analysis*, vol. 30, no. 1, pp. 248–273, 2018.

[11] J. Vela, J. Nogue, and R. Govers, "Visual landscape as a key element of place branding," *Journal of Place Management and Development*, vol. 10, no. 1, pp. 23–44, 2017.

[12] P. Iyer, A. Davari, and A. Paswan, "Determinants of brand performance: the role of internal branding," *Social Science Electronic Publishing*, vol. 25, no. 4, pp. 1–15, 2018.

[13] G. Lindsay, "Bricks, branding, and the everyday: defining greatness at the united nations plaza in san francisco," *International Journal of Architectural Research*, vol. 11, no. 2, pp. 123–136, 2017.

[14] A. N. Geurin and L. M. Burch, "User-generated branding via social media: an examination of six running brands," *Sport Management Review*, vol. 20, no. 3, pp. 273–284, 2017.

[15] R. Odoom, B. Narteh, and R. Boateng, "Branding in small- and medium-sized enterprises (SMEs): current issues and research avenues," *Qualitative Market Research*, vol. 20, no. 1, pp. 68–89, 2017.

[16] M. De Jong, Y. Chen, S. Joss et al., "Explaining city branding practices in Chinas three mega-city regions: the role of ecological modernization," *Journal of Cleaner Production*, vol. 179, no. APR.1, pp. 527–543, 2018.

Hindawi
Mobile Information Systems
Volume 2022, Article ID 4877746, 12 pages
https://doi.org/10.1155/2022/4877746

Research Article

An Intelligent Cloud Computing Data Processing System for College Innovation and Entrepreneurship Data Statistics

Hongjun Jia[1] **and Wenjing Chen**[2]

[1]*College of Innovation and Entrepreneurship, Yellow River Conservancy Technical Institute, Kaifeng, 475004 Henan, China*
[2]*College of Information Engineering, Yellow River Conservancy Technical Institute, Kaifeng, 475004 Henan, China*

Correspondence should be addressed to Hongjun Jia; 2007810480@yrcti.edu.cn

Received 12 March 2022; Revised 4 April 2022; Accepted 21 April 2022; Published 25 May 2022

Academic Editor: Liming Chen

With the improvement of the enrollment rate in recent years, innovation and entrepreneurship in colleges and universities have become the focus of the country and people. However, the statistics of innovation and entrepreneurship in colleges and universities have become more and more complicated and difficult. The purpose of this paper is to study how to face the statistics of innovation and entrepreneurship in colleges and universities, then to study the intelligent cloud computing data processing system, and put forward the importance of innovation and entrepreneurship and cloud computing in colleges and universities. The experiment results show that it can be seen that the number of graduates has risen sharply from 2011 to 2020 and the percentage has risen from about 20% to about 90%, which has also led to a great increase in the difficulty of graduate entrepreneurial data management. The difficulty of graduate entrepreneurial data management has risen from around 18% at the beginning to around 87% in 2020. Therefore, it is necessary to study the data processing system to make data processing more efficient. The intelligent cloud computing data processing system significantly improves the quality and efficiency of entrepreneurial service management, and the data mining application in the system can also provide data support for the analysis and prediction of graduates' entrepreneurial situations. The intelligent cloud computing data processing system significantly improves the quality and efficiency of entrepreneurial service management, and the data mining application in the system can also provide data support for the analysis and prediction of graduates' entrepreneurial situations.

1. Introduction

With the rapid expansion of higher education in China in recent years, the number of students has also increased significantly, which has brought great pressure to graduates with entrepreneurial spirit, and also to the staff who manage their entrepreneurship. Faced with this pressure, more and more scholars hope to use the data processing system to improve the management of graduate information, so as to better provide guidance and help for graduates to start their own businesses. Cloud computing has 10 trillion operations per second. With such powerful computing power, it is possible to simulate nuclear explosions, predict climate change, and market trends. In the future, whether it is intelligent driving, emotional companion robots, and many other artificial intelligence products, it is inseparable from the support of cloud computing and even edge computing.

Entrepreneurship of college graduates has always been an important issue in the field of education. The state pays great attention and accordingly puts forward a series of policies for the graduate entrepreneurial service system. In order to respond to these policies in a timely manner, it is necessary to follow up the development of national informatization, and from the perspective of innovative work services, mainly by means of informatization services, to more efficiently and effectively promote the management of graduate entrepreneurship.

The innovations of this paper are as follows: (1) It introduces the theoretical knowledge of innovation and entrepreneurship and cloud computing in colleges and universities,

and uses data mining to analyze the importance of data mining in intelligent cloud computing data processing systems. (2) It expounds data mining and association rules. Through experiments, it is found that the intelligent cloud computing data processing system based on data mining algorithm can improve the work efficiency of data statistics.

2. Related Work

As the country attaches great importance to innovation and entrepreneurship, more and more people choose to start their own businesses after graduation. LIN found that in recent years, social entrepreneurship education has ushered in a period of vigorous development. However, in the field of entrepreneurship education for college students, social entrepreneurship education is not satisfactory. The scholar mentioned that innovation and entrepreneurship is the general trend and also found that entrepreneurship education is not very perfect, but he did not propose how to solve this problem [1]. Deng found that mobile users generally have high demand for localization and information services. However, retrieving data from remote locations is often inefficient, so there is edge computing, which is an extension of cloud computing. In this basic framework, it is very important to study the interaction and cooperation between edge computing and cloud technology. Although the scholar realized that it is important to study the relationship between edge computing and cloud technology, he did not mention what the relationship between the two is [2]. Wei found that the existing resource scheduling algorithms cannot meet the resource scheduling requirements required by cloud computing and the current cloud infrastructure solutions only provide operational support at the basic level. Considering the competitive nature in cloud computing, he proposed a cloud resource allocation model using the Hidden Markov Model in cloud computing environment. Although the scholar proposed a cloud resource allocation model, he did not mention the specific concept of this model, nor did experiments to prove its feasibility [3]. Jin finds that data sharing is an attractive service offered by cloud computing platforms because of its convenience and economy. As a potential technology to realize data sharing, attribute-based encryption has attracted a lot of attention. However, most of the existing encryption solutions have the disadvantages of high computational overhead and weak data security, which seriously hinders resource-constrained mobile device customization services. The scholar found that encryption is a promising technology and also found its shortcomings, but did not propose specific solutions for these shortcomings [4]. Hirai found that cloud computing provides a large-scale parallel distributed processing service, in which a huge task is split into multiple subtasks, and processing the subtasks takes a long time. An efficient way to mitigate this problem is to have another worker perform the same subtask, so he takes into account the efficiency of the backup task. However, the scholar has no specific experiments to prove whether the backup task can really effectively improve work efficiency [5]. Ghahramani found that the resources of cloud computing are provided by the user with minimal administrative effort; however, there are some obstacles and concerns in the use of the cloud. The scholar only mentioned some obstacles and concerns in the use of cloud computing, and did not give a clear introduction to these obstacles [6]. Barsoum found that more and more organizations are choosing to outsource data to remote cloud service providers (CSPs), where customers can pay to store large amounts of data. To improve scalability, availability, and durability, some customers may wish to replicate their data across multiple servers in multiple data centers. Therefore, the customer needs to have a strong guarantee, and he proposes a dynamic data ownership scheme. Although the scholar proposed corresponding solutions for the corresponding problems, there is no actual case to prove that this solution is really feasible [7]. Tsai found that in modern society, the number of mobile users increased dramatically, he proposed an efficient distributed mobile cloud computing service authentication scheme, and the proposed scheme provides security and convenience for mobile users. The security strength of the proposed scheme is based on the cryptographic system and dynamic random number generation. Although the scholar proposed a safe and reliable scheme, he did not enumerate the relevant data to support the authenticity of his proposed scheme [8].

3. Data Mining Algorithm Based on Big Data

3.1. The Concept of Cloud Computing and Innovation and Entrepreneurship. With the advancement of technology, the hardware composition of computers has undergone great development. The Internet is changing every day, and the amount of data on the network is increasing by leaps and bounds. No matter how many resources are added, the demand cannot be met. Due to the huge amount of data on the Internet, the computer is completely unable to perform the corresponding tasks [9]. How to integrate and optimize resources has become an important topic in the field of computer applications. Under the premise of such application, cloud computing is put on the agenda. The architecture of cloud computing is shown in Figure 1.

As shown in Figure 1. the large-scale data storage of cloud computing is mainly realized by the decentralized file system, and the design of the decentralized file system must meet the requirements of transparency, scalability, failure resistance, and security [10]. With the rapid development of China's economy, the number of university enrollments continues to increase, and many university graduates will face enormous pressure to start a business. The state's emphasis on innovation and entrepreneurship in universities is shown in Figure 2.

As shown in Figure 2, for China, how to deal with the times and develop innovative education is a major issue facing China's higher education. Now, China is actively adopting reforms to promote innovation and entrepreneurship. In order to promote entrepreneurship, the state has accelerated the construction of makerspaces and supported and encouraged enterprises, investment institutions, industry organizations, and other social forces to invest in construction in accordance with the principles of marketization. Therefore,

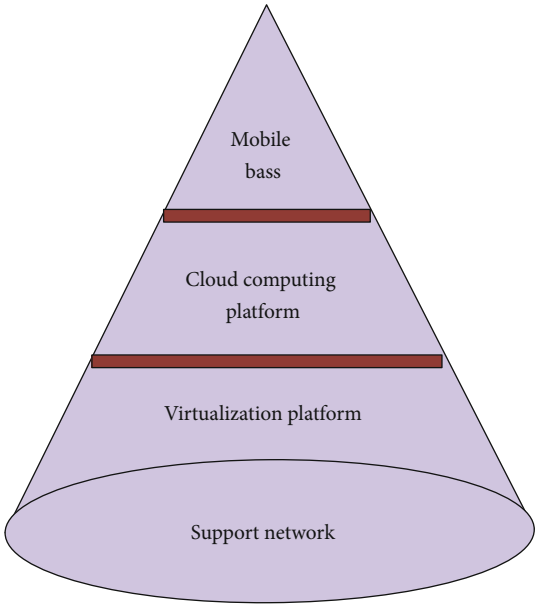


Figure 1: Architecture of cloud computing.

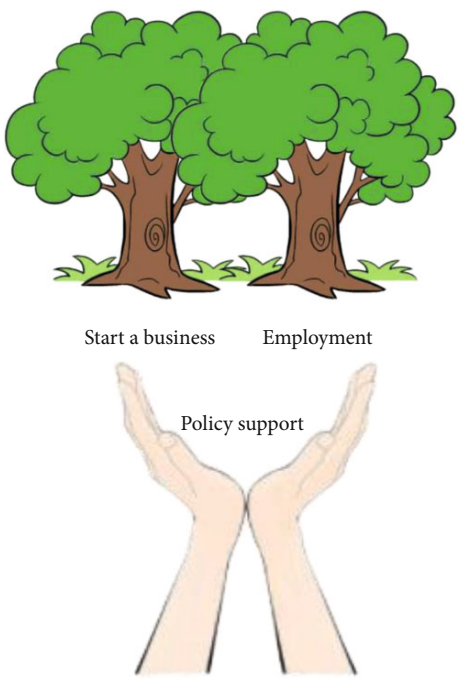


Figure 2: Innovation and entrepreneurship supported by the state.

in order to cultivate a talent team with innovative consciousness and entrepreneurial spirit and realize the sustainable development of China's modern economy, the state has proposed a series of supporting policies [11].

The education and training of colleges and universities is of great significance to the cultivation of outstanding talents. Therefore, it is very critical and necessary to conduct data mining on the information of college students [12]. With the advancement of science and technology, the innovation and entrepreneurship data statistics system is also constantly updated. Innovation and entrepreneurship in the information age are shown in Figure 3.

As shown in Figure 3, with the advent of the era of big data, especially the rapid development of big data-related technologies, universities are paying more and more attention to the analysis and mining of existing historical data, and innovation and entrepreneurship are carrying out more scientific educational activities [13].

There is a large amount of entrepreneurial data information stored in the student data management system, and the hidden relationship plays a crucial role in the reform of entrepreneurial methods and innovation systems [14]. The flowchart of the innovation and entrepreneurship data statistics system is shown in Figure 4.

As shown in Figure 4, this flowchart fully shows the process of data mining in the system. The system should have all kinds of information of students during school so that it can achieve data sharing and easy for users to analyze student information [15]. It provides efficient services for the staff engaged in education and at the same time realizes the systematization, standardization, and automation of student information management.

3.2. Parallel Apriori Algorithm Based on Weighted Itemsets. The Apriori algorithm is a frequent itemset algorithm for mining association rules. Its core idea is to mine frequent itemsets through two stages: candidate set generation and plot downward closure detection. The parallel Apriori algorithm based on weighted itemsets implements the distributed Apriori algorithm. In order to achieve efficient parallel computing on the original database, preprocess the data, and filter out all infrequent itemsets, this paper transforms the database into weight matrix and Boolean matrix [16]. For any given transaction database D, let Equation (1) hold:

$$f : D \longrightarrow R. \tag{1}$$

Among them, $R = f(D) = (r_{ij})_{n^* m}$, n is the number of transactions, m is the number of items, and transaction set r_{ij} is shown below:

$$r_{ij} = \left\{ \begin{array}{l} 1, I_j \in T_i \\ 0, I_j \notin T_i \end{array} \right\}. \tag{2}$$

Apriori is a data mining algorithm that uses multiple loop iterations to find all frequent itemsets layer by layer, but it has two relatively more serious defects: multiple scans of the original data set and too large a candidate itemset per iteration [17]. In order to improve the main defects of Apriori algorithm, scholars proposed a distributed Apriori algorithm.

The Apriori algorithm under the distributed architecture is their key execution data parallelization strategy that is to cut and distribute the data to the corresponding processors, then perform processing operations on the local data, obtain the local processing results, then integrate the results on all processors, and finally get all the results [18]. This paper compares and analyzes the traditional Apriori algorithm

Figure 3: Innovation and entrepreneurship in the information age.

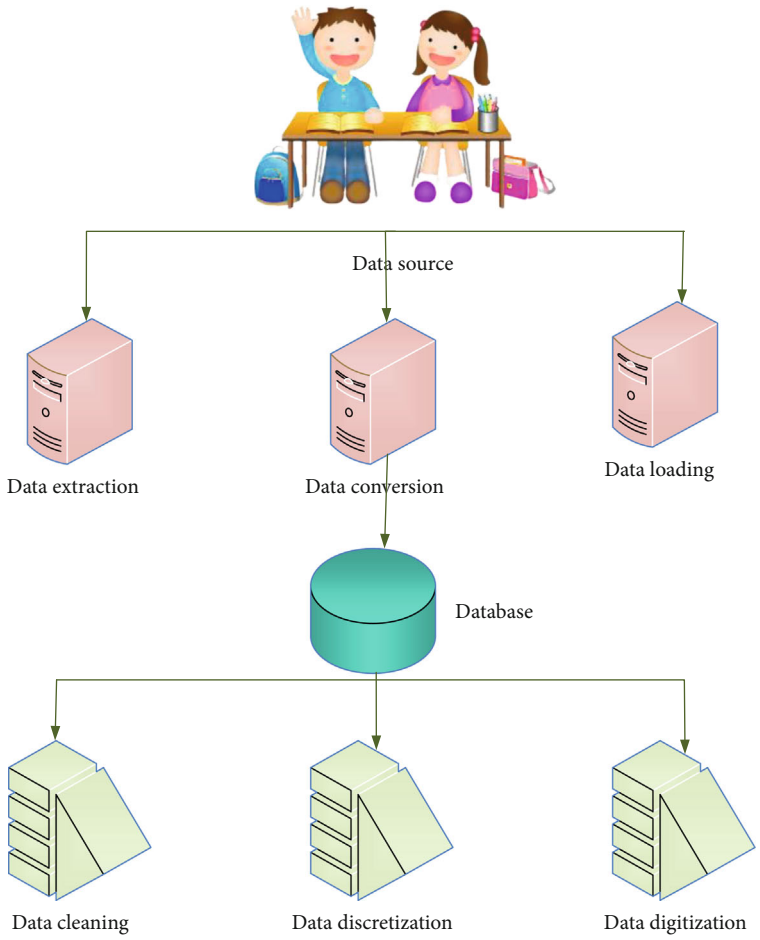


Figure 4: Flow chart of the innovation and entrepreneurship data statistics system.

and the distributed Apriori algorithm, as shown in Tables 1 and 2.

As shown in Tables 1 and 2, the running time of the traditional Apriori algorithm is between 28 min and 36 min, the computing power is between 39% and 47%, and the computing efficiency is between 28% and 32%. Compared with the traditional algorithm, the parallel Apriori algorithm shortens the running time, improves the computing power, and also improves the running efficiency of the algorithm. It can be seen that choosing the distributed Apriori algorithm is obviously more advantageous [19].

3.3. Data Preprocessing. Data preprocessing refers to some processing performed on the data before the main processing. For example, before converting or enhancing most of the data, firstly, the irregularly distributed measurement network is converted into a regular network through interpolation, so as to facilitate computer operations. If the data is directly calculated, the data is preprocessed first because the data is too large and the infrequent candidate itemsets are repeatedly calculated. After filtering out the non-frequent itemsets, the candidate itemsets and higher itemsets will be reduced by a large amount [20]. The efficiency of the algorithm is improved because the support calculation of unnecessary candidate itemsets is reduced and the running time of the algorithm is shortened.

First, the original database D is scanned once, and the itemsets in all transactions are traversed, and the support counts are superimposed on the occurrences. Record the support count of itemset A denoted as $A.\sup$:

$$A.\sup = sumA(T_i). \tag{3}$$

In the equation, $i = 1, 2, \cdots, n$ and n are the number of transactions in the data, and $i = 1, 2, \cdots, n$ is the sum of the occurrences of itemset A in all transactions.

The first stage of association rule mining must find out all high-frequency item groups from the original data set. High frequency means that the frequency of a certain item group must reach a certain level relative to all records. In the study of association rules, people often only care about the existence of itemset A, but ignore the quantity of A itself in a transaction. The degree of association between A and B should not only consider the number of times they appear in the transaction database at the same time, but also the number of A and B themselves [21].

In a certain transaction, the minimum value of the number of all items in the itemset A is the weight of A in the transaction, which is represented by $A.weight$:

$$A.weight = \min\,(A_i.weight), \tag{4}$$

where A_i represents any item in itemset A.

The average weight is the ratio of the cumulative sum of the weights of itemset A in all transactions to $A.weight$, represented by $A.averageweight$:

$$A.averageweight = \sum A.weight(A_i)/A\ \sup, \tag{5}$$

Table 1: Traditional Apriori algorithm.

Analysis object	Times 1	Times 2	Times 3
Operation hours	36 min	28 min	32 min
Calculate ability	39%	47%	45%
Operating efficiency	28%	32%	30%

Table 2: Distributed Apriori algorithm.

Analysis object	Times 1	Times 2	Times 3
Operation hours	10 min	8 min	9 min
Calculate ability	73%	79%	90%
Operating efficiency	68%	67%	70%

In Equation (5), $i = 1, 2, \cdots, n$, and n is the number of transactions in the data, and $sumAweight(A_i)$ is the cumulative sum of the weights of A in all transactions.

When it comes to parallel association rule mining algorithms, the amount of chunked data allocated to each host must be considered. If the data block is large, the computing pressure on the node will be large, and the data cutting is too small to lose the meaning of parallel computing.

When performing data mining on a given database, the process of association rule mining is generally divided into two processes, as shown in Figure 5.

As shown in Figure 5, allocating data of balanced size to nodes can make full use of the computing resources of the cluster and shorten the running time of the algorithm. The operation of Boolean matrix is the same as that of general matrix, for example, it can be connected and can be transposed. The weight matrix refers to the frequency of each number in the weighted average of complex or real sets arranged in a rectangular array. The Boolean matrix and the weight matrix are, respectively, cut into two small matrices and then transposed to the following:

$$BR_1 = \begin{bmatrix} 0 & 1 \\ 1 & 0 \end{bmatrix}, BR_2 = \begin{bmatrix} 1 & 0 \\ 0 & 1 \end{bmatrix}. \tag{6}$$

Dividing the data into n blocks and the sum of the local minimum support in n nodes is the global minimum support. Therefore, the size of the local minimum support is the product of the global minimum support and the number of transactions in the node data block, which is represented by L min_sup:

$$L\ \text{min\_sup} = \text{min\_sup}^* |BR|/n. \tag{7}$$

Both the local average weight and the global average weight represent the correlation degree of a certain item combination within the itemset, which is represented by $A.LaverageWeight$:

$$A.LaverageWeight = \sum A_i weight/A.L\ \sup, \tag{8}$$

where $A.L$ sup is the local support count of A.

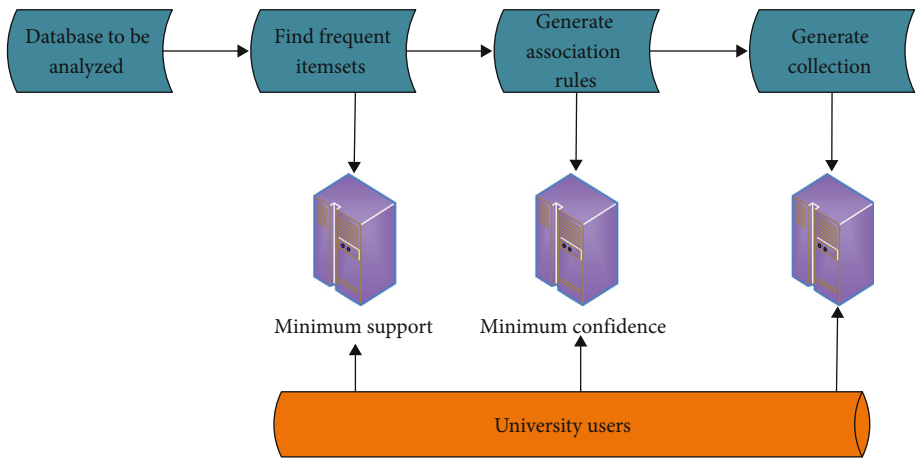


Figure 5: Association rule process.

The weight of an itemset is the number of times that each item contained in the itemset has its own occurrence in a transaction. Taking the minimum number of occurrences can represent the maximum number of common occurrences of all items in the set, and also the number of occurrences of the set in this transaction. The average weight is the average of the occurrences of an item in the minimum computing environment and represents the correlation within the set among all items.

Calculate the support count and average weight of each candidate itemset, which is represented by $A.GaverageWeight$:

$$A.GaverageWeight = \sum \min A_i.(weight)/A.G\sup, \quad (9)$$

where $A.G$ sup is the global support count of itemset A.

A frequent itemset is a set whose support degree is greater than or equal to the minimum support degree, where the support degree refers to the frequency of a certain set appearing in all transactions. All the itemsets that satisfy the minimum average weight and minimum support at the same time are another part of the global frequent itemsets, and these two frequent itemsets are all the global frequent itemsets.

3.4. K-Means Algorithm. K-means is one of the most commonly used clustering algorithms. The biggest feature of the algorithm is that it is simple, easy to understand, and fast in operation, but it can only be applied to continuous data. The k-means algorithm finally gathers the sample data into k clusters. Therefore, the algorithm first needs to select k initial cluster centers, then calculate the distances from the remaining data samples to the k cluster centers, respectively, and put the data sample into the category corresponding to the smallest cluster center in the distance from all k cluster centers.

As shown in Figure 6, although the k-means algorithm has many areas that need to be improved and optimized, when processing some basic large data sets, the obtained clustering effect and the efficiency of the algorithm processing data have been generally recognized.

When a specific function is used to evaluate the criterion of the pros and cons of the strategy adopted by the system, it is called a criterion function. The criterion function equation of the clustering algorithm is

$$E = \sum_{i=1}^{k} \sum_{a \in C_i} a = a_i^2. \quad (10)$$

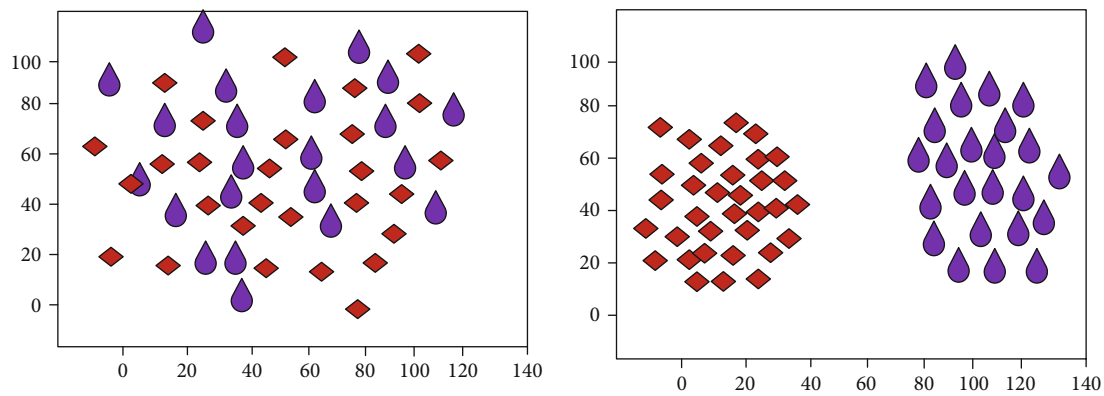
Compared with other algorithms, the k-means algorithm is simpler in principle and operation and has high algorithm execution efficiency.

3.5. Fuzzy C-Means Clustering (FCM) Algorithm. The FCM algorithm is a partition-based clustering algorithm, and its idea is to maximize the similarity between objects that are divided into the same cluster, while the similarity between different clusters is the smallest. Scholars use fuzzy set theory to improve the k-means algorithm, finally replace the square of the distance between the sample and the cluster center in the criterion function of the k-means algorithm with the weight of the square of the membership degree, and obtain the objective function of the FCM algorithm.

The objective function is the target form that is pursued by the design variables, so the objective function is the function of the design variables, which is a scalar. Let n-dimensional sample data set be $X = \{x_1, x_2, \cdots, x_n\}$, and each sample data has s-dimensional attributes. If the FCM algorithm is used to aggregate this sample data into class c, then the objective function corresponding to the algorithm is

$$J_m(X, Y) = \sum_{i=1}^{c} \sum_{j=1}^{n} x_{ij}^m D_{ij}^2, \quad (11)$$

where x_{ij}^m represents the degree of membership between a certain sample data j and the ith category and $0 \le j \le n$. In the k-means algorithm, the value of the membership degree x_{ij}^m of the sample object and the corresponding category is either 1 or 0. In the fuzzy C-means clustering FCM algorithm, the value of membership degree is a certain value in



(a) Data set before clustering (b) Clustered data set

Figure 6: Data set performance before and after clustering.

the interval [0…1], indicating the probability that the data object belongs to this class.

When the objective function satisfies the constraint condition $\sum_{j=1}^{n} x_{ij}^{m} = 1$ and the minimum value is obtained, the corresponding fuzzy matrix and cluster center are obtained when the optimal clustering effect is obtained. Use the Lagrange multipliers to establish the Lagrange equation:

$$J_m^*(X, Y) = \sum_{i=1}^{c} \sum_{j=1}^{n} x_{ij}^{m} D_{ij}^{2} + \lambda \left(\sum_{j=1}^{n} x_{ij}^{m} - 1 \right). \tag{12}$$

Fuzzy matrix is used to represent the matrix of fuzzy relationship. If set X has m elements and set Y has n elements, the fuzzy relationship from set X to set Y can be represented by a matrix. The partial derivative of Equation (12) is calculated, and the fuzzy matrix and cluster center corresponding to the minimum value of the objective function are obtained through simplification, as shown below:

$$X_{ij} = \left[\sum_{k=1}^{c} \begin{bmatrix} D(a_j, v_i) \\ D(a_j, v_k) \end{bmatrix}^{m-1} \right]^{-1}, \tag{13}$$

$$v_i = \sum_{j=1}^{n} x_{ij} a_j. \tag{14}$$

At this time, we need to pay attention to a special case: When the denominator under the fuzzy matrix in Equation (13) is zero, the distance $D(a_j, v_i)$ between the sample data and the cluster center at this time is 0. It is generally considered that the jth sample data at this time belongs to the i class. After this process is completed, the average value of the cluster is recalculated to obtain a new cluster center, and this process is repeated until the standard function converges. The distance calculation function is generally Euclidean distance, and the distance convergence criterion for data objects is usually the square error criterion, which is

$$E = \sum_{i=1}^{k} \sum_{p \in C_i} |p - m_i|^2. \tag{15}$$

Among them, p represents any data object, and E represents the sum of squared errors of all data objects. m_i is the average value of the cluster C_i where the data p is located, that is, the sum of the squares of the distances between each data object and the center point of the cluster where it is located is finally obtained. The absolute deviation of the average can be calculated as

$$s_f = \frac{1}{n} \left(|a_{1f} - m_f| + |a_{2f} - m_f| + \cdots + |a_{nf} - m_f| \right), \tag{16}$$

Here, $a_{nf} - m_f$ is the n measures of f, and m_f is the average value of f, which is

$$m_f = \frac{1}{n} \left(a_{1f} + a_{2f} + \cdots + a_{nf} \right). \tag{17}$$

The normalized measure is calculated as

$$z_{\text{if}} = \frac{a_{\text{if}} - m_f}{s_f}. \tag{18}$$

Among them, the mean absolute deviation of a_{if} is more robust to abnormal data than the standard deviation. The most commonly used distance measure is the Euclidean distance. Euclidean metric, also known as Euclidean distance, is a commonly used definition of distance, which refers to the true distance between two points in m-dimensional space, or the natural length of a vector. Euclidean distance in 2D and 3D space is the actual distance between two points, which is

$$d(i, j) = \sqrt{|a_{i1} - a_{j1}|^2 + |a_{i2} - a_{j2}|^2 + \cdots + |a_{ip} - a_{jp}|^2}. \tag{19}$$

Here, a_{ip} and a_{jp} are two P-dimensional data objects. Another commonly used distance calculation method is

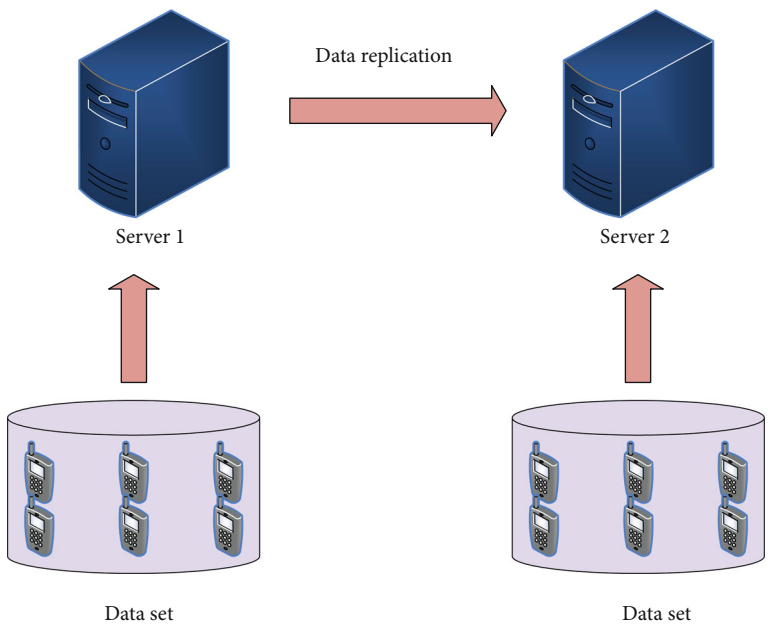


Figure 7: The general process of data replication technology.

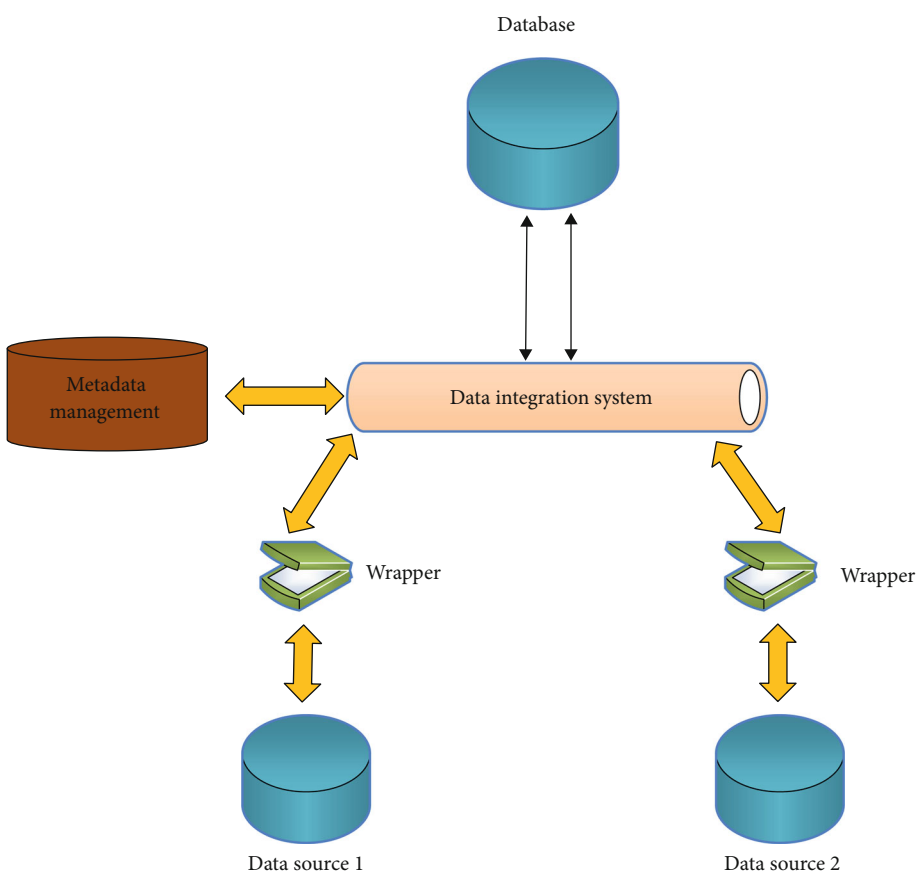


Figure 8: Data integration model based on data warehouse.

the Manhattan distance. The Manhattan distance, also known as Manhattan distance, is the distance between two points in the north-south direction plus the distance in the east-west direction. When the coordinate axis changes, the distance between the points will be different, and its specific calculation equation is defined as

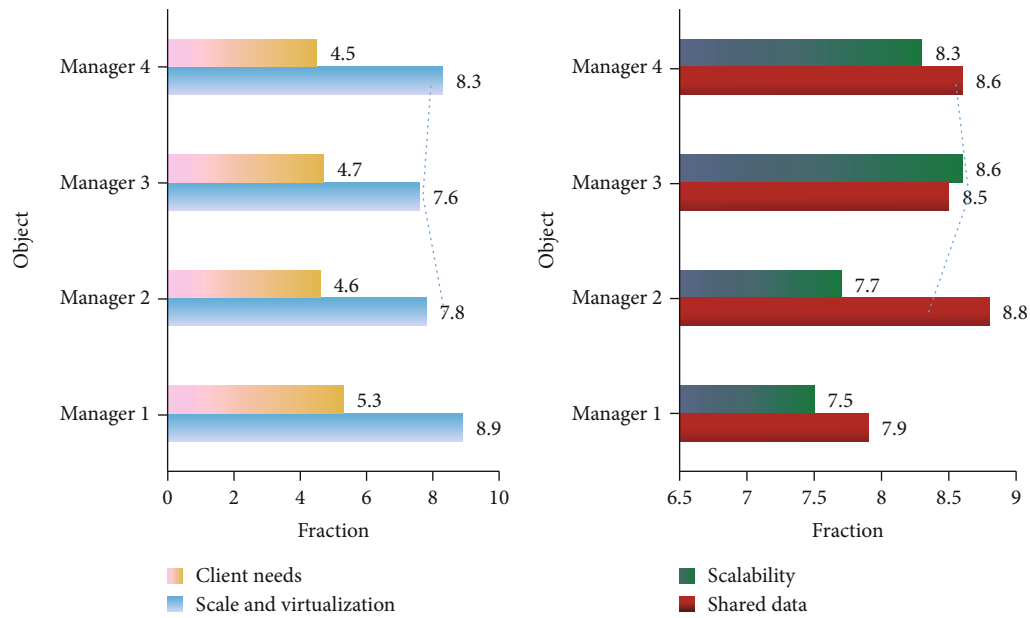


Figure 9: Characteristics of cloud computing.

Table 3: Problems existing in entrepreneurship data collection.

Years	Utilization level	Use awareness	How to use
2015	36%	52%	Single
2016	31%	49%	Single
2017	28%	38%	Single
2018	40%	42%	Single
2019	37%	45%	Single

$$d(i,j) = |a_{i1} - a_{j1}| + |a_{i2} - a_{j2}| + \cdots + |a_{ip} - a_{jp}|. \quad (20)$$

Data replication technology solves the mismatch of different data to a certain extent by copying data from each data source to other related data sources, which greatly improves the efficiency of information sharing and use. The general process of data replication technology is shown in Figure 7.

As shown in Figure 7, data replication technology can ensure that the same data stored on different nodes is consistent. In this way, when a node fails, data can be obtained from other nodes that store the data to avoid data loss, thereby improving the reliability of the system. Data replication improves the performance of the data merging system by reducing the amount of different data sources and avoids frequent access to different data sources, which reduces query efficiency.

Because there are many different databases, the extraction of data information and the development of knowledge mining are limited to a certain extent. In order to lift this limitation, data warehouse technology came into being. The data integration model based on the data warehouse is shown in Figure 8.

As shown in Figure 8, the data warehouse itself is also a database, and it is very simple for users to access the data warehouse. At the same time, the data warehouse stores all the data required for user decision support, mining and analysis,and provides users with powerful analysis and execution data support.

4. Data Processing System Experiment and Analysis of Intelligent Cloud Computing

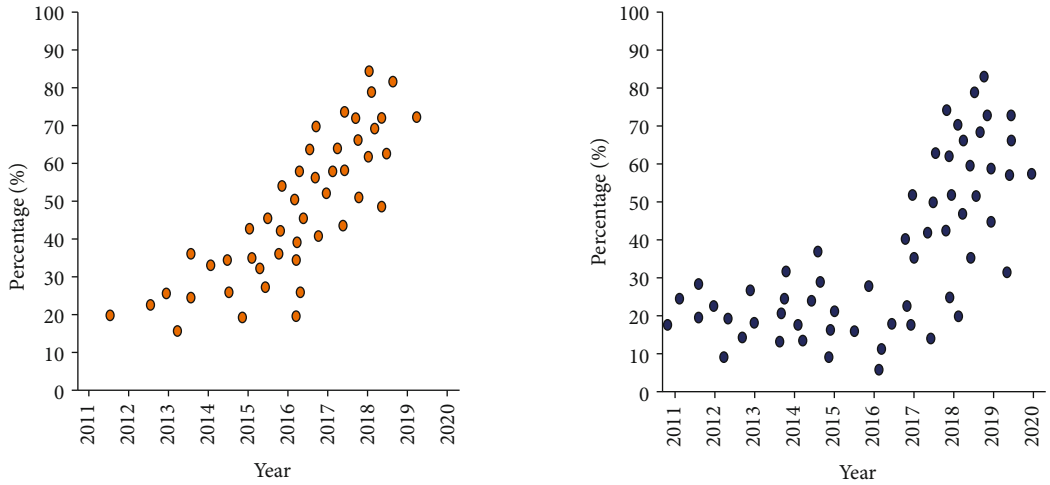
4.1. Characteristics of Cloud Computing. This article interviewed 4 campus data system managers and analyzed their characteristics of cloud computing, as shown in Figure 9.

As shown in Figure 9, the characteristics of cloud computing are as follows:

(1) Hyperscale and virtualization: Cloud computing provides the most reliable and secure data storage center. Users do not have to worry about data loss, virus intrusion, and other issues. At the other end of the "cloud" are the world's most professional teams that support information management and the most advanced data centers that help keep data

(2) Client demand is low: Cloud computing requires the least equipment on the client side and is the most convenient to use. For example, in order to prevent viruses from being introduced during downloading, antivirus and firewall software have to be installed repeatedly. With cloud technology, as long as you have a computer with Internet access and a favorite browser, you can enjoy the infinite fun that cloud computing brings to you

(3) Easily share data: Cloud computing can simply realize the sharing of data and applications between different devices. In the network application model of cloud computing, all electronic devices can access



(a) Percentage of graduates in 2011-2020 (b) Difficulty in managing entrepreneurship data for graduates in 2011-2020

Figure 10: Percentage of graduates from 2011-2020 and difficulty of graduate entrepreneurial data management.

Table 4: Traditional data processing systems.

Number of experiments	Scientific	Practicality	Efficiency	Cost
5	47.8%	35.7%	27.9%	58.9%
10	43.6%	34.2%	28.5%	56.1%
15	46.7%	36.0%	26.6%	55.0%
20	42.9%	37.2%	29.0%	54.5%

the same data at the same time by simply connecting to the Internet

(4) Strong scalability: Cloud computing is not application specific. By supporting "cloud," various applications can be built according to the needs of users. The scale of the "cloud" can also be dynamically scaled to adapt to the needs of the application environment and the expansion of the user scale

4.2. Traditional Data Processing System and Intelligent Cloud Computing Data Processing System. At present, various colleges and universities generally have two problems: the lack of scientificity and accuracy in the collection of graduate entrepreneurial data and the low level of utilization of entrepreneurial data. For colleges and universities, it is difficult to obtain accurate entrepreneurial data and make effective use without a set of scientific entrepreneurial data collection processes and standards. The problems existing in the collection of entrepreneurial data are shown in Table 3.

As shown in Table 3, the utilization rate of entrepreneur data is low, the awareness of utilization is low, and the utilization method is simple. The lack of scientific and accurate data collection for entrepreneurs directly reduces the value and importance of data utilization.

How to make good use of the valuable resource of entrepreneurial data and provide a scientific basis for the transformation of schools and the reform of disciplines and majors is a problem that colleges and universities urgently need to solve. The solution of these problems is of great significance to the country, universities, and graduate groups.

With the expansion of undergraduate enrollment in Chinese universities year by year, in an environment where the number of graduates increases significantly every year, the graduate department of the Talent Center not only needs to use the comprehensive management information system for entrepreneurial services to manage a large amount of graduate data, but also need to analyze these data. This paper analyzes the percentage of graduates from 2011 to 2020 and the difficulty of graduate entrepreneurial data management, as shown in Figure 10.

As shown in Figure 10, therefore, in order to intelligently and quickly obtain useful information and knowledge on entrepreneurial services such as entrepreneurial trainees from a large amount of data to help staff make overall planning for entrepreneurial services, data mining of historical data in the comprehensive management information system of entrepreneurial services, and analysis of the models and relationships in the mining results have become an indispensable link.

With the realization of global information resource sharing, the rapid growth of the amount of information and the improvement of the request for information. At present, it is difficult to meet the needs of practical applications based on traditional information extraction methods, so data mining technology is proposed. This paper compares the traditional data processing system and the intelligent cloud computing data processing system, as shown in Tables 4 and 5:

As shown in Tables 4 and 5, driven by today's high-tech development, the application scope of data mining is getting wider and wider. Applying it to university management can not only promote the further reform, improvement and development of school management, but also provide a favorable basis for managers to make correct decisions. At the same time, it also improves the scientificity, practicability and efficiency of the school's educational administration management methods. It uses data mining technology to

Table 5: Intelligent cloud computing data processing system.

Number of experiments	Scientific	Practicality	Efficiency	Cost
5	67.9%	89.4%	73.5%	20.1%
10	78.3%	76.7%	69.0%	15.7%
15	79.2%	81.5%	72.7%	12.9%
20	84.0%	77.3%	75.8%	13.8%

extract and analyze massive data, find hidden clues, and provide more valuable basis for further decision-making.

5. Discussion

This paper discusses how to study an intelligent cloud computing data processing system for college innovation and entrepreneurship data statistics, describes the theoretical knowledge related to intelligent cloud computing and college innovation and entrepreneurship, and focuses on the difficulty of data statistics. It explores a more scientific method of data statistics, discusses the effect of cloud computing on data processing system research through experimental analysis, and finally finds that cloud computing can make data processing systems more practical.

This paper also studies the cluster analysis and studies the cluster analysis before and after the improvement. It combines traditional clustering analysis with fuzzy theory and obtains an improved fuzzy clustering analysis algorithm. Cluster analysis plays an important role in data mining, which can make data classification more rapid.

It can be known from the experimental analysis in this paper that using the data mining method in the intelligent cloud computing data processing system can not only improve the practicability of the intelligent cloud computing data processing system, and the accuracy of data statistics has also been greatly improved.

6. Conclusions

With the increase of college graduates in recent years, the problem of entrepreneurship of college graduates has also become a national concern. The state not only encourages graduates to actively start their own businesses but also encourages them to actively innovate and start businesses and has given them a lot of support. However, with the increase of talents, it becomes more and more difficult to collect information and data for these graduates. Therefore, this paper proposes an intelligent cloud computing data processing system for college innovation and entrepreneurship data statistics. The system is based on the basis of data mining and is implemented in combination with cloud computing. However, because of the author's limited ability, this paper makes a general analysis and research on the framework of the data processing system. In the method part, it mainly expounds the association rule algorithm and cluster analysis method based on data mining. It applies two algorithms to the intelligent cloud computing data processing system, which can improve the efficiency of data processing and classify data, thus making it easier for graduates to innovate and start businesses. In the experiment, this paper analyzes the advantages of cloud computing and finds that cloud computing not only has a large scale to process data, but also can share data, which makes the information collection of entrepreneurship more convenient. The experiment finally found that the data processing system based on cloud computing is more efficient than the traditional data processing system, and has a high degree of science.

Data Availability

No data was used to support this study.

Conflicts of Interest

The authors declare that there is no conflict of interest with any financial organizations regarding the material reported in this manuscript.

Acknowledgments

This work were supported by the Key Scientific Research Projects of Colleges and Universities in Henan Province (20B880015) and Special research project on innovation and entrepreneurship teaching reform of Yellow River Conservancy Technical Institute in 2021(2021CXCYJG008).

References

[1] A.-J. Lin and H. Tang, *Social Entrepreneurship Education: New Development in College Entrepreneurship Education*, no. 2017-3, pp. 125–125, 2021.

[2] R. Deng, R. Lu, C. Lai, T. H. Luan, and H. Liang, "Optimal workload allocation in fog-cloud computing toward balanced delay and power consumption," *IEEE Internet of Things Journal*, vol. 3, no. 6, pp. 1171–1181, 2017.

[3] W. Wei, X. Fan, H. Song, X. Fan, and J. Yang, "Imperfect information dynamic Stackelberg game based resource allocation using hidden Markov for cloud computing," *IEEE Transactions on Services Computing*, vol. 11, no. 1, pp. 78–89, 2018.

[4] L. Jin, Y. Zhang, X. Chen, and Y. Xiang, "Secure attribute-based data sharing for resource-limited users in cloud computing," *Computers & Security*, vol. 72, pp. 1–12, 2018.

[5] T. Hirai, H. Masuyyama, S. Kasahara, and Y. Takahashi, "Performance analysis of large-scale parallel-distributed processing with backup tasks for cloud computing," *Journal of Industrial & Management Optimization*, vol. 10, no. 1, pp. 113–129, 2014.

[6] M. H. Ghahramani, M. C. Zhou, and T. H. Chi, "Toward cloud computing QoS architecture: analysis of cloud systems and cloud services," *IEEE/CAA Journal of Automatica Sinica*, vol. 4, no. 1, pp. 6–18, 2017.

[7] A. Barsoum and M. A. Hasan, "Provable multicopy dynamic data possession in cloud computing systems," *IEEE Transactions on Information Forensics & Security*, vol. 10, no. 3, pp. 485–497, 2017.

[8] J. L. Tsai and N. W. Lo, "A privacy-aware authentication scheme for distributed mobile cloud computing services," *IEEE Systems Journal*, vol. 9, no. 3, pp. 805–815, 2017.

[9] L. Ping, J. Li, Z. Huang et al., "Multi-key privacy-preserving deep learning in cloud computing," *Future Generation Computer Systems*, vol. 74, pp. 76–85, 2017.

[10] W. Tang and W. Feng, "Parallel map projection of vector-based big spatial data: coupling cloud computing with graphics processing units," *Computers, Environment and Urban Systems*, vol. 61, pp. 187–197, 2017.

[11] M. Abdel-Basset, M. Mai, and V. Chang, "NMCDA: a framework for evaluating cloud computing services," *FUTURE GENERATION COMPUTER SYSTEMS-THE INTERNATIONAL JOURNAL OF ESCIENCE*, vol. 86, pp. 12–29, 2018.

[12] H. Cai, B. Xu, L. Jiang, and A. V. Vasilakos, "IoT-based big data storage systems in cloud computing: perspectives and challenges," *IEEE Internet of Things Journal*, vol. 4, no. 1, pp. 75–87, 2017.

[13] J. Du, L. Zhao, F. Jie, and X. Chu, "Computation offloading and resource allocation in mixed fog/cloud computing systems with min-max fairness guarantee," *IEEE Transactions on Communications*, vol. 66, no. 4, pp. 1594–1608, 2018.

[14] N. Kratzke and P. C. Quint, "Understanding cloud-native applications after 10 years of cloud computing - a systematic mapping study," *Journal of Systems & Software*, vol. 126, pp. 1–16, 2017.

[15] Z. Cao, L. Jin, C. Wan, Y. Song, Y. Zhang, and X. Wang, "Optimal cloud computing resource allocation for demand side management," *IEEE Transactions on Smart Grid*, vol. 8, no. 4, pp. 1943–1955, 2017.

[16] S. Wang, K. Liang, J. K. Liu, J. Chen, J. Yu, and W. Xie, "Attribute-based data sharing scheme revisited in cloud computing," *IEEE Transactions on Information Forensics & Security*, vol. 11, no. 8, pp. 1661–1673, 2016.

[17] X. F. Liu, Z. H. Zhan, J. D. Deng, Y. Li, T. Gu, and J. Zhang, "An energy efficient ant colony system for virtual machine placement in cloud computing," *IEEE Transactions on Evolutionary Computation*, vol. 22, no. 1, pp. 113–128, 2018.

[18] V. Sudarsan and N. Satyanarayana, "Secure and practical outsourcing of linear programming in cloud computing: a survey," *International Journal of Computer Applications*, vol. 159, no. 4, pp. 1–4, 2017.

[19] A. Javed, H. Larijani, A. Ahmadinia, and D. Gibson, "Smart random neural network controller for HVAC using cloud computing technology," *IEEE Transactions on Industrial Informatics*, vol. 13, no. 1, pp. 351–360, 2017.

[20] M. S. Hasan, Y. Kouki, T. Ledoux, and J. L. Pazat, "Exploiting renewable sources: when green SLA becomes a possible reality in cloud computing," *IEEE Transactions on Cloud Computing*, vol. 5, no. 2, pp. 249–262, 2017.

[21] F. Zafar, A. Khan, S. Malik et al., "A survey of cloud computing data integrity schemes: design challenges, taxonomy and future trends," *Computers & Security*, vol. 65, pp. 29–49, 2017.

Hindawi
Mobile Information Systems
Volume 2023, Article ID 9805762, 1 page
https://doi.org/10.1155/2023/9805762

Retraction

Retracted: Cross-Border E-Commerce Platform Logistics and Supply Chain Network Optimization Based on Deep Learning

Mobile Information Systems

Received 19 September 2023; Accepted 19 September 2023; Published 20 September 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] H. Guo and T. Zou, "Cross-Border E-Commerce Platform Logistics and Supply Chain Network Optimization Based on Deep Learning," *Mobile Information Systems*, vol. 2022, Article ID 2203322, 10 pages, 2022.

Hindawi
Mobile Information Systems
Volume 2022, Article ID 2203322, 10 pages
https://doi.org/10.1155/2022/2203322

Research Article

Cross-Border E-Commerce Platform Logistics and Supply Chain Network Optimization Based on Deep Learning

Hongli Guo[1] and Tong Zou[2]

[1]*Business School, Shandong Jianzhu University, Jinan 250101, Shandong, China*
[2]*School of International Economics and Trade, Shandong University of Finance and Economics, Jinan 250002, Shandong, China*

Correspondence should be addressed to Tong Zou; 161849018@masu.edu.cn

Received 24 March 2022; Revised 19 April 2022; Accepted 5 May 2022; Published 21 May 2022

Academic Editor: Liming Chen

E-commerce and logistics are symbioses with each other, but cross-border e-commerce (CBEC) still cannot break away from cross-border logistics. With the progress of economic internationalization, economic and trade ties around the world have become closer and closer, and the level of international business exchanges has been improved. The rise of multinational e-commerce has also caused unprecedented difficulties to multinational logistics and supply chain management. The application of deep neural networks in various fields provides opportunities for cross-border e-commerce platforms to solve these problems. The existing logistics distribution model cannot keep up with the development of CBEC and has become a constraint and bottleneck for the development of CBEC. Therefore, this article introduces deep learning neural network to cross-border logistics and supply chain based on the analysis of the existing cross-border logistics model and supply chain model and the status quo of e-commerce development. It optimizes the existing cross-border logistics and supply chain network in order to break through the current bottleneck in the development of CBEC. This paper shows through research that introducing deep learning neural networks into CBEC logistics and supply chain can improve the efficiency of logistics and supply chain. Compared with the previous efficiency, the efficiency of network optimization can be increased to about 50%, reducing the cost of cross-border logistics and supply chain. The research in this article has great theoretical and guiding significance for the development of CBEC.

1. Introduction

At present, CBEC is developing rapidly, but cross-border logistics has become a constraining factor for CBEC. Although with the standardization and quality development of CBEC, related service companies have gradually formed a specialized division of labor and complementary advantages under the organization and guidance of integrators. A CBEC service logistics supply chain is characterized by collaborative integration and service innovation. However, cross-border logistics is slow in time, high in cost, corresponding after-sales service, lag of information exchange, and other problems that have not been effectively solved [1]. At the same time, deep learning neural networks are widely used in various fields. This also brings some effective enlightenment to cross-border logistics and supply chain. Is it possible to apply deep learning neural networks to the logistics and supply chain of CBEC platforms to change the current bottleneck in the development of CBEC? This achieves the simultaneous development of CBEC and cross-border logistics, enables cross-border logistics and supply chain to achieve network optimization, and improves the efficiency of cross-border IoT, and the supply chain is one of the current research hotspots.

This paper applies deep neural networks to CBEC platforms to optimize cross-border logistics and supply chain research, which can change the dilemma of e-commerce platform development. This enables the innovation of e-commerce platforms and the development of healthy and green cross-border logistics. This article aims to improve the problem of slow timeliness and high cost of cross-border logistics, in order to improve the distribution efficiency of cross-border logistics and reduce the cost of cross-border logistics, and promote the further development of CBEC. It

improves cross-border electricity supply; improves the ability of cross-border electric business platform of the supply chain management, contributing to the brand effect; improves the marketing ability of the platform; implements cross-border electricity in the production and circulation of commodities of green development; changes traditional trade form, and implements different products and services, promoting cross-border market at the heart of the economic development status and efficiency [2].

In order to improve the distribution efficiency of cross-border logistics and reduce the cost of cross-border logistics, as well as to realize the green and healthy development of the supply chain, many scholars have carried out in-depth research on the logistics and supply chain of CBEC platforms. Among them, Zhang H analyzes all aspects of the CBEC logistics process based on big data processing technology. He built a standardized and modular logistics optimization platform and used logistics networks as an example to verify its effectiveness. This provides reference and guidance for further improving CBEC logistics technology. Although Zhang's research combined big data technology, it failed to achieve the healthy development of the supply chain [3]. Sun P proposed the construction of cross-border e-commerce logistics supervision system based on internet of things technology. Through experiments, the proposed cross-border supervision system is safe and controllable. In addition, e-commerce logistics protect the privacy of users and data and can prevent forgery and fraud [4]. Ene S established a multiobjective optimization model to determine the network design of the green supply chain. This model can be used as a strategic decision-making tool to solve problems with multiple goals and conflicts [5]. His research has a certain guiding significance for the optimization of the supply chain of CBEC, but it lacks theoretical support. Zheng et al. analyzed the coordination mechanism of supply chain finance in B2C CBEC. He proposed the use of a reputation mechanism to link the credit repayments of upstream manufacturers with the credit lines of financial institutions. And he believes that the reputation mechanism can increase the chance of contract performance, thereby solving the problem of SCF default caused by information asymmetry [6]. Although his research can improve some of the problems in the supply chain, it still fails to improve the efficiency of the supply chain. Due to the explosive growth trend of CBEC, Yan W conducts research on the supply chain from the perspective of decision-making and coordination. He used the Shapley value method and the full-cooperative income incremental sharing mechanism to redistribute profits under different cooperation modes, in order to provide a scientific decision-making reference for domestic CBEC companies to rationally choose cooperative relations [7]. His research is very novel but lacks the support of theoretical data. Therefore, this article will optimize the CBEC platform logistics and supply chain on the basis of their research to improve the problems in cross-border logistics and supply chain.

This article has the following innovations in the research of CBEC platform logistics and supply chain: (1) it applies a deep neural network to cross-border logistics and improves and optimizes the network based on the original cross-border logistics model, thereby improving the efficiency of cross-border logistics and reducing the cost of cross-border logistics; (2) it applies the deep neural network to the supply chain service segment of the CBEC platform to improve the slowness of the service end of the supply chain in contact with customers, and provide the timeliness of the response; and (3) the deep learning neural network is integrated into supply chain management, and the unsupervised autonomous learning ability of the deep learning neural network is utilized to optimize the logistics transportation and inventory management ability in the supply chain.

2. CBEC Platform Logistics and Supply Chain Network Optimization Methods

2.1. Deep Learning Neural Network. Deep learning is a new concept proposed relative to shallow learning. Bringing it into the CBEC platform logistics and supply chain is to apply the deep learning neural network to the cross-border logistics and supply chain. The deep learning neural network model can effectively improve the efficiency of cross-border logistics, reduce the cost of cross-border logistics, and promote the healthy and green development of the supply chain of CBEC platforms. The proposal of a deep neural network naturally cannot leave the research on the human brain, so the deep neural network is based on the human brain. It can also be widely used in medical, transportation, business, and other fields. The generation and application of deep neural networks are shown in Figure 1:

Deep learning is a technology in the field of machine learning. It is generated through the study of the human brain. The purpose is to make it close to the human brain and stimulate the human brain to deal with various affairs, so as to acquire new knowledge or skills and reorganize the existing knowledge structure to continuously improve its own performance [8]. Therefore, applying deep learning networks to cross-border logistics and supply chains can make logistics and supply chains more intelligent and precise. Deep learning neural network is a multilayered framework. It adds a hidden layer on the basis of the BP nerve, which can enhance the learning ability of the deep learning model. Therefore, in cross-border logistics, when the deep learning model is used in the logistics model, it can operate in accordance with specific instructions internally to improve the efficiency of logistics and supply chain. The network structure of deep learning is shown in Figure 2.

The deep learning neural network originated from BP neural network. It realizes the establishment of a deep learning network through the superposition of RBM layer by layer. Each RBM is a probabilistic generative model, which restricts input and output data through RBM. To realize the adjustment of the weights of the deep learning network, the probability model of any RBM is

$$R(g, f) = \frac{j^{-E(g,f)}}{K}. \tag{1}$$

In the structure diagram of Figure 2, the middle layer is the hidden layer of deep learning. If the input is defined as g

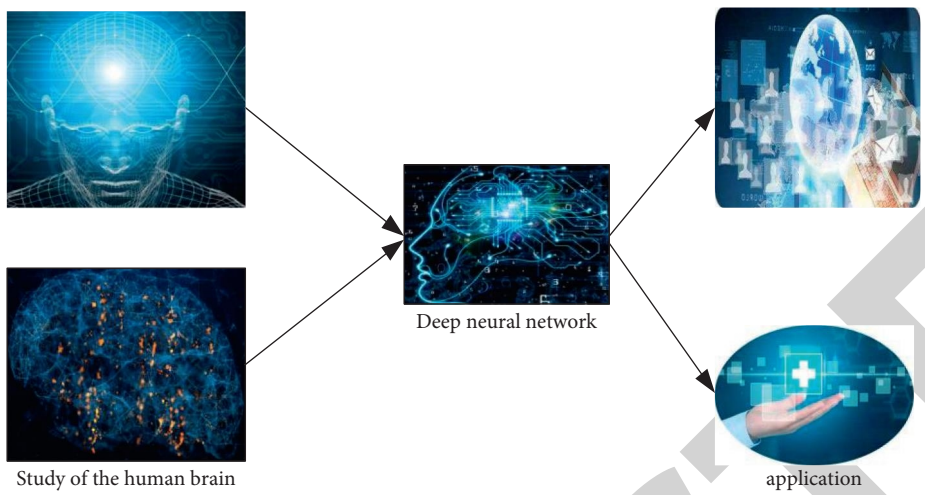


Figure 1: The generation and application of deep neural networks.

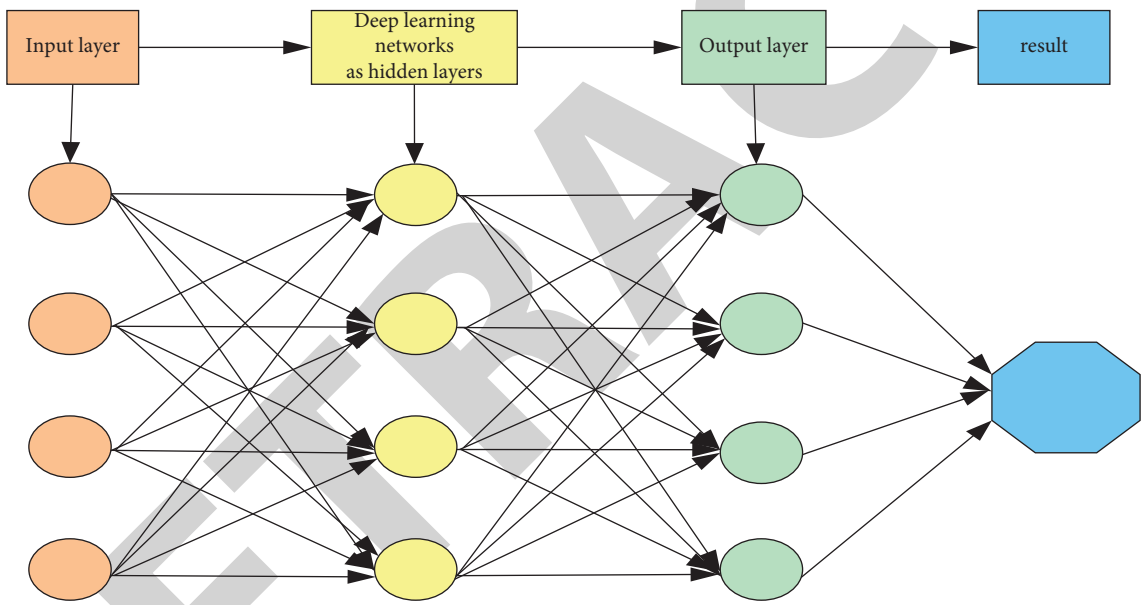


Figure 2: Network structure diagram of deep learning.

and the output is defined as f, the connection weight between the input layer and the hidden layer is represented by d. The bias is expressed by x and t, and $Q(g, f)$ is defined as the relationship function of this neuron. The normalization factor is K; then the relationship between K and the relationship function $Q(g, f)$ can be expressed as follows:

$$Q(g, f) = -x'g - t'f - f'\mathrm{d}x,$$
$$K(g, f) = \sum_{g,f} j^{-E(g,f)}. \tag{2}$$

where g and f represent all possible states of all nodes in the deep learning neural network. If it is used for e-commerce platform logistics, it can grasp the various situations that appear on the platform and make improvements. If the state of the input layer has been determined, the condition of the state of the hidden layer of the deep neural network is

$$R\left(\frac{g}{f}\right) = \frac{\exp(x'g + t'f + f'\mathrm{d}g)}{\sum_f \exp(x'g + t'f + f'\mathrm{d}g)},$$
$$R\left(\frac{g}{f}\right) = \frac{\exp(x'g + f'\mathrm{d}g)}{\sum_K \exp(x'g + f'\mathrm{d}g)}. \tag{3}$$

Formula (3) can be simplified to

$$R\left(\frac{g}{f}\right) = \frac{\prod_n \exp(x_n g_n + f_n d_n g)}{\prod_n \sum_K \exp(x_n g_n + f_n d_n g)},$$
$$R\left(\frac{g}{f}\right) = \frac{\coprod_n \exp[g(x' + f'd)]}{\prod_n \sum_K \exp[g(x' + f'd)]}, \tag{4}$$
$$R\left(\frac{g}{f}\right) = \prod_n R\left(\frac{f_n}{g}\right),$$

where n is the threshold of neurons in the neural network structure. It can be seen from the above formula that if the information of the input layer is known, then the probability of each node in the hidden layer in the deep learning network is a factorial. That is to say, in the e-commerce platform, each logistics is independent of the other but is interconnected. In the algorithm of deep learning, the neural network in deep learning adopts unsupervised learning. Applying it to the cross-border e-commerce platform can realize the intellectualization of the platform and improve the efficiency of the platform in dealing with problems. When the value weight in the neuron of deep learning is 1 and 2 and a node is in the activated state, the activation probability is

$$R\left(f_n = \frac{1}{g}\right) = \frac{\exp\left(x_n + d_n x\right)}{1 + \exp\left(x_n + d_n x\right)}. \tag{5}$$

Formula (5) can be expressed as follows:

$$R\left(f_n = \frac{1}{g}\right) = \operatorname{sigm}\left(x_n + d_n x\right). \tag{6}$$

In the same way, it can be concluded that the conditional probability of the input layer is

$$R\left(g_n = \frac{1}{f}\right) = \operatorname{sigm}\left(t_n + d_n t\right), \tag{7}$$

where $y = \operatorname{sigm}(x)$ is the activation function of neurons in the deep learning neural network. When the value weight of the input layer and the hidden layer are both the conditional probability of 1, the activation function can be indexed, and the normalization function can be obtained as follows:

$$R(g, f) = \frac{1}{K} j^{-Q(g,f)}, \tag{8}$$

where K is the normalization factor. Then it adds the input layer and the hidden layer to get

$$K = \sum_{g,f} j^{-Q(g,f)}. \tag{9}$$

The amount of business data allocated to the input layer by the network is the sum of the value weights of all the input layers, and it can get

$$R(f) = \frac{1}{K} \sum_{g} j^{-Q(g,f)}. \tag{10}$$

Since the neurons between the input layer and the hidden layer are independent and interrelated, there are:

$$\begin{aligned} R\left(\frac{f}{g}\right) &= \prod_{n}^{x} R\left(\frac{f_n}{g}\right), \\ R\left(\frac{g}{f}\right) &= \prod_{n}^{t} R\left(\frac{g_n}{f}\right). \end{aligned} \tag{11}$$

In this case, when the deep learning network is completed on the e-commerce platform, it can be used as a supporter for optimizing the logistics information network and communication network, helping to deal with the problems related to the supply chain. It can improve existing problems by applying deep neural networks to the logistics of transnational e-commerce platforms. It can also promote the speed of logistics and shorten the cycle of logistics and promote the healthy and green development of the supply chain of cross-border business platforms.

2.2. CBEC Platform Logistics and Supply Chain. CBEC refers to two traders who exist in different countries, through the e-commerce platform to reach a transaction between the two parties. When the transaction is completed, the product needs to be delivered to the consumer. Therefore, it needs to deliver goods to consumers through cross-border logistics to complete the entire cross-border transaction [9]. Of course, this is one of the supply chains, which is called the logistics supply chain. Cross-border transactions need to be concluded as long as there are commodities, and commodities are produced by enterprises, so cross-border transactions require the cooperation of multiple parties to complete. The cross-border transaction process is shown in Figure 3.

In Figure 3, the cross-border transaction requires consumers to place an order on the shopping platform, and the seller of the cross-border e-commerce platform will deliver the goods according to the received order and then send the goods to the buyer from the domestic logistics to the customs and the overseas logistics.

CBEC has competitive advantages such as fewer sales links and convenient payment. With the continuous improvement of the competitiveness of the international trade market, the rapid development of CBEC has brought huge profits at the same time. It also exposed the shortcomings of the CBEC platform development model. One is that most CBEC companies have not formed core competitiveness and brand effects. Each enterprise has its own governance, competing with each other in the form of price wars, and the products have become severely homogenized [10]. In terms of logistics, goods purchased across the border will undergo express delivery violence during transportation, resulting in quality problems and high costs in a long logistics cycle. In terms of logistics, the delivery service quality of CBEC is generally low. However, the speed of logistics distribution is relatively slow, and the cost of logistics distribution is also high. And it is prone to damage to goods during transportation. Some multinational e-commerce companies mainly engaged in small transactions are fragmented due to their relatively small trade scale. Therefore, the customs clearance time is too long, and the settlement method is not standardized. In addition, although the development of communication technology and science and technology has realized cross-border payments. However, although cross-border payment has realized the convenience of payment, it cannot guarantee the security of payment. There are still great security risks in the payment process [11]. Therefore, CBEC companies must take the initiative to seize the huge market opportunities provided by international big data resources, optimize the supply chain platform, and improve the quality

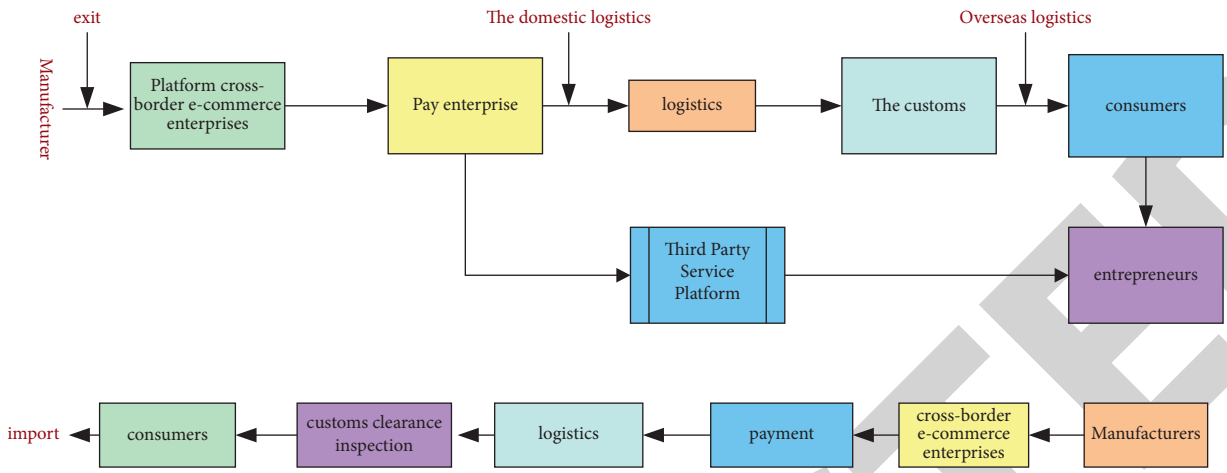


Figure 3: Cross-border transaction process.

of logistics services and the efficiency of logistics distribution. Although the development of CBEC is fast, there are still risks and shortcomings. Therefore, if it wants to better promote the development of CBEC, it needs to actively build a scientific and reasonable supply chain platform [12].

The current cross-border logistics speed cannot keep up with the development of cross-border commerce platforms, which will lead to a series of problems. For example, the logistics cycle is too long, which leads to the failure of logistics tracking, which leads to the repetition of work, and the delivery violence leads to quality problems. This makes a lot of unnecessary problems to occur. And, if the logistics, capital flow, and information flow cannot be carried out simultaneously, it will lead to the rework of many procedures, resulting in a large amount of time and capital costs. Therefore, it needs to optimize the cross-border platform logistics and supply chain network. It is necessary to promote the synchronization of the logistics, capital flow, and information flow of the CBEC platform to ensure the healthy and stable development of the e-commerce platform.

2.3. CBEC Platform Logistics and Supply Chain Network Optimization. At present, the development of cross-border logistics and CBEC is still not coordinated. The rapid development of CBEC makes it difficult for the development of cross-border logistics to keep up, but there are still many outstanding problems. Therefore, the network optimization of the supply chain of the CBEC platform is mainly aimed at optimizing the supply chain for the problem that logistics, capital flow, and information flow cannot be synchronized [13]. The goods of CBEC will pass through two or more countries during the transportation process, making it difficult to track the goods during the transportation process. So it is necessary to optimize the network for this problem. And, in the process of transportation, if the two countries are far apart, the goods will be delayed for a long time on the way of transportation, requiring a lot of time and cost [14]. Therefore, it uses deep learning neural networks to optimize the logistics and supply chains of multinational e-commerce platforms. The optimized network structure is shown in Figure 4:

As an e-commerce platform serves as a bridge between sellers and buyers, this platform needs to provide buyers and sellers with timely logistics information to prevent parcels from being lost. For this reason, in order to solve the loss of parcels between the two countries, the e-commerce platform can set up a warehouse overseas. In other words, it can first aggregate the goods delivered by domestic logistics to overseas warehouses. It then carries out foreign transportation to promote the efficiency of transportation. This can also reduce the cost of lost packages [15]. It is shown in Figure 5.

For the network optimization of the supply chain, its optimization adheres to low-carbon and environmental protection, optimizes the resource allocation of CBEC, and changes the situation of e-commerce enterprises being independent so that the resources of the e-commerce platform can be shared. The means to promote information communication provide a good information foundation for logistics tracking and e-commerce platforms. This is the complementarity between members in terms of production, capital, technology, and management relying on the e-commerce platform [16]. In addition, it is necessary to optimize the information infrastructure and remote communication technology, promote communication and contact between all parties, achieve the goal of timeliness, and improve the disadvantages caused by information delay. The management capability of the supply chain is measured from different aspects. These include online marketing capabilities, inventory management capabilities, and brand management capabilities, as shown in Figure 6.

Online marketing capabilities refer to sales capabilities on e-commerce platforms. The ability in this area is currently considerable because it saves consumers a lot of time and cost on the e-commerce platform, so online consumption is very happy [17]. Of course, for different commodities, the sales volume will of course be different. Therefore, the sales volume of this single product is difficult to consider and can only be seen from the sales capacity of the entire e-commerce platform. Inventory management capabilities will involve

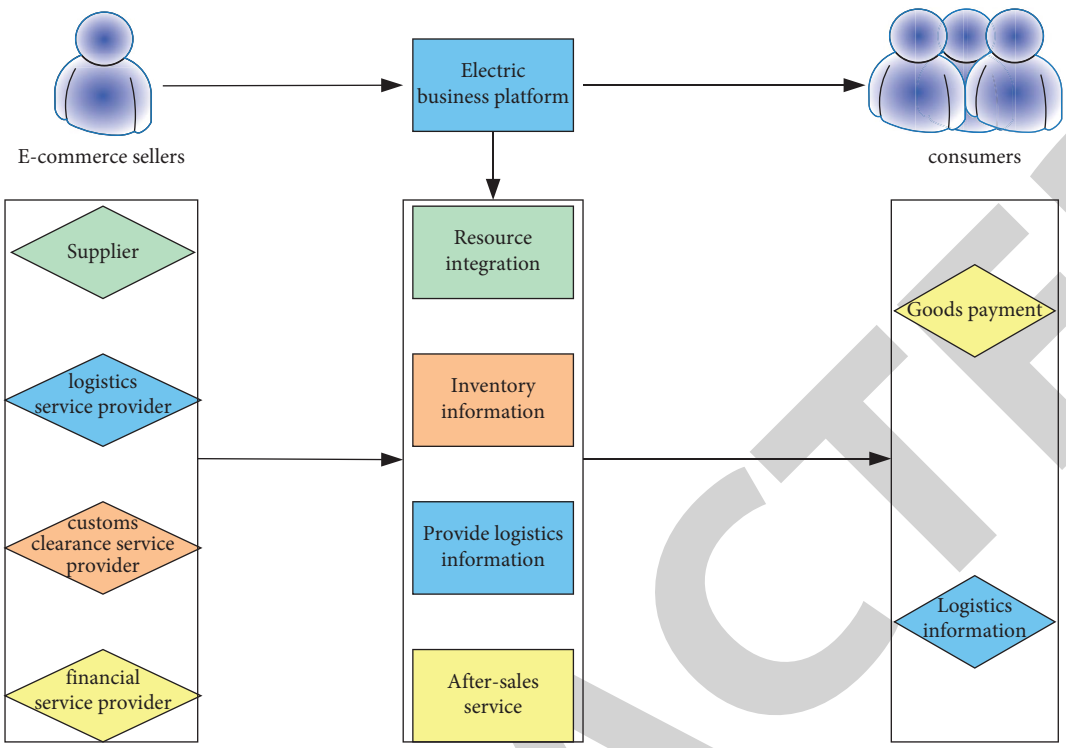


Figure 4: Network optimization structure.

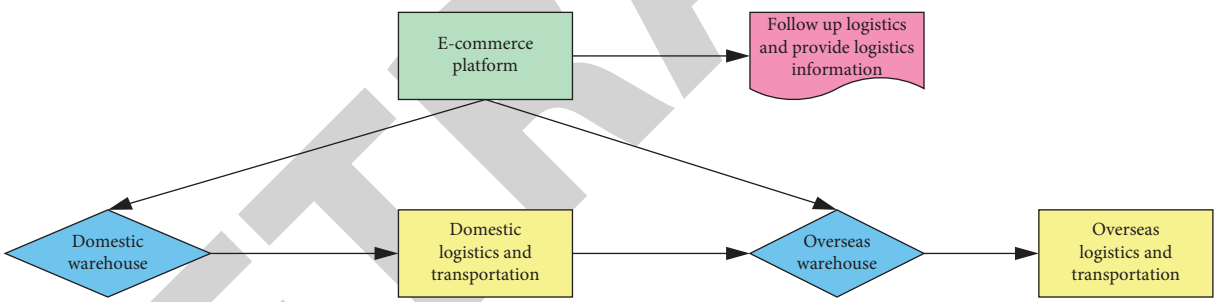


Figure 5: Supply chain logistics management of e-commerce platform.

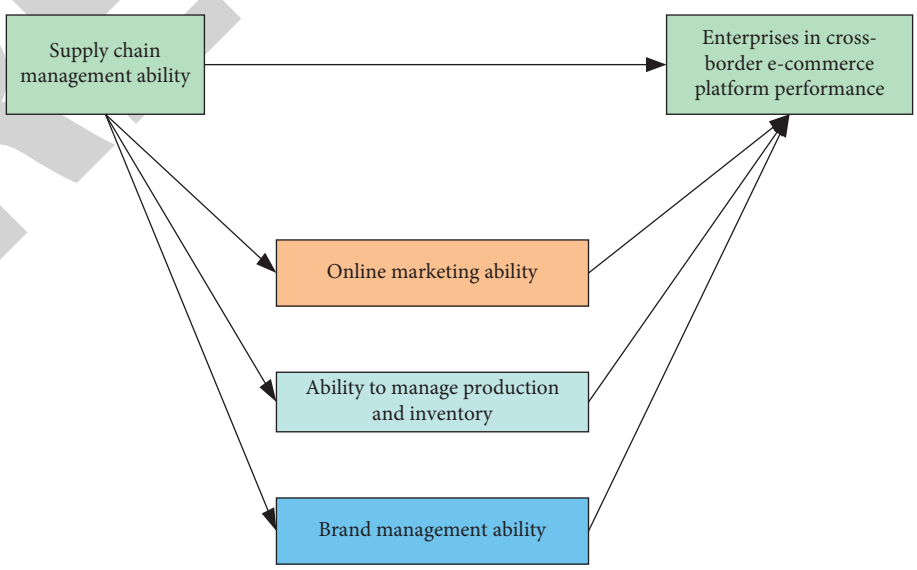


Figure 6: Measurement dimensions of supply chain capabilities.

logistics transportation. If inventory management can be carried out in an orderly manner, it is best if the inventory is sufficient, but there is not too much surplus. Logistics enterprises are part of the supply chain, so the inventory management of logistics enterprises also needs to be informatized, networked, and highly integrated. In this way, logistics management costs can be saved [18]. Brand management ability means that brand effects can be formed through the supply chain, but there are currently many CBEC companies. This makes different products compete to imitate in terms of performance, appearance, and even marketing methods, and it has also brought a huge impact to CBEC. Therefore, a resource aggregation platform is needed to integrate the resources of these homogeneous commodities. This article hopes to achieve brand effects and promote the healthy and stable development of e-commerce platforms [19].

3. Experiment and Analysis of CBEC Network Optimization Platform Logistics and Supply Chain

3.1. Is the Transportation Speed of the Logistics Supply Chain Improved? The network optimization of CBEC is to improve the efficiency of logistics and supply chain and to promote the green and healthy development of the supply chain. This experiment will measure and record the number of days required for express delivery from China to Switzerland and will use two logistics for transportation. One of them is the logistics after network optimization, and the other is the logistics before network optimization. Because the weight of goods will also affect the speed of logistics, the greater the weight, the longer the logistics transport time, so the weight of goods is also recorded. The goods to be shipped are shown in Table 1.

In Table 1, it can be seen that their logistics will deliver five items of different weights to the same place in the same country. To this end, it records the time required for the entire supply chain of different commodities from production to consumers in Table 2.

In Table 2, it has not yet recorded the returns and exchanges. If the product has quality problems during transportation, a lot of time cost may be incurred in the middle. Therefore, their current CBEC logistics will not only lose the goods but also may cause quality problems due to being too violent. For this reason, it recorded the logistics and supply chain efficiency of the CBEC platform after network optimization and compared it with the logistics and supply chain before optimization. The results are shown in Figure 7.

From Figure 7, the transportation speed of logistics transportation has been significantly improved after network optimization. In particular, the transportation speed of heavyweight commodities such as furniture and rubber has basically increased by about 50%, which shows that the transportation speed is very fast. However, the effect of increasing speed is not very obvious. The transportation speed dropped directly from 30 days to 5 days, and its efficiency was greatly improved. Therefore, in the transportation of small commodities, the efficiency improvement of the optimized logistics and the optimized logistics is uncertain, and it needs to be investigated according to the actual situation.

Table 1: Cross-border commodities.

Departure area	Destination	Goods	Weight of goods (kg)
China	Switzerland	A set of furniture	110
		Clothes	5
		Rubber sheet	50
		Makeup	20
		Shoes	15

Table 2: Time required for the entire supply chain.

Goods	Time (day)	
	Production	Transport
A set of furniture	30	20
Clothes	15	14
Rubber sheet	45	17.5
Makeup	20	30
Shoes	35	8

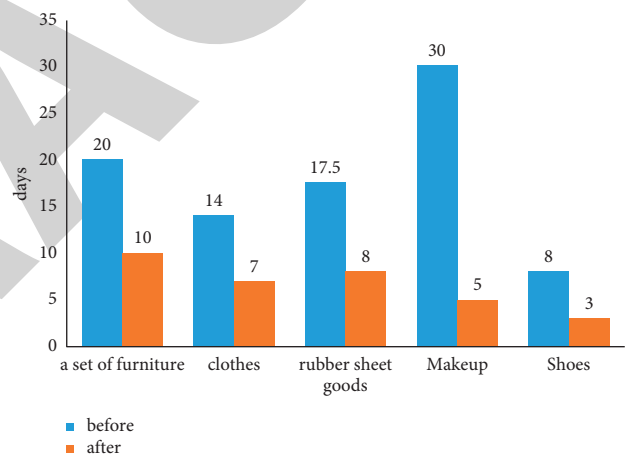


Figure 7: Time comparison chart before and after logistics and transportation optimization.

Cross-border logistics circulates between the two countries, so it also records the time from domestic to customs and the time of overseas transportation for comparison. At the same time, it also compared and analyzed the required transportation time before and after network optimization. During the period, it may fail to track the logistics when it uses the logistics before network optimization to go abroad. Therefore, overseas transportation will take more time. The recorded time is shown in Figure 8.

It can be clearly seen from Figure 8 that domestic logistics is faster than overseas logistics, whether it is before or after optimization, so domestic logistics tracking is very

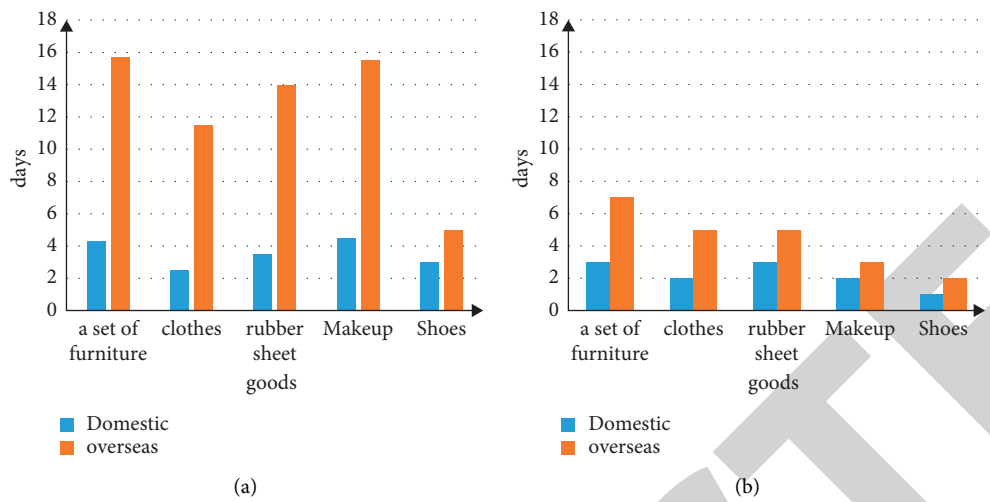


Figure 8: Comparison of domestic and overseas logistics speed: (a) before optimization and (b) after optimization.

time-efficient. However, in foreign countries, the logistics information will not be transmitted to the CBEC platform in time, which leads to more time spent on logistics abroad. The transportation efficiency of overseas logistics after network optimization is obviously much faster than that of overseas logistics before optimization. It saves a lot of time and cost, so in the logistics supply chain, the optimized CBEC platform logistics has a much higher commodity transportation efficiency.

3.2. Changes in the Management Capabilities of the Optimized Cross-Border Platform Supply Chain. This experiment is mainly to test the marketing capabilities of the optimized CBEC platform for various commodities. Its marketing ability is judged by the amount of sales. For the products that need to be calculated and the sales of these products in 2020, as shown in Table 3.

The product categories in this experiment are divided into five categories: electronic products, clothing, beauty, food, and daily necessities. It calculates and compares the sales before optimization, and the sales after optimization for these five categories to see if the marketing capabilities of the optimized CBEC platform supply chain management have improved. The result is shown in Figure 9.

Without network optimization, it can clearly see that sales are less than optimized sales. Because the optimized CBEC platform provides instant services, consumers have a better shopping experience. And, under the speed of logistics, the quality of the transportation process will also be guaranteed.

In terms of inventory management capabilities and brand management, supply chain management after network optimization can better promote the management of the two and realize the reasonable allocation of resources. Therefore, the abilities in these two aspects can naturally be improved accordingly, and in addition to better serving consumers, it also promotes the healthy development of bright orange in the supply chain.

Table 3: Product categories and sales in 2020.

Category of goods	Sales (million)
Electronic products	40,697,678
Clothing	77,865,445
Cosmetics	67,675,774
Food	73,465,683
Daily necessities	998,777,667

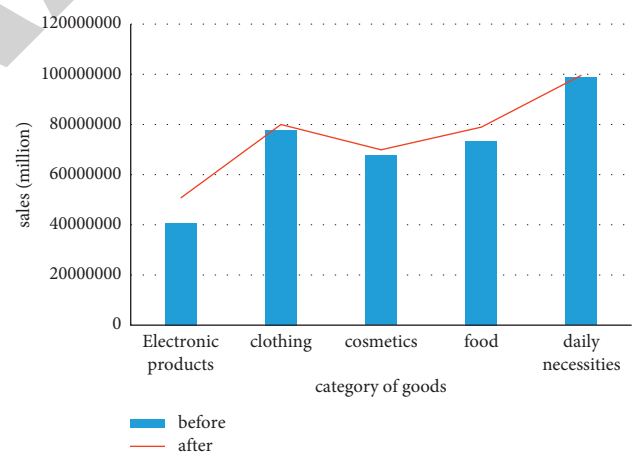


Figure 9: Comparison of sales before and after optimization.

3.3. Experiment Summary. The above experiments show that the network optimization of the logistics and supply chain of the CBEC platform has shown that the speed of its logistics has increased compared with the past, and its speed and efficiency have increased by about 50%. After the supply chain has been optimized, its inventory management capabilities have also increased significantly, which has promoted the rational allocation of resources. This effectively improves the speed of logistics transportation between regions. In a unified CBEC platform, it has improved the phenomenon of product homogeneity and promoted the

generation of brand effects. It has also promoted the online sales capabilities of CBEC platforms and increased annual sales in various categories. Gather individual foreign trade enterprises on the cross-border e-commerce platform to improve the brand effect of the industry and promote the green development of cross-border e-commerce.

4. Discussion

This article discusses the principles of deep learning neural networks. The deep learning neural network is composed of output, input, and hidden layers. The three tiers can operate simultaneously, and applying them to CBEC platforms can effectively serve buyers and sellers as well as e-commerce platforms. Output and input can be used to transmit various messages about logistics and supply chain. The hidden layer is the intermediate e-commerce platform, which makes the communication between buyers and sellers time-sensitive and reduces the loss caused by information delay [20]. Furthermore, deep learning neural networks can coordinate commodity resources for e-commerce platforms, carry out effective integration, and promote the rational use of resources. At the same time, in order to keep up with the development speed of CBEC platforms, deep learning neural networks can be trained on the platform first and then unsupervised learning according to the processing mode of the platform. It can be used as a manual operation on the platform to improve the efficiency of the e-commerce platform.

Secondly, the logistics and supply chain problems of multinational e-commerce platforms are now more prominent. Therefore, it is necessary to find solutions to these outstanding problems and to a certain extent improve the speed and level of logistics. At the same time, it is also necessary to ensure the quality of the goods required by buyers during the transportation process, improve the satisfaction of overseas customers, and reduce the probability of return and exchange. It needs to truly achieve the simultaneous development of supply chain, logistics, and CBEC and promote the green and healthy development of CBEC. In addition, it is also necessary to optimize the e-commerce platform, promote the service capability and service level of the e-commerce platform and the ability to solve problems, and improve the professional level of the e-commerce platform.

This article integrates deep learning neural networks into the CBEC platform logistics and supply chain. The purpose is to improve the current shortcomings of CBEC and promote the long-term development of CBEC. At the same time, it has also improved the management capabilities of the supply chain, changed the homogeneity of various commodities, and improved the service capabilities of the CBEC platform. This allows consumers to obtain a better consumer experience, can increase consumers' desire to consume, and promote sales. Secondly, it is possible to summarize the homogeneous products of different brands to promote the reasonable distribution of these products. This enables the simultaneous development of logistics speed and supply chain management with CBEC platforms.

5. Conclusions

This article has conducted an in-depth discussion on the theory of deep learning neural networks and also sorted out and explained the shortcomings of current CBEC platforms. This provides a better reference for the logistics and supply chain network optimization of the CBEC platform in the following article. In this paper, regarding the current e-commerce platform development and logistics problems and the lagging problems of information resources and capital chain, the deep learning neural network is integrated into the e-commerce platform to improve these problems. It has greatly improved the marketing capabilities, inventory management capabilities, and brand management capabilities of the cross-border business platform. It improves the efficiency of logistics and brings a better experience to consumers. This article has great theoretical significance and reference value for the research of CBEC platform logistics and supply chain network optimization. However, the research in this paper fails to fully consider the factors affecting the development of e-commerce platforms, and there are still many deficiencies. It is hoped that future research can consider other factors to promote the stable development of cross-border e-commerce platforms.

Data Availability

No data were used to support this study.

Conflicts of Interest

The authors declare that they have no conflicts of interest.

Acknowledgments

This study was supported by the Humanities and Social Science Project of Shandong Province, China (Grant No. 2021-YYJJ-29), project name: "Research on the Development Path of Shandong Cross-Border E-Commerce under the Digital Economy."

References

[1] W. Jiang, E. H. M. Sha, Q. Zhuge, and L. Wu, "Efficient assignment algorithms to minimize operation cost for supply chain networks in agile manufacturing," *Computers & Industrial Engineering*, vol. 108, pp. 225–239, 2017.

[2] A. Alglawe, A. Schiffauerova, O. Kuzgunkaya, and I. Shiboub, "Supply chain network design based on cost of quality and quality level analysis," *The TQM Journal*, vol. 31, no. 3, pp. 467–490, 2019.

[3] H. W. Zhang, X. Man, Y. Wang et al., "Characterization of a double WAP domain-containing protein from the red swamp crayfish *Procambarus clarkii*," *Fish & Shellfish Immunology*, vol. 71, no. 4, pp. 329–337, 2017.

[4] P. Sun and L. Gu, "Optimization of cross-border e-commerce logistics supervision system based on Internet of Things technology," *Complexity*, vol. 2021, no. 4, 11 pages, Article ID 4582838, 2021.

Hindawi
Mobile Information Systems
Volume 2022, Article ID 4627111, 9 pages
https://doi.org/10.1155/2022/4627111

Research Article

Satellite/Inertial Navigation Integrated Navigation Method Based on Improved Kalman Filtering Algorithm

Ning Wang

College of Intelligent Systems Science and Engineering, Harbin Engineering University, Harbin, 150001 Heilongjiang, China

Correspondence should be addressed to Ning Wang; jerry_wn@hrbeu.edu.cn

Received 22 March 2022; Revised 20 April 2022; Accepted 28 April 2022; Published 19 May 2022

Academic Editor: Liming Chen

With the continuous development of positioning technology in today's world, the accuracy requirements for navigation and positioning are also getting higher and higher. Global Positioning and Navigation System (GPS) can provide high-precision long-term navigation and positioning information. However, it has a strong dependence on the external environment, which means that it is easily disturbed by environmental changes and affects the accuracy of navigation and positioning and even leads to positioning failure. The inertial navigation system (INS) is an autonomous navigation system. It uses sensors to measure the specific force and angular velocity of the carrier for positioning and navigation, which means that it is less affected by the environment. However, the inertial navigation device will produce a certain initial error due to the restriction of the manufacturing level, and the error will increase with time, so the inertial navigation method is not suitable for long-term navigation. Therefore, it is of great practical significance to realize satellite/inertial navigation integrated navigation by combining the respective advantages of satellite navigation and inertial navigation methods and avoiding their respective disadvantages. This paper is aimed at studying the satellite/inertial navigation integrated navigation method based on the improved Kalman filter algorithm. The satellite inertial navigation integrated navigation experiment is carried out based on the improved Kalman filter algorithm. In the experiment, the noise reduction experiment of the designed satellite inertial navigation system was carried out by using the filtering noise reduction function of the improved Kalman filter algorithm, and the conclusion was drawn after the experiment. The navigation accuracy of the satellite inertial navigation system is improved by a total of 2 m after the improved Kalman filter algorithm is used to filter the noise reduction.

1. Introduction

With the development of science and technology, the requirements for the accuracy of navigation and positioning in all walks of life are getting higher and higher. There are many navigation systems currently on the market, with different functions and their own advantages and disadvantages, such as satellite navigation systems and inertial navigation systems. Satellite navigation systems and inertial navigation systems are currently commonly used navigation systems. Satellite navigation system is a navigation method formed by combining astronomical navigation and radio navigation. Since the birth of the satellite navigation system, after years of development, it can provide high-precision positioning, navigation, and timing functions for a long time. The inertial navigation system refers to the navigation method in which the inertial component data is measured by sensors, and then, the inertial navigation solution is performed by using Newtonian mechanics. The elements of inertial navigation are mainly composed of gyroscopes and accelerometers. They are, respectively, used to measure the navigation information such as the angular velocity and acceleration of the moving carrier; calculate the speed, position, and attitude angle of the moving carrier through the mathematical model; and finally realize the purpose of navigation and positioning. Integrated navigation refers to the fusion of two or more navigation systems to enhance the strengths and avoid weaknesses, to improve the navigation accuracy of the navigation system. At the same time, the method of combined navigation can also improve the redundancy of a single navigation system, improve the stability of the navigation system, and has high application value.

Satellite navigation systems and inertial navigation systems have their own advantages and disadvantages, and there are good complementary characteristics between them. The fusion application of these two navigation systems can give full play to their respective advantages and can improve the positioning and navigation accuracy of the system to the greatest extent. In this paper, based on the improved Kalman filter algorithm, the research on the combined navigation method of satellite and inertial navigation is carried out.

The main innovations of this paper are as follows: (1) The fusion application research is carried out on the two navigation methods and systems of satellite navigation and inertial navigation, and a satellite inertial navigation integrated navigation system is designed. (2) The improved Kalman filter algorithm is introduced in detail. Combined with the algorithm, the satellite/inertial navigation integrated navigation experiment is carried out, and finally, an effective conclusion is drawn.

2. Related Work

There have been many researches related to improving the Kalman filter algorithm in academia. Among them, Ren et al. mainly studied the improved Kalman filter algorithm to solve the problems of real-time estimation difficulty and low accuracy of lithium-ion battery state of health estimation under various working conditions. He established an improved model based on the improved Kalman filter algorithm to improve these problems [1]. Hao et al. put forward a positioning method based on the improved Kalman filter algorithm through his research to eliminate the problem of clock synchronization in most positioning systems [2]. Through his research, Li et al. proposed a gradient boosting decision tree algorithm based on the improved Kalman filter algorithm to improve the performance of GBDT [3]. Wang et al. proposed a new highway traffic state estimation method based on the improved Kalman filter algorithm to improve the accuracy and time efficiency of highway traffic state estimation [4]. Zhu-Li et al.'s research found that the standard Kalman filter algorithm cannot accurately predict the prior statistical characteristics of system noise and observation noise. Therefore, he proposed an improved Kalman filter algorithm to improve the problem [5]. Zhang proposed a new control method based on the improved Kalman filter algorithm to improve the landing accuracy of the aircraft [6]. Although the above researches are closely related to improving the Kalman filter algorithm, the practicability of these researches is not strong enough. And the research process is also more complicated and difficult to operate.

3. Satellite/Inertial Navigation Integrated Navigation Method

3.1. Overview of Satellite Navigation and Inertial Navigation and Positioning System. First of all, the Beidou satellite navigation and positioning system are a satellite positioning and communication system completely developed by China. It consists of three parts: space base, ground monitoring, and user terminal. The ground monitoring part of satellite navigation consists of an injection station that sends navigation information to satellites, a main control station that processes data, and a detection station that provides real-time observation data to the main control station [7]. The satellite navigation user equipment part analyzes the Beidou satellite messages in real time according to the NEMA-0183 protocol and obtains the receiver's position, speed, and other navigation and positioning information, to provide users with positioning and navigation services [8]. The composition of the satellite navigation system is shown in Figure 1.

Inertial navigation systems, on the other hand, work according to the principle of inertia. It does not need to rely on external information when working, and the system itself may autonomously and covertly measure the carrier's specific force and angular velocity and other positioning information under all weather conditions. It can provide the complete motion state information of the carrier in time. It is an indispensable and important navigation equipment for the carrier [9, 10].

The core measurement devices in an inertial navigation system are gyroscopes and accelerometers. The accelerometer can measure and analyze the force on the three axes. It uses Newton's second law to measure the acceleration, and then, the magnitude and direction of the acceleration for the three axes of the accelerometer can be obtained. And it can get the velocity and displacement of the carrier by integrating and calculating in the time domain. Specifically, the calculation method of the instantaneous speed of the carrier is shown in the following formula [11]:

$$V = V_0 + \int_0^t a. \tag{1}$$

The displacement of the carrier is given by the following formula:

$$S = S_0 + V_0^t. \tag{2}$$

It can be obtained from the above formula that the inertial navigation system only needs to perform data acquisition and integral operation on the attitude sensor fixed on the carrier to obtain the current displacement data without external electromagnetic interference and without external radiation information [12]. When the three-axis accelerometer is placed horizontally, the accelerometer is only supported by gravity and vertically upwards in the vertical direction. Therefore, there is only the vertical acceleration, and the value is the gravitational acceleration value. Because this paper only discusses two-dimensional positioning, the carrier only moves on the horizontal plane, so the acceleration value component in the vertical direction is not considered, and the acceleration value of the carrier on the horizontal plane is obtained [13].

$$a = \sqrt{a_x^2 + a_y^2}. \tag{3}$$

The pitch and roll angles of the carrier can be calculated from the acceleration values. However, the yaw angle in the

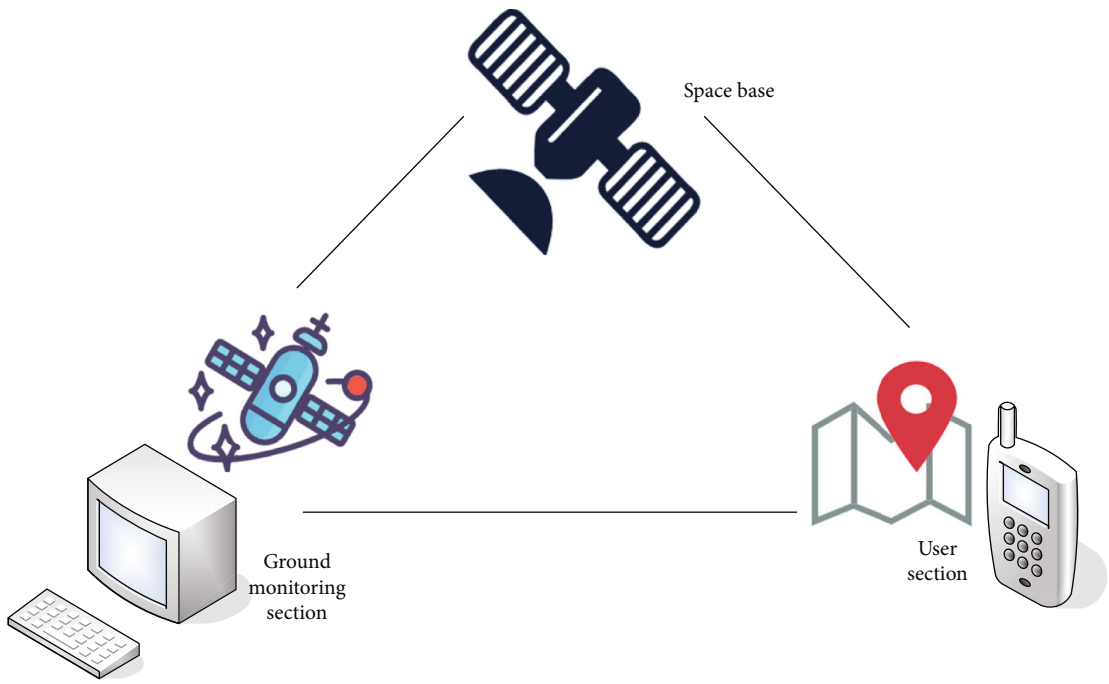


Figure 1: Satellite navigation system.

X-Y plane can only be obtained by integrating the angular velocity output by the gyroscope. The MEMS three-axis gyroscope first measures a voltage signal proportional to the angular velocity. The voltage signal is converted into a discrete signal after analog-to-digital conversion and input to the microcontroller, and the signal at this time is the instantaneous angular velocity data. Then, the X-axis, Y-axis, and Z-axis ADC module values of the three-axis gyroscope of the carrier are read separately. Finally, the time is integrated to obtain the yaw angle, and its calculation formula is as follows [14, 15]:

$$\theta = \theta_0 + \int_t^{t+1} (\text{Gyro} - \theta\text{bias})dt. \tag{4}$$

Among them, θ_t represents the yaw angle at time t, and Cyro is the angular velocity value output by the gyroscope. θbias is the static drift error constant of the gyroscope [16]. However, when the carrier is moving, the external noise and jitter will make the measurement of the angular velocity value inaccurate, so it needs to be corrected by the static drift error constant of the gyroscope [17].

3.2. The Positioning Principle and Application of Satellite/Inertial Navigation Integrated Navigation System. The basic principle of satellite inertial navigation integrated navigation (SINS/GNSS) is to establish the system state formula and system measurement formula. It uses Kalman filter technology for fusion and estimates the errors of SINS and GNSS. It can feedback and correct system errors in real time or eliminate them to achieve the purpose of high-precision integrated navigation. When using Kalman filter for SINS/GNSS integrated navigation, the system state formula and measurement formula need to be established first. According to the selection of state variables, it can be divided into direct filtering and indirect filtering. The direct method filtering directly takes the navigation parameters of the SINS/GNSS navigation system as the estimation object. For example, the acceleration value and the angular velocity value are directly used as the state variables of the system formula. The indirect method filtering takes the error between each navigation system as the estimation object [18].

In the direct method filtering, the magnitude of the state variable is large, and the change is fast. Information such as velocity, attitude angle, and position is all instantaneous values. In practice, its state formula is often nonlinear. The direct method filtering is shown in Figure 2.

In the indirect method filtering, the error value between SINS and GNSS navigation system is used as the state variable. Compared to the navigation parameters themselves, their magnitudes are much smaller and change relatively slowly. The transfer law of navigation error can be described more accurately by using the linear state formula. Therefore, the estimation accuracy of the state variables is relatively high [19]. Indirect filtering is a commonly used method in engineering applications. The indirect filter diagram is shown in Figure 3.

As can be seen from Figure 3, the indirect method of filtering and correcting navigation parameters can be divided into two types: output correction and feedback correction. The output correction is to directly use the state estimation value to correct the output value of the strapdown solution of the SINS or feed it back into the solution flow of the subsystem, to ensure that the navigation subsystem will no longer generate accumulated errors. If the output correction cannot track the navigation error inside the navigation subsystem and correct it, the filtering is easy to diverge after working for a long time. The feedback calibration can track

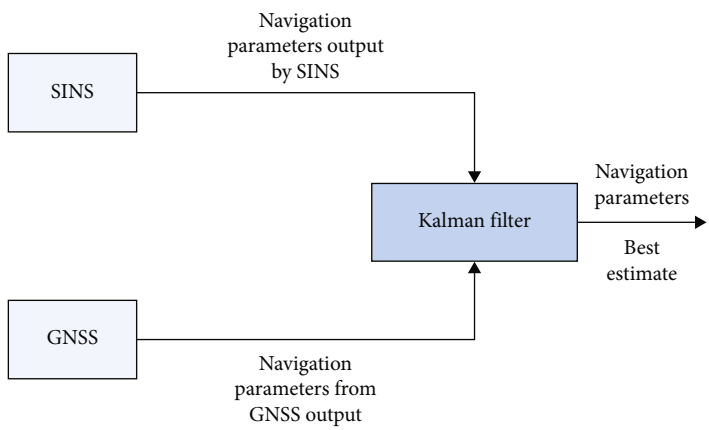


Figure 2: Direct method filtering.

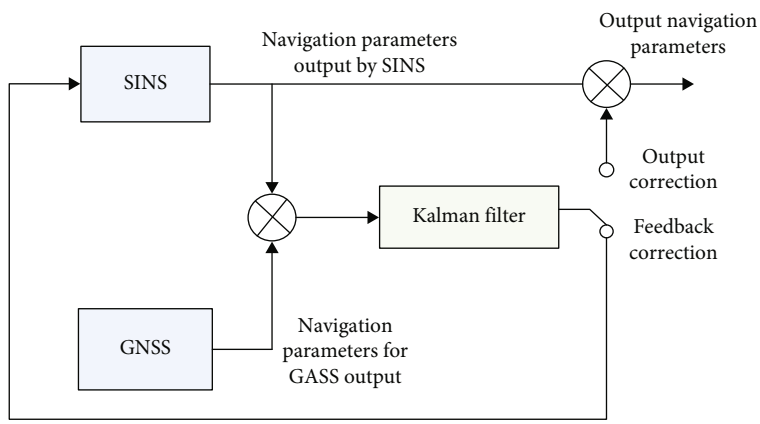


Figure 3: Indirect method filtering.

and correct the navigation error inside the subsystem, so it can also ensure the stability and convergence of the filtering when working for a long time.

3.3. Improved Kalman Filter Algorithm

3.3.1. Kalman Filter Algorithm. Kalman filter algorithm (UKF) is an algorithm that uses the linear system state formula to optimally estimate the system state through the system input and output observation data. However, the traditional Kalman algorithm still needs to be improved in terms of convergence speed, calculation accuracy, and prediction accuracy. Therefore, the improved Kalman filter algorithm appeared. The improved Kalman filter algorithm is mainly aimed at improving the state noise adaptive Kalman filter algorithm and the observation disturbance adaptive Kalman filter algorithm [20].

3.3.2. Improvement of Kalman Filter Algorithm Adaptive to State Noise. To make the derivation under additive noise easier to understand, the observation formula is assumed to be linear and then the innovation covariance, that is, the sequence of prediction residuals in the UKF algorithm:

$$p_k = \frac{1}{m}\sum_{j=1}^{m}(x_{k1} - x_{k2}). \tag{5}$$

The predicted variance p_k obtained in the above formula is the calculated innovation covariance $\tilde{p}_k$. Considering the importance of variance prediction, the scaled state noise variance should be compared to the changes in state noise variance obtained from p_k and $\tilde{p}_k$. The innovation and prediction formulas are generated:

$$d_k = (H_k x_k + v_k) - H_k \tilde{x}_k. \tag{6}$$

Assuming that the filtering is optimal, the variable whose Gaussian white noise sequence is expected to be 0 is d_k, take the square root of both sides of the equal sign of the above formula, and take the variance:

$$\frac{1}{m}\sum_{j=1}^{m} d_{k-j} = H_k + R_k. \tag{7}$$

Although $\check{p}_k$ cannot be solved by the above formula, it is used as a criterion for estimating the variance of state noise, and a scaling factor β_k is added:

$$\beta_k = \frac{tr\left((1/m)\sum_{j=1}^{m} d_{k-j} - R_k\right)}{trH_k p_k}. \tag{8}$$

To make the final effect of variance under state noise approximately smooth, it needs to be scaled by the following formula:

$$\tilde{\delta}_k = \delta_{k-1}\sqrt{\beta_k}. \tag{9}$$

3.3.3. Improvement of Kalman Filter Algorithm Adaptive to Observation Interference. Residuals emerge from the filtered values and observed differences as follows:

$$e(k) = y_k - \tilde{y}_k. \tag{10}$$

In the above formula, when the observation value y_k and the filter value $\tilde{y}_k$ are filtered without deviation, the variance $e(k)$ needs to satisfy the following formula to perform the mean square root:

$$\frac{1}{\mu}\sum_{k-\mu+1}^{k} e(j) = P_k + p_{yk}. \tag{11}$$

In the above formula, μ represents the size of the rolling window, P_{yk} represents the estimated variance of the observation, and R_k represents the variance matrix of the observation noise. When the observation disturbance occurs in the estimation system, the actual error will be higher than the theoretical value, and the equal conditions on the left and right sides of the equal sign in the above formula will also not exist. Therefore, the addition of adaptive $S(k)$ is necessary. The definition of the adaptive matrix $S(k)$ is as follows:

$$s(k) = \frac{1}{\mu}\sum_{k-\mu+1}^{k} e(j) - R_k. \tag{12}$$

Therefore, the definition of the adaptive matrix $S(k)$ is as follows:

$$s(k) = \frac{1}{\mu}e(j) - p_k. \tag{13}$$

The existence of abnormal values can be observed by detecting $S(k)$, and the adaptive matrix generated by each round of filtering is judged by self-adaptation, namely:

$$s^2 = \frac{1}{n-1}\sum_{i=1}^{k} z. \tag{14}$$

From the distribution properties of s^2, it can get:

$$s^2(n-1) = \frac{n-1}{\delta^2}. \tag{15}$$

Then, the final state estimate can be revised as follows:

$$x(k+1) = g(k)e(k)\acute{x}^2. \tag{16}$$

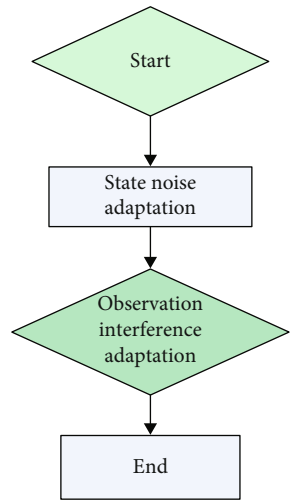


Figure 4: The overall process of the improved Kalman filter algorithm.

The overall process of the improved Kalman filter algorithm is shown in Figure 4.

As can be seen from Figure 4, the entire process of improving the Kalman filter algorithm is not complicated. The experimental section below will also apply to this algorithm.

4. Satellite/Inertial Navigation Integrated Navigation Experiment

4.1. Experimental Design and Main Steps. In this experiment, a satellite inertial navigation combined system is first designed, and then, the system is used to conduct a positioning and navigation experiment in a certain area of Nanchang. After the preliminary positioning and navigation experiment on the selected area based on the system are completed, the positioning and navigation accuracy of the system for the selected area is tested by combining the filtering and noise reduction function of the improved Kalman filter algorithm. The positioning and navigation accuracy of the system on the selected area is tested by combining with the improved Kalman filter algorithm. In the whole experiment, the positioning and navigation effect of the satellite inertial navigation integrated navigation system is judged mainly by the error calculation of the navigation position and speed. The satellite inertial navigation integrated navigation system designed in this experiment is shown in Figure 5.

It can be seen from Figure 5 that the satellite inertial navigation integrated navigation system designed in this experiment is mainly divided into hardware platform and software part. The hardware platform includes a core processor module (Tiny6410), an inertial measurement unit (BWT901CL nine-axis gyro attitude sensor), a satellite receiver (UM22-11I), a wireless communication module (ESP8266), and auxiliary equipment such as a power supply module and compiler. The software part mainly runs on the core processor Tiny6410, which realizes the functions of data acquisition and calculation, data preprocessing, evolution strategy selection, data transmission and debugging,

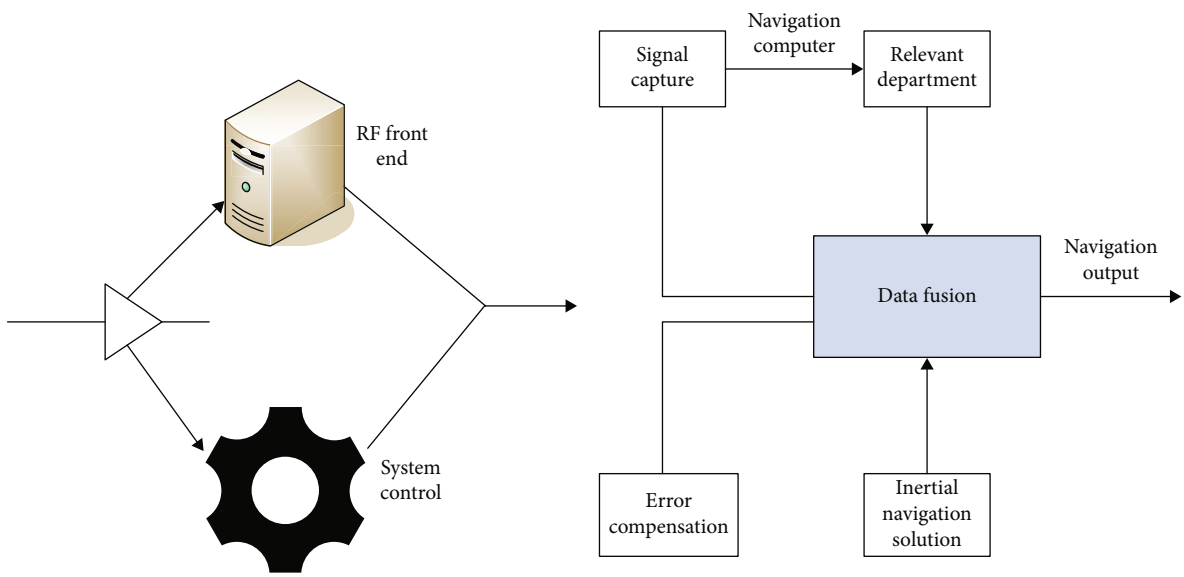


Figure 5: Satellite inertial navigation integrated navigation system.

Table 1: System performance parameters.

Parameter	Technical indicators	
Attitude	Output range, dynamic accuracy, resolution	0 ~ 360
GPS	Positioning accuracy, startup time	Position: 10 m circular error, speed: 0.1 m/s, time: 1 μs
Measuring range	Accelerometer	Gyroscope, magnetometer

Table 2: Experimental area positioning information.

Position	Longitude	Latitude
East	115°27′E	114°27′N
South	116°27′E	111°27′N
West	116°21′E	113°27′N
North	115°26′E	115°27′N

and user terminal display. At the same time, by improving the evolutionary game algorithm to build a combined navigation model, it can choose different combination strategies and different weights according to the specific environment to improve the quality of the navigation data and speed up the data convergence speed, which can achieve the best performance.

The performance parameters of the system are shown in Table 1.

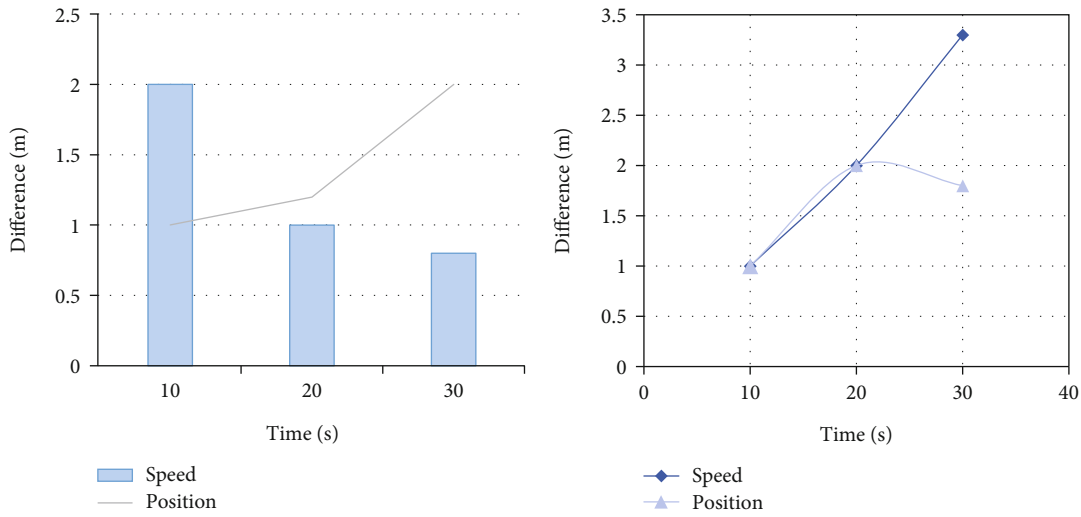
4.2. Preliminary System Positioning and Navigation. First, the positioning data of the selected area based on the satellite inertial navigation integrated navigation system designed in this experiment are shown in Table 2.

After the positioning of the selected area is completed, the landmark buildings located in the four directions of the east, south, west, and north in the area are randomly selected; the designed satellite inertial navigation integrated navigation system is used to start the navigation experiment on these landmark buildings. After the navigation of the system is completed, the navigation results of these landmark buildings by the system are compared with the actual situation, and the navigation errors of the system's position and speed for the selected area within 30 s are calculated, to judge the navigation accuracy of the system.

The position and velocity navigation error results of the system for the east, south, west, and north positions of the selected area within 30 s are shown in Figures 6 and 7.

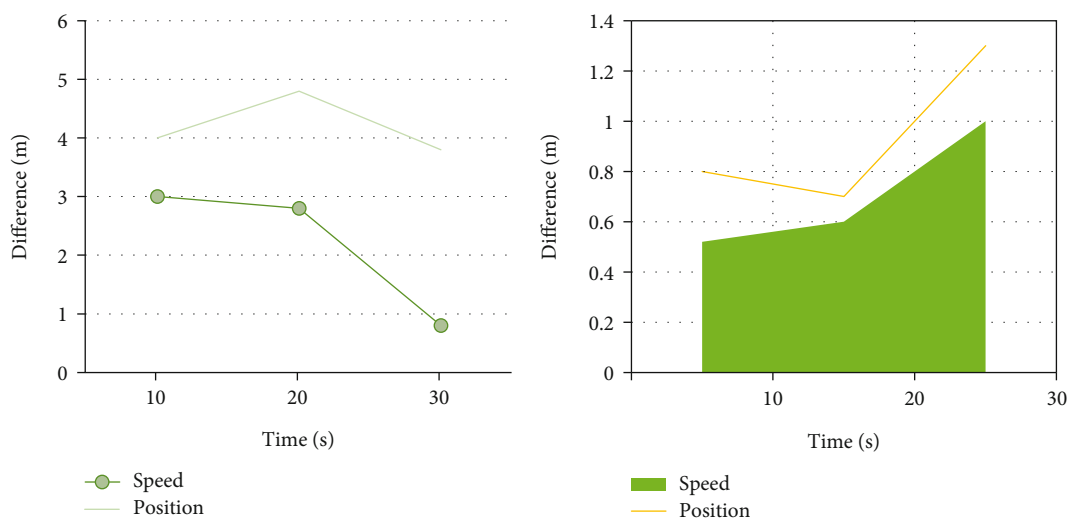
It can be seen from Figures 6 and 7 that the system controls the position and velocity navigation errors of the selected area as well as a whole. The navigation error values of both position and speed are controlled within 0-5 m. And the maximum error value for position and speed navigation is only 2.2 m. The maximum navigation error value in the four directions of east, south, west, and north is 2.7. Therefore, after comprehensive calculation, it can be obtained that the comprehensive navigation error value of the satellite inertial navigation integrated navigation system designed in this experiment for the selected area is 2.4 m.

4.3. Navigation Accuracy Test Based on Improved Kalman Filter Algorithm. The last step of the experiment is to test the positioning and navigation accuracy of the satellite inertial navigation integrated navigation system designed in this experiment for the selected area combined with the improved Kalman filter algorithm. The principle of this step is to use the filtering and noise reduction function of the improved Kalman filter algorithm to reduce the navigation



(a) North position and velocity error (b) West position and velocity error

Figure 6: Velocity and position errors within 30 s of navigation for east and west systems.



(a) South position and velocity error (B) North position and velocity error

Figure 7: Velocity and position errors within 30 s of south and north system navigation.

error of the system, thereby improving the navigation accuracy of the system. The test results are shown in Figure 8.

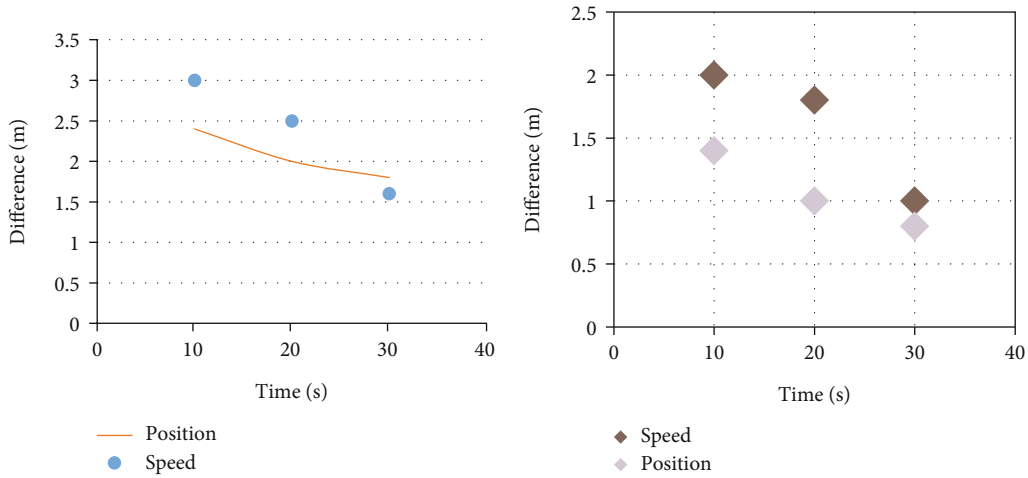
It can be seen from Figure 8 that after the improved Kalman algorithm filtering and noise reduction, the position error value of the system's overall navigation has decreased by 1 m, and the speed error value has also decreased by 1 m. From this calculation, it can be seen that after the improved Kalman filter algorithm filtering and noise reduction, the overall navigation accuracy of the system is improved by 2 m.

At this point, the whole experiment is over. The experimental conclusions drawn can be summarized as follows: Based on the filtering and noise reduction function of the improved Kalman filter algorithm, the overall navigation accuracy of the satellite inertial navigation system is improved by 2 m.

5. Discussion

With the growing demand for navigation services in various industries, many navigation systems with different functions and advantages and disadvantages have emerged in the market, such as satellite navigation systems and inertial navigation systems. However, no matter which single navigation system is used, there are certain navigational limitations. This is because individual navigation systems are always flawed in some way. If the complementary roles between different navigation methods can be brought into play, the formed integrated navigation system can be applied; it is possible to improve the problems of navigation with a single navigation system to a certain extent.

This paper mainly studies the satellite inertial navigation integrated navigation system composed of satellite navigation



(a) The overall error before filtering and noise reduction

(b) Overall error after filtering and noise reduction

Figure 8: Improved Kalman filtering algorithm navigation error noise reduction results.

system and inertial navigation system. Satellite navigation system is a navigation system composed of three parts: space base, ground monitoring, and user terminal. However, it falls a little short on the navigation speed. The inertial navigation system is a navigation system that works according to the principle of inertia. However, it has certain flaws in navigation accuracy. Therefore, combining the satellite navigation system and the inertial navigation system to form a satellite inertial navigation integrated navigation system can improve the problems existing in the single satellite navigation system and the inertial navigation system and improve the overall navigation accuracy.

In addition, this paper also combined the improved Kalman filter algorithm to carry out the navigation experiment of the satellite inertial navigation integrated navigation system. A satellite navigation integrated navigation system is experimentally designed, and the improved Kalman filter algorithm is mainly used to filter and reduce the navigation error of the designed satellite inertial navigation system. Finally, it is found that the overall navigation accuracy of the satellite inertial navigation integrated navigation system is improved by 2 m by combining the filtering and noise reduction function of the improved Kalman filter algorithm. This experimental conclusion can be said to be of great significance for improving the navigation accuracy of the satellite inertial navigation system.

6. Conclusions

To sum up, the research conclusions of this paper on the satellite inertial navigation integrated navigation method based on the improved Kalman filter algorithm are as follows: Based on the improved Kalman filter algorithm, the overall navigation accuracy of the satellite inertial navigation system is improved by 2 m. And the accuracy of navigation position and speed has been improved. The research conclusions drawn in this paper undoubtedly have a certain reference values for the application of the improved Kalman filter algorithm in improving the navigation accuracy of the satellite inertial navigation integrated navigation system. It is also of great significance to promote the progress and development of satellite inertial navigation integrated navigation methods. However, it cannot be said that the research in this paper is perfect. In fact, due to the limited research level and conditions, the research in this paper also has certain deficiencies in some aspects. For example, the research methods and research angles are not comprehensive and innovative enough. It is hoped that continuous efforts will be made in the future to improve the existing problems in the research, to make more contributions to the research of satellite inertial navigation integrated navigation methods. It also contributed some modest efforts to promote the update and development of the satellite inertial navigation integrated navigation system.

Data Availability

Data sharing not applicable to this article as no datasets were generated or analyzed during the current study.

Conflicts of Interest

The author declares that there are no conflicts of interest.

References

[1] P. Ren, S. Wang, M. He, and W. Cao, "Novel strategy based on improved Kalman filter algorithm for state of health evaluation of hybrid electric vehicles Li-ion batteries during short- and longer term operating conditions," *Journal of Power Electronics*, vol. 21, no. 8, pp. 1190–1199, 2021.

[2] Z. Hao, B. Li, and X. Dang, "An improved Kalman filter positioning method in NLOS environment," *Communications*, vol. 16, no. 12, pp. 84–99, 2019.

[3] L. Li, S. Dai, Z. Cao, J. Hong, S. Jiang, and K. Yang, "Using improved gradient-boosted decision tree algorithm based on Kalman filter (GBDT-KF) in time series prediction," *The Journal of Supercomputing*, vol. 76, no. 9, pp. 6887–6900, 2020.

[4] C. Wang, B. Ran, H. Yang, J. Zhang, and X. Qu, "A novel approach to estimate freeway traffic state: parallel computing and improved Kalman filter," *IEEE Intelligent Transportation Systems Magazine*, vol. 10, no. 2, pp. 180–193, 2018.

[5] R. Zhu-Li, W. Li-Guan, and B. Lin, "Improved extended Kalman filter based on fuzzy adaptation for SLAM in underground tunnels," *International Journal of Precision Engineering and Manufacturing*, vol. 20, no. 12, pp. 2119–2127, 2019.

[6] H. Zhang, "Aero-craft's navigation and control based on adaptive simple uncertain Kalman filter algorithm," *Guofang Keji Daxue Xuebao/Journal of National University of Defense Technology*, vol. 40, no. 6, pp. 141–150, 2018.

[7] L. Cheng, Z. Wang, J. Chen, and G. Xie, "An improved multipath estimation algorithm using particle filter and sliding average extended Kalman filter," *Journal of Electronics and Information Technology*, vol. 39, no. 3, pp. 709–716, 2017.

[8] H. Bi, J. Ma, and F. Wang, "An improved particle filter algorithm based on ensemble Kalman filter and Markov chain Monte Carlo method," *IEEE Journal of Selected Topics in Applied Earth Observations & Remote Sensing*, vol. 8, no. 2, pp. 447–459, 2015.

[9] Z. Huang, Y. Fang, and J. Xu, "SOC estimation of Li-ION battery based on improved EKF algorithm," *International Journal of Automotive Technology*, vol. 22, no. 2, pp. 335–340, 2021.

[10] H. J. Sena, F. Silva, and A. Fileti, "ANN model adaptation algorithm based on extended Kalman filter applied to pH control using MPC," *Journal of Process Control*, vol. 102, no. 10, pp. 15–23, 2021.

[11] K. Doanay, W. Y. Wang, and N. H. Nguyen, "Bias-compensated diffusion pseudolinear Kalman filter algorithm for censored bearings-only target tracking," *IEEE Signal Processing Letters*, vol. 26, no. 11, pp. 1703–1707, 2019.

[12] J. W. Wang, K. Y. Qi, K. H. Yang, K. Liang, and J. Yan, "Roll angle estimation algorithm with improved Sage-Husa adaptive Kalman filtering based on dual-spin mortar shell," *Binggong Xuebao/Acta Armamentarii*, vol. 39, no. 6, pp. 1103–1108, 2018.

[13] F. Ahmad, K. Rashid, A. Rasool, A. Sabanovic, and M. Elitas, "An improved unscented Kalman filter based dynamic state estimation algorithm for electric distribution systems," *COMPEL*, vol. 36, no. 4, pp. 1220–1236, 2017.

[14] M. Arsalan, A. Santra, and C. Will, "Improved contactless heartbeat estimation in FMCW radar via Kalman filter tracking," *IEEE Sensors Letters*, vol. 4, no. 5, pp. 1–4, 2020.

[15] J. Wang, L. U. Zhiyu, and J. Wang, "A location algorithm with improved accuracy based on correction of noise high- order cumulant," *Chinese Journal of Electronics*, vol. 26, no. 1, pp. 179–184, 2017.

[16] Y. Xie, S. Wang, C. Fernandez et al., "Improved gray wolf particle filtering and high-fidelity second-order autoregressive equivalent modeling for intelligent state of charge prediction of lithium-ion batteries," *International Journal of Energy Research*, vol. 45, no. 13, pp. 19203–19214, 2021.

[17] R. Havangi, "Target tracking based on improved unscented particle filter with Markov chain Monte Carlo," *IETE Journal of Research*, vol. 64, no. 6, pp. 873–885, 2018.

[18] P. Dong, "Adaptive cubature Kalman filtering SLAM algorithm based on variational Bayes," *Journal of Harbin Institute of Technology*, vol. 51, no. 4, pp. 12–18, 2019.

[19] H. Xiong, J. Tang, H. Xu, W. Zhang, and Z. Du, "A robust single GPS navigation and positioning algorithm based on strong tracking filtering," *Sensors Journal IEEE*, vol. 18, no. 1, pp. 290–298, 2018.

[20] Q. Xu, H. L. Wang, L. Feng, W. Jiang, S. H. You, and Y. Y. He, "An improved augmented X-ray pulsar navigation algorithm based on the norm of pulsar direction error," *Advances in Space Research*, vol. 62, no. 11, pp. 3187–3198, 2018.

Hindawi
Mobile Information Systems
Volume 2023, Article ID 9834172, 1 page
https://doi.org/10.1155/2023/9834172

Retraction

Retracted: Dynamic Analysis of Deep Integration of Artificial Intelligence Based on High-Performance Computing for Ideological and Political Teaching Evaluation

Mobile Information Systems

Received 1 August 2023; Accepted 1 August 2023; Published 2 August 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. Li and D. Yao, "Dynamic Analysis of Deep Integration of Artificial Intelligence Based on High-Performance Computing for Ideological and Political Teaching Evaluation," *Mobile Information Systems*, vol. 2022, Article ID 4748544, 15 pages, 2022.

Hindawi
Mobile Information Systems
Volume 2022, Article ID 4748544, 15 pages
https://doi.org/10.1155/2022/4748544

Research Article

Dynamic Analysis of Deep Integration of Artificial Intelligence Based on High-Performance Computing for Ideological and Political Teaching Evaluation

Ye Li[1] and Dengfeng Yao[2]

[1]*College of Economy and Management, Zhejiang Business Technology Institute, Ningbo, 315012 Zhejiang, China*
[2]*Beijing Key Laboratory of Information Service Engineering, Beijing Union University, Beijing 100101, China*

Correspondence should be addressed to Dengfeng Yao; tjtdengfeng@buu.edu.cn

Received 19 March 2022; Revised 18 April 2022; Accepted 28 April 2022; Published 18 May 2022

Academic Editor: Liming Chen

At present, the teaching evaluation of courses is more and more important, and teaching evaluation is a main means to measure the quality of teachers' teaching. Among many course teaching evaluations, ideological and political courses have become the main position for teaching evaluation reform due to their unique strategic position and subject specificity. In the era of rapid development of science and technology, artificial intelligence combined with high-performance computing has made frequent progress in various fields. The trend of development is unstoppable. Therefore, based on the current problems in the evaluation of ideological and political teaching, this paper proposes an artificial intelligence theory based on high-performance computing. This paper will closely integrate it with the evaluation of ideological and political teaching. In the research process of this paper, high-performance computing, artificial intelligence, and ideological and political teaching evaluation are explained in detail. This paper focuses on the introduction of artificial intelligence algorithms for high-performance computing. Finally, this paper proves the feasibility of this method in the evaluation of ideological and political teaching through the actual integration experiment with the evaluation of ideological and political teaching and proposes a series of teaching evaluation methods. Finally, the experiment shows that our new evaluation method can pay attention to 56.7% of students' comprehensive development and 63.7% of students' personal quality.

1. Introduction

The ideological and political course is a course dedicated to the all-round development of people. It focuses on people's thoughts and positions and guides people's values in terms of right and wrong. However, in the traditional ideological and political teaching process, teachers cannot obtain correct evaluations in a timely and efficient manner. At the same time, we learned that at present, most schools do not have mature teaching evaluation methods, and the evaluation of teaching quality is still in the manual stage. In the case of many evaluation subjects, subjective evaluation results, and complex data, we introduce high-performance artificial intelligence for evaluation attempts. By comparing the traditional manual evaluation methods, we propose a high-performance artificial intelligence algorithm, and on this basis, it is deeply integrated with teaching evaluation. Based on this algorithm, we can realize the dynamic adjustment of teaching evaluation [1, 2]. It allows teachers to correct and adjust the teaching process in time and promotes the teaching team to constantly clarify their responsibilities and remember their original intentions. At the same time, with the new teaching evaluation system and continuous adjustment of teaching, students' self-development and students' personal quality will be greatly improved. The evaluation and adjustment of ideological and political teaching can

play a huge role in the innovation of ideological and political courses. It contributes to the development of high-quality teachers and a highly innovative student body.

The innovation of this paper is as follows:

(1) This paper expounds the combination of high-performance computing and artificial intelligence and its integration with teaching evaluation. This is a breakthrough for artificial intelligence to enter teaching quality management, and it is also an enrichment for teaching reform plans

(2) From the ultimate goal of the research, this research will help to improve the quality of education and teaching and cultivate talents. High-performance artificial intelligence provides data support for teaching evaluation and builds a bridge between theory and practice. To a certain extent, this is a booster for realizing the transformation from traditional educational concepts to new educational concepts

2. Related Work

Many scholars have provided a lot of references for research on artificial intelligence, high-performance computing, and ideological and political teaching evaluation.

Su et al. first introduced the progress of combining artificial intelligence and high-performance computing (HPC) in the field of scientific computing. They analyzed several typical scenarios and summarized the characteristics of corresponding computing resource requirements. They then further listed four general methods for integrating AI computing with traditional HPC, along with their key features and application scenarios. Finally, they also introduced the design strategy of Pengcheng Cloud Brain II Supercomputing Center in improving AI computing power and clusters [3].

Milojicic demonstrated accelerators for artificial intelligence (AI) and high-performance computing (HPC) on a large dataset. He identified a significant problem in the data and also used the trained network to virtually screen several benchmark sets [4].

D. Hagan and M. Hagan used statistical analysis of the weights of a single-layer network to select suitable descriptors. They used Monte Carlo cross-validation to provide confidence measures of network performance as well as identify problems in the data and added new chemical descriptors to improve network accuracy. They also used self-organizing graphs to analyze the performance of trained networks and identify anomalies [5].

Cecotti proposed a two-level hierarchical k-nearest neighbor classifier, along with a low-cost computer. He also made constructive comments on the development of low-cost computers and their practical operability in the future. This move allows us to rethink layers in image processing and pattern recognition. The first stage uses a Graphics Processing Unit (GPU) and the second stage uses a High Performance Cluster (HPC) [6].

Ju et al. observed changes caused by automated 3D data collection systems. They outline a primary surface profile-(PSP-) optimized two-phase computational 3D crack detection method and propose a PSP-based data filtering algorithm. It is an innovative upgrade solution to the previous unbiased 3D pavement crack detection [7].

Chen et al. established a new teaching model in which ideological and political education was integrated into the curriculum by incorporating ideological and political elements into the teaching process of professional courses. They strengthened the cooperation between professional institutions and universities and integrated ideological and political education into the teaching of human parasitology in the basic medical course. On the basis of improving the construction of the teaching staff, they insist on moral education and education-oriented professional course teaching. They explored the path of combining ideological and political education with medical science education [8].

Li et al. proposed a new neural network for facial expression recognition, which is a novel and efficient deep fusion convolutional neural network. This neural network consists of a feature extraction subnet, a feature fusion subnet, and a learning network layer. All of these are fed jointly to a facial recognition neural network for feature learning and fusion learning. [9].

3. High-Performance Computing and Artificial Intelligence and Ideological and Political Teaching Evaluation

3.1. High-Performance Computing. High-performance computing, or HPC for short, refers to the use of aggregate computing power to process data-intensive computing tasks that cannot be performed on standard workstations, including simulation, modeling, and rendering [10, 11]. When solving various computing problems, we often encounter situations where a general-purpose computer cannot complete the work in a reasonable amount of time due to the large number of operations required, or the available resources are limited due to the large amount of data required. The HPC approach effectively overcomes these limitations by using dedicated or state-of-the-art hardware or by combining the computing power of multiple units. In terms of hardware configuration, there are two commonly used ones: shared memory computer and distributed memory cluster [12].

On a shared memory computer, random access memory (RAM) is accessible to all processing units; in a distributed memory cluster, it is not possible to access memory across different drives or nodes.

High-performance computing often uses different data computing modes, and distributed computing is commonly used. When this article uses a distributed memory configuration, there must be an interconnected network (Figure 1) because different processor units cannot access the same memory space. It is used to send messages between these units or to use other communication mechanisms [13].

In this network structure, each unit has a memory for storing messages to be sent, and the memory is connected to the core of the unit. That is, each core can call the content

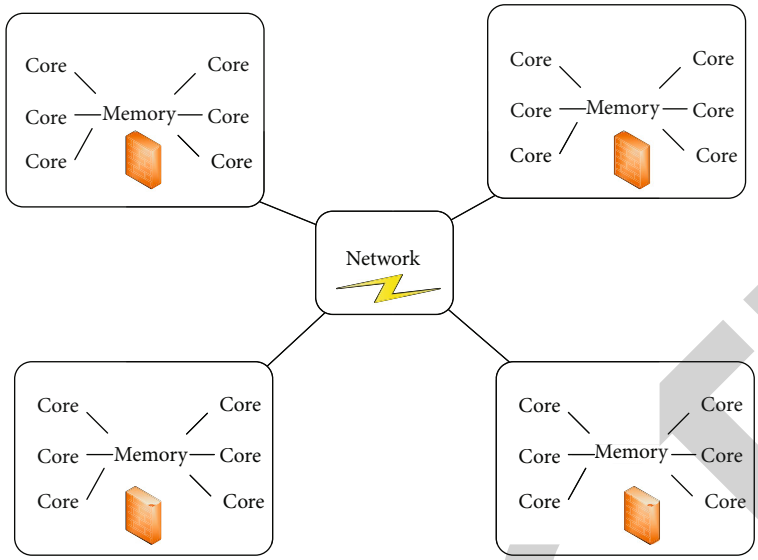


Figure 1: Processing unit network structure.

in the memory, and finally data exchange between different memories can be realized through the network.

For decades, HPC has played an important role in academic research and industrial innovation. It helps engineers, data scientists, designers, and other researchers solve many large and complex problems more efficiently. Key benefits of HPC include the following: Reduced need for physical testing: HPC can be used to create simulations without requiring the user to perform physical testing. For example, when testing a car crash, HPC can generate crash simulations more cost-effectively and simply than actual crash testing.

This paper integrates HPC simulations into AI to extend simulated training data or provide controlled labeling for normally unlabeled data. Alternatively, it can build AI into HPC simulations, replacing explicit first-principles models with learned functions [14]. Figure 2 shows the main application areas of HPC.

3.2. Artificial Intelligence Based on High-Performance Computing. The algorithms and computable modeling problems involved in high-performance computing are the focus of research. In the process of high-performance computing development, there are several troubles that need to be solved. Among them, several main problems that we need to solve are as follows: efficient algorithm based on numerical calculation and data fusion algorithm based on mechanism and modeling.

In numerical computation, we start with the following operations based on the efficiency and precision of differential formulas:

$$\begin{gathered} P_n(a) \in \{Pi(a), P_s(a)\} | f(p_m(a)) = \max\{P_i(a), P_s(a)\}, \\ \mathrm{m}_{ij}(n+1) = m_{ij}(n+1) + a_1 * p_{1i}(n) * \left(p_{1i}(n) - x_{ij}(n)\right), \\ x_{ij}(n) = \mathrm{m}_{ij}(n+1) + m_{ij}(n+1). \end{gathered} \tag{1}$$

Among them, i represents the particles, j represents the components, and the learning factors a_1 and p_i are nonnegative real numbers. In this process, we define an optimal position and characterize it by formula (2). M represents the total number of positions, and p_i represents the overlap between the dimension and the current position.

$$\mathrm{n}best = \frac{1}{M}\sum_{n}^{M} p_i(n). \tag{2}$$

During this process of change, the value of M is not fixed and is generally taken according to the following formula:

$$\begin{gathered} PP_i = f_{ij}(n+1) \times P_{ij}(n) + (1-n) f_{ij}(n), \\ X_{\mathrm{ij}} = PP_i(m) + nbest_i(n+1) \times \ln\left(\frac{1}{m_{ij}(n+1)}\right). \end{gathered} \tag{3}$$

That is, it changes from m to n with a linear change. And, with the passage of time, the optimal position is inversely proportional to time, and its calculation formula is shown in formula (4).

$$s(t) = m - mn \times \frac{t}{Maxnbest_j}. \tag{4}$$

We then randomly initialize a position value and define an optimal position and an optimal global position. In order to distinguish them, we use the following formula to express:

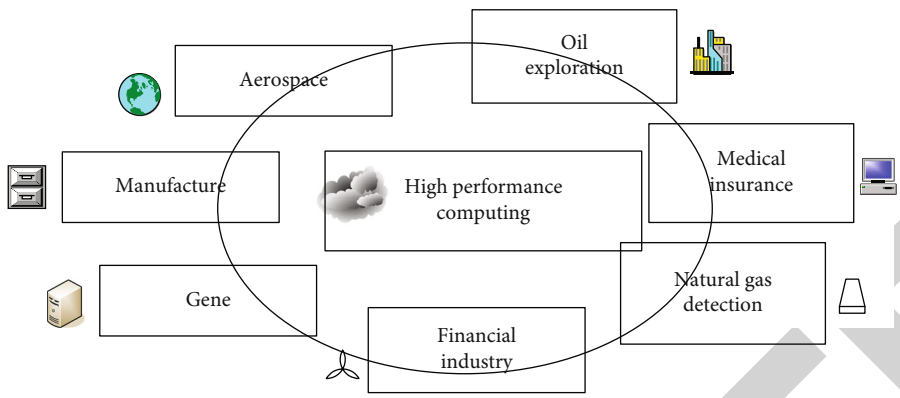


Figure 2: Main application areas of HPC.

$$f(x) = \sum_{n} x_i^2,$$
$$f(n) = \sum_{m}^{n-1} \left(100 - x_i^1\right)\left(x_j - 1\right)^2, \tag{5}$$
$$f_n(m) = \sum_{i=1}^{n} \left(x_{ij}^2 - 100 \tan\left(3 \prod n_j\right)\right) + 9m.$$

The change of position is based on the maximum and minimum values of the data in the initialization position we define, aiming to convert the position change of the data into a suitable interval. Through the tangent calculation, we convert the position changes at different times to a specific range. During this operation, the information of the unmarked position will be reserved for function learning and calculation, as shown in Figure 3. Through the algorithm, we can basically achieve high-performance computing. However, in the actual process, the calculation is often affected by the amount of data and the scale of the data [15].

In order to use a learned function in place of an explicit model, iterative computations and scaled data comparisons are required. Figure 4 is a flowchart of the operation of the algorithm.

At the beginning of the operation, we will introduce an initial value and perform certain initialization operations on the initial value. Next, we measure and calculate its individual location, then update the unmarked location information appropriately, and finally see if its location meets the accuracy and range requirements. If it is satisfied, end the operation, if not, return to recalculate the individual position.

In the actual amount of data, the transformation process of the information of the unmarked position is shown in formula (6):

$$V = V_j + c_i \times r_j \times (P_n - X_n). \tag{6}$$

Among them, c_i stores the position information for marking, and r_i stores the position information that has not been marked. By marking their position information, we can get a standardized functional relationship V. In the subsequent calculation and storage process, we will continue to adjust the standard functional relationship to prevent data errors.

$$X_{\mathrm{n}} = X_i + V_i(n+1),$$
$$P(\gamma) = [(X, y_{\mathrm{n}}) + 1]. \tag{7}$$

Among them, E_{n} and y_n represent the absolute numerical relationship and the size of the storage unit, respectively. In the absolute numerical relationship, the logarithm describes the relationship of the value of its function, and the cell size describes the degree of change in its rate of change. The larger the value, the more severe the change in the numerical relationship; the smaller the value, the more gradual the change in the numerical value.

$$E_{\mathrm{n}}(|\gamma - y_n|) = \ln\left(-\frac{|\gamma - y_m|^2}{\theta^2}\right),$$
$$X(n+1) = X(n) + \beta\left(-\frac{\partial P(n)}{\partial(P)}\right). \tag{8}$$

The proportional coefficient k_I represents the ratio of the efficiency in the learning process to the amount of data.

$$k_I = \chi_\mu - f(p_I) = \chi_\mu - \sum_{\nu=1}^{h} E_\mu \theta_\nu(\gamma_I). \tag{9}$$

To further illustrate the effect of the ratio, we compare it with the PSO algorithm, and the following is its calculation process:

$$\mathrm{z_n} = \Delta \frac{\partial \lambda}{\partial z_n},$$
$$\theta = \Delta_{\max} - \frac{m(\Gamma_{\max} - \Gamma_{\min})}{m_{\max}}, \tag{10}$$
$$\Omega \equiv \frac{1}{2}\sum_{u=1}^{m} \sqrt{\theta} + \frac{\theta}{2}\sum_{i=1}^{n_h} m_i z(\mathrm{x}_i).$$

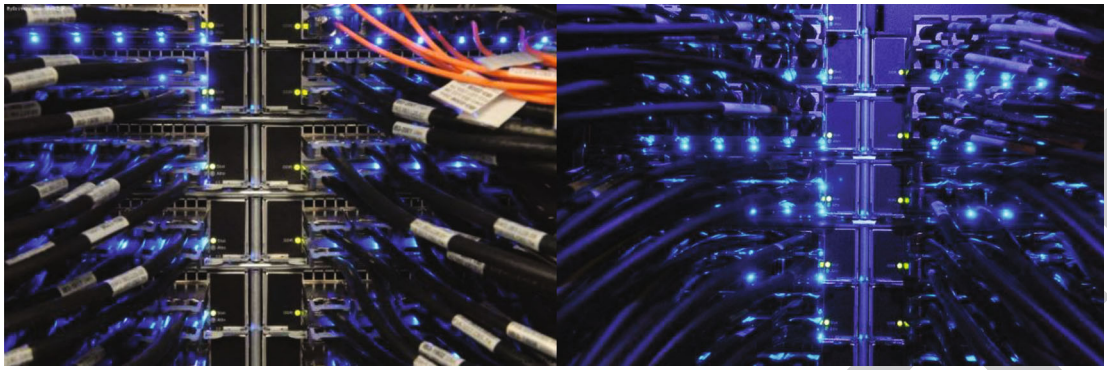


Figure 3: High-performance computing.

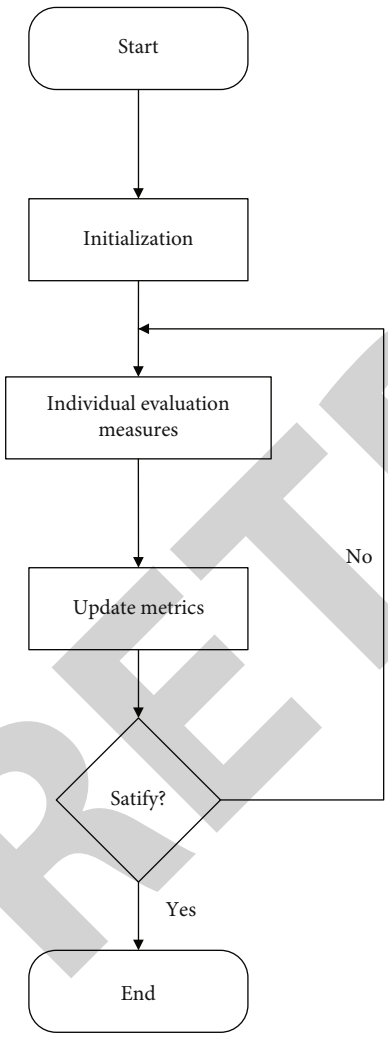


Figure 4: Algorithm operation flowchart.

Among them, the algorithm only refers to the maximum and minimum values of z_n and θ to make corresponding adjustments, and the relevant parameters in the adjustment process must also be set to a certain extent, so its global search ability is relatively weak.

$$\theta(m,n) = \sqrt{\sum_{n=1}^{m} (p_m - p_n)^2},$$
$$F_n = o[D_s n] * \theta^2. \tag{11}$$

Through the verification of its convergence and robustness, we define the efficiency test function, where P represents its convergence and D represents its robustness. F_n represents the final result, and the difference between its value and the minimum value is the result value, so the larger the final result value, the lower the efficiency, and the smaller the result value, the higher the efficiency.

3.3. Ideological and Political Teaching. In ideological and political courses, teaching evaluation is often based on specific teaching values or goals. It uses actionable scientific resources to systematically collect information and materials, and use them to evaluate teaching activities. In ideological and political teaching courses, learning evaluation includes three aspects: student evaluation, teacher evaluation, and school evaluation [16]. The standard of ideological and political teaching evaluation is mainly reflected in its judgment of the quality of teaching by evaluating the performance of teachers and students in the learning process and the learning situation of students.

3.3.1. Evaluation of Ideological and Political Teaching. However, in the evaluation system measured by performance, the teaching evaluation of ideological and political courses must have the correct value orientation. First of all, we should make it clear that the basic objective of evaluation must always be the overall development of students. Ideological and political courses focus not only on students' learning outcomes but also on students' overall development, develop students' multidimensional potential, help students understand themselves, and build self-confidence. Therefore, in the process of ideological and political evaluation, it is required that the evaluation standards should be adapted to the development needs of students, so as to understand and meet the development needs of students to the greatest extent.

Ideological and political courses play a pivotal role in the field of education. As we all know, thoughts determine actions, and actions explain thoughts. In the teaching process of ideological and political courses, what we advocate is a kind of cultural consciousness and cultural self-confidence. Therefore, the teaching evaluation of ideological and political courses should be based on the culture itself, so that the culture can carry people's values and value orientation. Therefore, in the evaluation process of ideological and political courses, we mainly have two main subjects to evaluate. One is to evaluate teachers and the other is to evaluate students [17].

In the evaluation of teachers, we mainly focus on the potential ability of teachers to learn and teaching level. It mainly evaluates teachers' teaching attitude, teaching content, teaching method, and learning effect. The evaluation of students' learning effect is an important part of evaluating ideological and political courses. If the student's learning objectives have been achieved, then the purpose of this evaluation has been basically achieved.

Therefore, the learning of ideological and political courses should be composed of the three-dimensional goals of knowledge and skills, process and methods, emotional attitudes, and values of ideological and political courses. First, it assesses students' knowledge and skills. Ideological and political courses require students not only to master relevant basic knowledge but also to develop skills. With the advent of the information society, mastering the systematic knowledge of disciplines is no longer the primary purpose of ideological and political teaching. More importantly, students are required to learn the spirit of criticism, thinking, and innovation [18].

Secondly, it evaluates the process and method of ideological and political teaching. Ideological and political courses require students to gain knowledge experience in a learning and communication environment and learn specific teaching methods such as independent learning, collaborative learning, exploratory learning, discovery learning, group learning, and communicative learning.

Finally, it assesses students' feelings, attitudes, and values. Emotions refer to students' enthusiasm and interest in learning. Attitude refers to students' learning attitude, including life attitude, truth-seeking attitude, and tolerance of life attitude. Values emphasize the unity of personal values, social values, and natural values [19–21]. It is something invisible and intangible that must be subtly shaped through the emotional development of students.

3.3.2. Problems Faced by Ideological and Political Teaching Evaluation

(1) The Subject of Teaching Evaluation Is Single. In the current ideological and political teaching process, teachers often focus on the progress of students' performance [22]. Therefore, in the actual teaching evaluation process, the main body of our evaluation is often focused on the teaching performance, ignoring the guiding function of ideological and political courses for students' thinking. Even if some schools do not focus on evaluating grades, their selection of evaluation subjects in the evaluation process is often relatively simple, and they are only limited to individual students or teachers themselves.

(2) The Evaluation Method Is Single. Restricted by the evaluation methods, the evaluation methods adopted by schools are often limited. In some backward schools, people's evaluations of ideological and political courses are often judged by students' dictation, which to a certain extent has led to a single-minded evaluation. Because in this type of evaluation process, teachers often choose children with good grades to participate in the evaluation process. In other areas, the evaluation method adopted by schools is often in the form of table scoring. Although this method quantifies the evaluation, it cannot analyze the evaluation data as a whole, so it loses its original purpose of evaluation.

(3) The Indicator System Is Not Perfect. Under the limitation of evaluation methods, the evaluation indicators used by people are often lacking. Typically, schools evaluate courses by focusing first on grades, followed by the discipline of the curriculum. In the face of achievement and discipline, other indicators have given way, and this also loses the meaning of evaluation [23]. Moreover, due to the old educational system or old educational ideas, the new teaching evaluation system is often not well spread and used in the teaching process, which brings challenges to the teaching evaluation innovation.

3.3.3. Evaluation Principles of Ideological and Political Teaching. After understanding a series of standards and attitudes for ideological and political course evaluation, we also found that in the specific ideological and political course evaluation process, there are the following principles that we need to abide by at all times:

(1) Comprehensiveness. In the process of ideological and political teaching, the previous course teaching was often only for grades and teachers' own job selection [24]. Therefore, when evaluating ideological and political teaching, people often only focus on the parts that are beneficial to themselves, so they will lose attention to the student level. But later, people gradually discovered the insufficiency and defect of this kind of teaching evaluation. Therefore, in the current evaluation of ideological and political teaching, we constantly emphasize the comprehensiveness and soundness of evaluation. On the one hand, we must evaluate the overall quality of students, and on the other hand, we must also conduct a strict evaluation of the quality of teaching and the overall quality of teachers [25]. In this process, the evaluation of talent is a complete process from point to surface, from surface to volume. However, we should also pay attention not to pay too much attention to the partial evaluation of students and forget the comprehensive development of students in the process of evaluation.

(2) Procedural. In part of the ideological and political teaching process, teachers often only pay attention to the last result and forget to make a judgment on the teaching

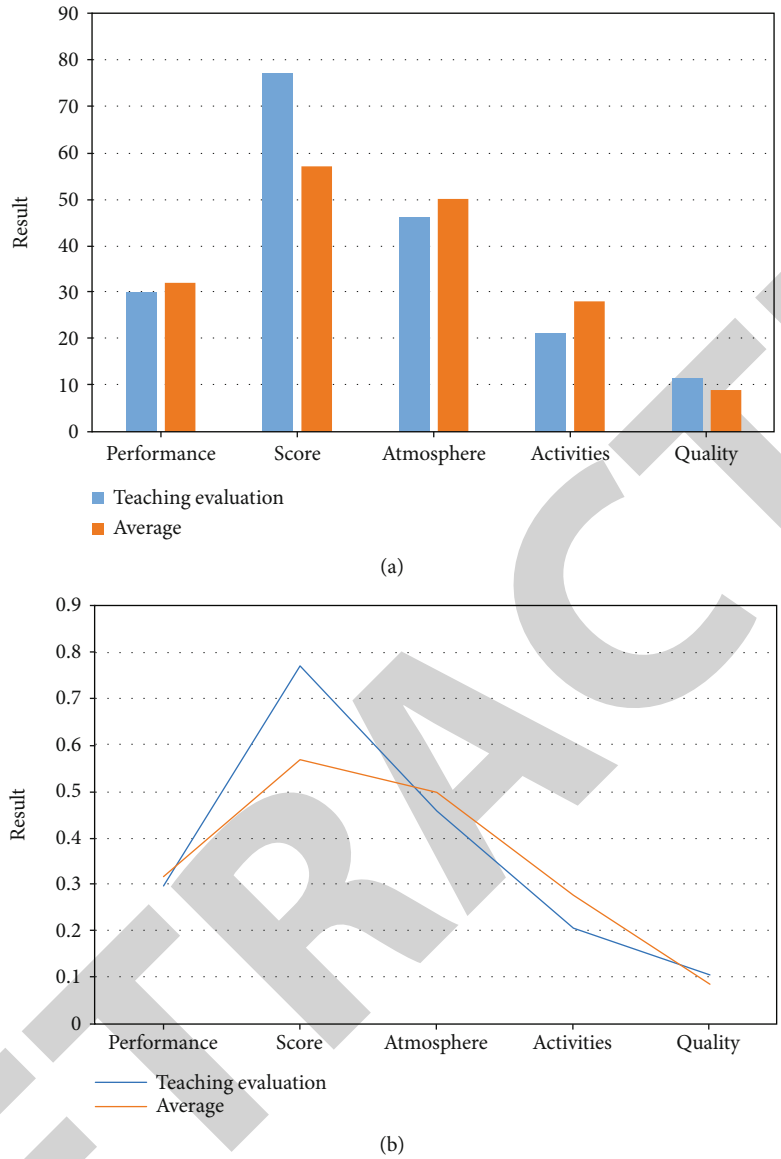


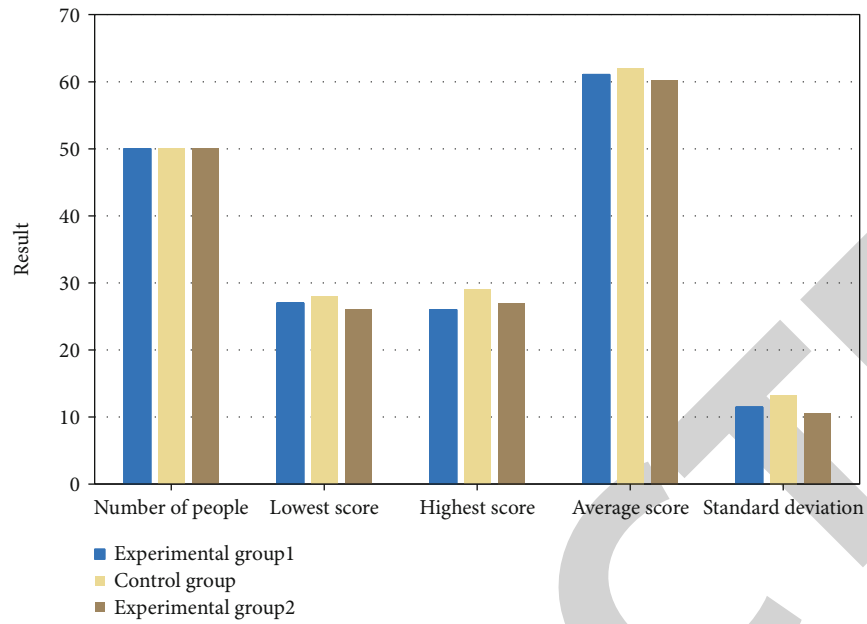
Figure 5: Factors affecting the evaluation of ideological and political teaching.

Table 1: Scores of students in different groups before the experiment.

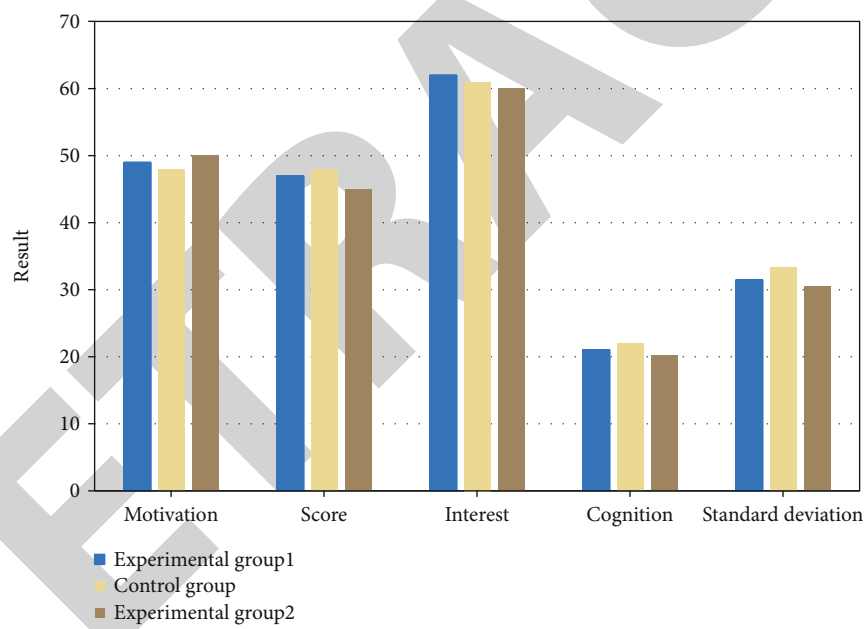
Class	The average score	Standard deviation	Mean square error
Experimental class	80.49	16.52	2.24
Experimental class	79.12	16.37	2.20
Control class	81.17	16.14	2.32

process. In fact, the process of teaching evaluation is also very important, because in this process, we can find the problems exposed in the evaluation process. It is often impossible to obtain the specific situation in the evaluation process only through the final evaluation result. Therefore, we should also pay special attention to some special situations that appear in the evaluation process. Especially in the part where teachers and students are confused or there are huge differences, we need to pay more attention. The integrity of ideological and political teaching determines that our research on its evaluation and its teaching process is a process of continuous development and improvement. What we need to do in this process is to keep each process and make an objective judgment on it.

(3) Subjectivity. The most ideal way for ideological and political education to enter the curriculum is "natural generation," that is, the natural entry from a certain curriculum



(a)



(b)

Figure 6: The experimental situation of the experimental group and the control group.

knowledge point, so that it will come naturally. The way of cutting is ingenious and natural, in which "ingenious" refers to a smooth transition, so that it will not be too straightforward and become preaching, and the design is "smart," so that the opening is not too large to be easy to put in and difficult to close. Specifically, the following methods can be used:

(i) problem creation, that is, a certain class involves ideological and political education problems in the professional field, which can trigger students' thinking or promote group discussions

(ii) events or case introduction, that is, the events related to the professional knowledge point of this course. It starts from the specific ideological and political education dimension, expounds the ideological and political education elements behind it, and promotes discussion

(iii) story introduction which combines the professional knowledge points with stories to guide students to explore

(iv) situation introduction, that is, based on situational presuppositions, guides students to enter the

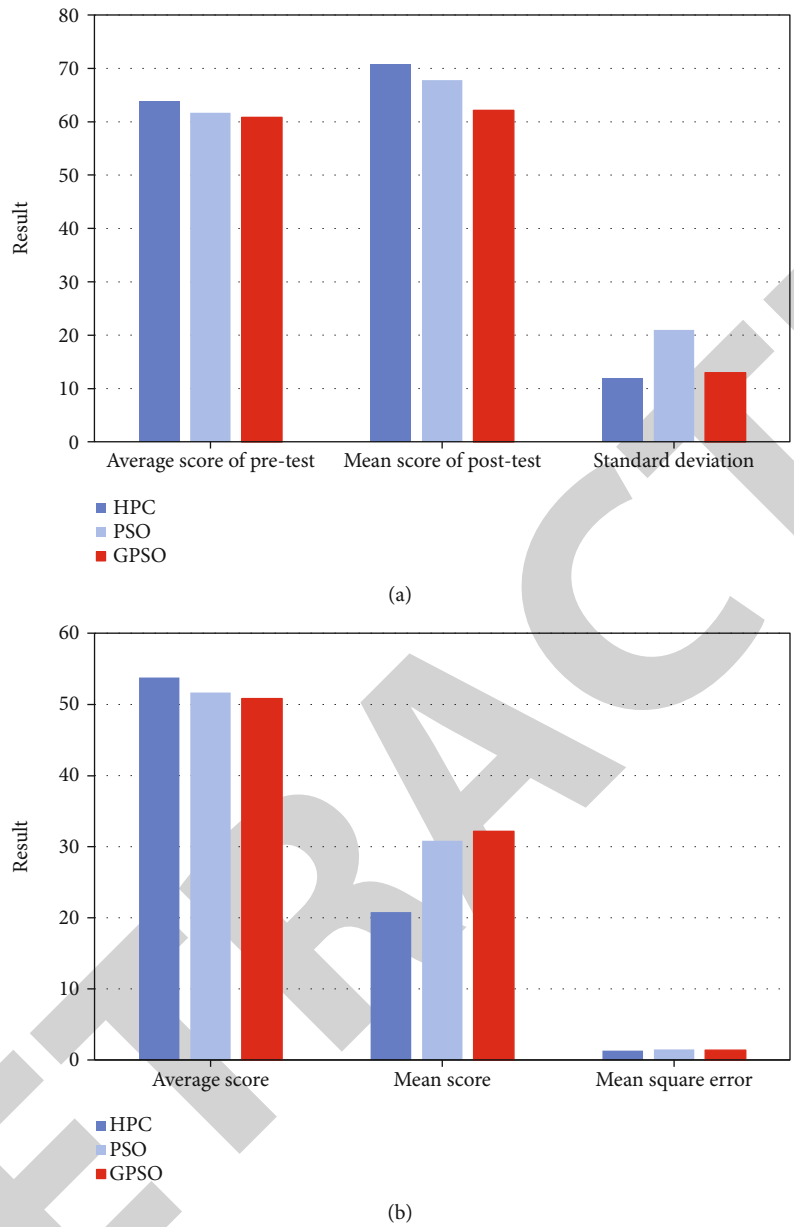


Figure 7: Comparison of various teaching evaluation methods.

situation, and gradually introduces the theme of ideological and political education

(v) Comparative introduction such as the comparison between China and foreign countries at the level of professional knowledge, which then introduce the theme of ideological and political education such as "sense of responsibility and mission" or "national spirit"

3.4. Basis for the Introduction of High-Performance Artificial Intelligence in Ideological and Political Teaching Evaluation

3.4.1. Requirements for the New Curriculum Reform. With the continuous development of science and technology, ideological and political teaching is also constantly advancing with science and technology [26]. In the context of artificial intelligence, the new type of ideological and political teaching also faces new problems, so it is necessary for us to carry out certain reforms on ideological and political teaching. In the process of continuous integration of science and technology into life, how to deal with traditional values and contemporary value orientation is the primary goal of new ideological and political teaching. Therefore, the new curriculum reform is imminent, and the introduction of ideological and political teaching evaluation into high-performance artificial intelligence is the best strategy to solve such problems, and it is also a good prescription in line with the new curriculum reform [27].

3.4.2. Requirements for the Function of Moral Education. The primary goal of ideological and political courses is to

Table 2: Scores of students in different groups after the experiment.

Class	The average score	Standard deviation	Mean square error
Experimental class	82.33	10.34	1.28
Experimental class	82.61	9.85	1.38
Control class	81.92	11.28	1.52

Table 3: Comparison of student evaluation motivation results.

Options	Before the experiment		After the experiment	
	Experimental class	Control class	Experimental class	Control class
Strong motivation	5	4	7	4
General motivation	2	2	1	2
Less motivated	2	3	1	3

Table 4: Comparison of student evaluation interest results.

Options	Before the experiment		After the experiment	
	Experimental class	Control class	Experimental class	Control class
Strong interest	5	4	7	4
General interest	2	2	1	2
Less interest	2	3	1	3

Table 5: Comparison of student evaluation cognitive results.

Options	Before the experiment		After the experiment	
	Experimental class	Control class	Experimental class	Control class
Strong cognition	5	4	7	4
General cognition	2	2	1	2
Less cognition	2	3	1	3

establish a good world outlook, outlook on life and values for students. In the context of artificial intelligence, new technological crimes and technological immorality have become a major problem we face. Therefore, the evaluation of ideological and political courses and the evaluation of the effects of ideological and political courses are our direct reference to the personal development of students. On this basis, we must clarify the moral education function of ideological and political courses and give full play to the leading role of ideological and political courses on students.

The teaching development and evaluation of ideological and political courses are developing in continuous progress, so we also need to use new technologies and new standards to measure one new requirement after another. However, the continuous development of ideological and political courses does not affect its original intention and mission, that is, to educate and cultivate people as its goal, and to cultivate good young people in the new era as its own responsibility. Therefore, combining ideological and political teaching evaluation with high-performance artificial intelligence and continuous integration and development are the requirements of ideological and political courses themselves.

3.4.3. Requirements for All-Round Development of Students. The development of students is the cornerstone of national development, and ideological and political teaching for students is an important measure to build the cornerstone of the nation [28]. Therefore, in the process of ideological and political teaching and practice, we must fully carry forward the policy of ideological and political education and cultivating people and constantly promote the all-round development of students, so that students can thrive in a good environment.

Students will always encounter a series of problems in the process of development, and these problems will often play a certain role in promoting the development of students. However, this role is good or bad. A good driving role can play a positive role in promoting the development of students, while a bad driving role will make students fall into a bad vicious circle. Therefore, ideological and political courses help students find good driving forces and help students develop in an all-round way in the process. However, it is time-consuming and laborious to rely solely on manual operations, so artificial intelligence integrating high-performance computing is the best choice for ideological and political courses.

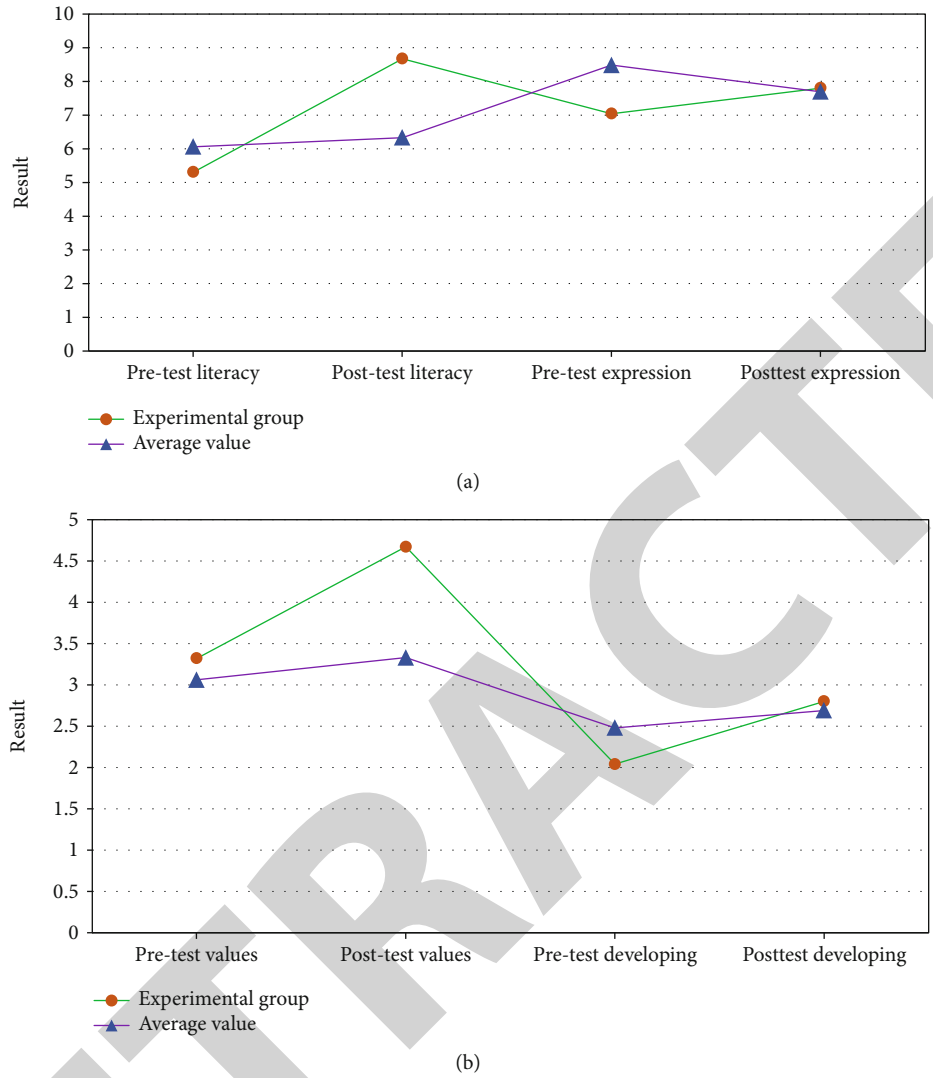


Figure 8: Changes in teaching evaluation before and after the experiment.

4. Integration of High-Performance Artificial Intelligence and Ideological and Political Teaching Evaluation

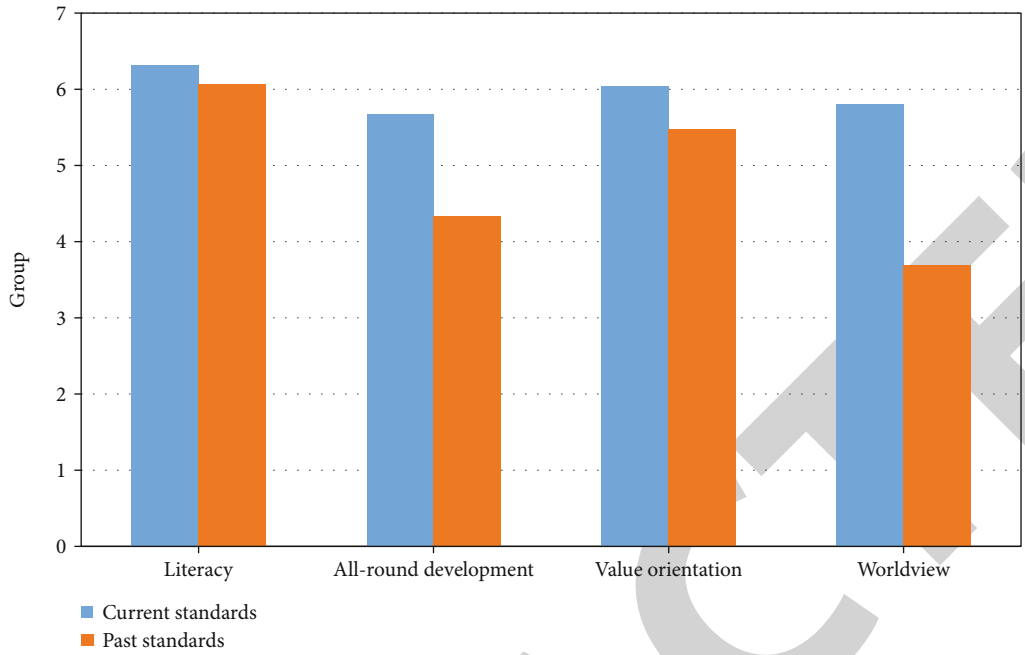
Before exploring the integration of high-performance artificial intelligence in ideological and political teaching evaluation, we made a statistic on the current main factors of ideological and political teaching evaluation. Modern ideological and political teaching evaluation is often affected by classroom performance, student scores, classroom atmosphere, classroom activities, and teaching quality, and the results are shown in Figure 5.

As shown in Figure 5(a), we can clearly find that the evaluation of ideological and political teaching is most affected by the characterization of scores, exceeding the standard value by nearly 20%. This shows that the first indicator of evaluation in the current evaluation system is student achievement. As shown in Figure 5(b), we found that except for student achievement, the proportions of other indicators are almost all below the average. We can find that the modern teaching evaluation standards are extremely unreasonable, and the only evaluation standard is grades.

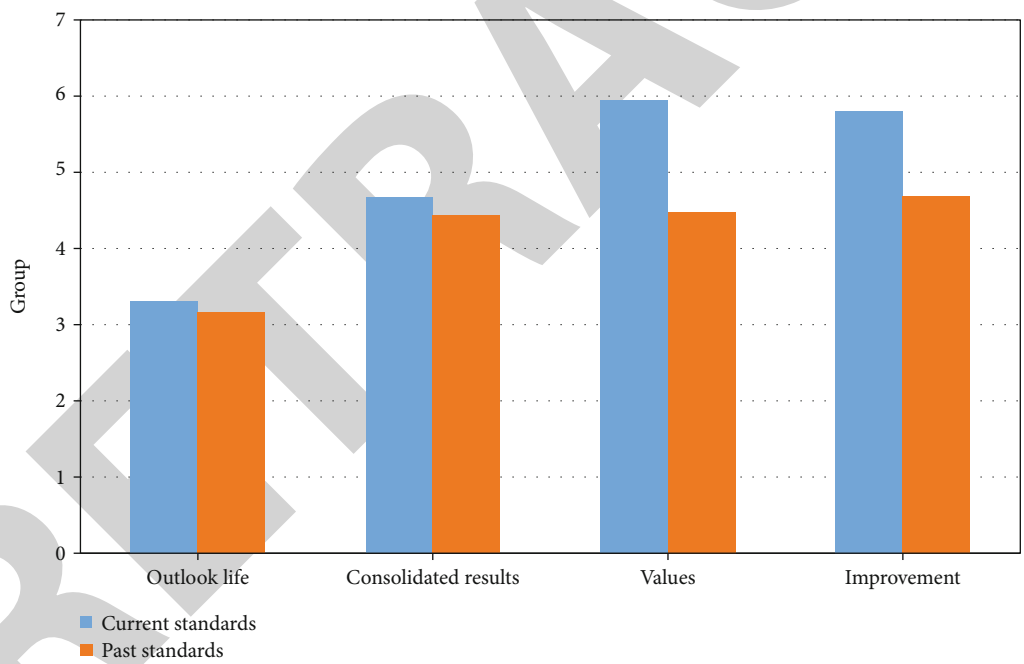
After knowing the problems of the current evaluation system, we conducted group evaluations for the classmates. Among them, we divided into two experimental groups and one control group. In this paper, the statistics of their achievements are separately calculated. The results are shown in Table 1.

From the table, we can find that before the experiment, the performance of the experimental group is not particularly ideal, that is, there is a certain gap compared with the control group. It is reflected in the standard deviation that the data of the experimental group is significantly larger, which shows that there are more fluctuations.

On this basis, we further analyzed the specific conditions of the experimental group and the control group. We selected different intervals and factors to conduct a comparative study, aiming to discover the core factors that affect the evaluation. Figure 6 is a comparison result.



(a)



(b)

Figure 9: HPC-based teaching evaluation factors.

Figure 6(a) shows that after comparing students' grades by region, we found that there is not much difference between the number of students with high scores and the number of students with low scores in ideological and political courses. This will affect the objectivity of the evaluation to a certain extent. Figure 6(b) shows that students' interest is an important factor affecting their evaluation of things, with a ratio of up to 60%.

On this basis, we conduct experiments to support and integrate the evaluation of ideological and political teaching through artificial intelligence based on high-performance computing. At the same time, we also conduct a comparison and analysis of other ideological and political evaluation methods, and the results are shown in Figure 7.

Figure 7(a) shows that students' grades and standard deviations are relatively low in the HPC-based evaluation

model, and we can clearly see that other methods also have certain advantages in standard deviations. Figure 7(b) shows that under HPC, the average score of ideological and political evaluation has a certain data advantage, and its standard deviation is 5% lower than other methods.

After having an HPC-based evaluation system, we believe that under this evaluation system, students will learn more from the ideological and political classroom, so we reevaluate the experimental group and the control group. The results are shown in Table 2.

Table 2 shows that after the experiment, the performance of the experimental group has been significantly improved, which fully shows that the HPC model based on benign ideological and political evaluation will also affect the students' performance. At the same time, we also evaluate students' motivation, interest, and evaluation cognition. The data performance of the control group and the control group is shown in Tables 3–5.

Table 3 shows that before and after the experiment, people's motivation for evaluation has changed to a certain extent. Especially in terms of strong motivation, the number of people has increased significantly, which shows that the HPC-based evaluation mechanism has achieved remarkable results. Table 4 shows that people's interest in evaluation has been improved to a certain extent after the experiment, and there has been a certain increase in the number of interested people. Table 5 shows that the overall performance of the experimental group and the control group was similar in terms of objective cognition and psychological cognition of the evaluation, but the number of people with strong psychological cognition still increased to a certain extent after the experiment.

Then, in the HPC-based ideological and political course evaluation system, Figures 8 and 9 give an answer about how we evaluate courses and teaching classrooms, as well as our key focus objects and teaching goals in the process of teaching evaluation.

Figure 8(a) shows that in terms of ideological and political literacy and ideological and political literature expression, the overall quality of students after the experiment has improved to a certain extent. This shows that the evaluation of teachers has played a certain role in the experiment process, and teaching pays more attention to the cultivation of students' literacy and overall development in the teaching process. Figure 8(b) shows that teachers' teaching evaluation plays a pivotal role in the overall development of students and has played a great role in the practice and formation of students' values.

After clarifying the subject and main object of ideological and political course evaluation, we made an overall summary of the evaluation factors based on this, and the results are shown in Figure 9.

Figure 9(a) shows that under traditional standards, although ideological and political teaching pays certain attention to students' literacy and value orientation, it is not enough. Under the new model based on HPC, the new evaluation system pays attention to the content of students' overall development and worldview, which was seldom paid attention to before. Among them, the attention to students' comprehensive development can reach 56.7%, which is much higher than the traditional 36.9%. Figure 9(b) shows that under the new standard, the evaluation focuses more on the evaluation of students' development and overall quality and pays less attention to previous grades and students' personal qualities. Under the traditional model, only 44.3% were concerned about the cultivation of students' personal qualities, while the new evaluation system paid 63.7% of the attention to students' personal development.

5. Discussion

With the development of the times, artificial intelligence has increasingly become the trend-setter of the times. In the context of artificial intelligence, traditional ideas and the school's consistent teaching philosophy have certain limitations, which affect the overall development of students to a certain extent. Artificial intelligence under high-performance computing shows its development vitality in the continuous development and continues to develop itself with the deepening of things. As an important course leading value and cohesion orientation, ideological and political courses are our first position in the face of new things. Therefore, improving the evaluation system and evaluation mechanism for ideological and political teaching is the requirement of the times and the requirement to promote the all-round development of students. Improving the evaluation of ideological and political teaching can not only play a huge role in the innovation and progress of ideological and political courses but also contribute to the smooth realization of the educational goals of the new curriculum standards and the cultivation of a modern high-quality teacher team. It is conducive to cultivating students' autonomous learning ability, collaborative inquiry ability, hands-on practice ability, and innovative spirit. It can also play a role in promoting the reform of teaching courses in the entire education industry.

6. Conclusion

The ideological and political courses should be guided by the concept of "everything is for the development of students" in the new curriculum standards and change the outdated evaluation thinking in the past. It not only pays attention to students' general cognition and understanding of the world but also pays more attention to students' all-round development, personal growth, and realization of personal value. Starting from the theory of developmental teaching evaluation and pluralistic teaching evaluation, this paper explores the indicators of ideological and political teaching evaluation. This paper analyzes from the perspective of HPC theory and mainly discusses how to use HPC theory combined with artificial intelligence to optimize and upgrade teaching evaluation in the teaching evaluation of ideological and political courses. Based on the current problems in the evaluation of ideological and political teaching, this research provides a detailed description of high-performance computing, artificial intelligence, and ideological and political teaching evaluation.

Data Availability

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

Conflicts of Interest

The authors declared no potential conflicts of interest with respect to the research, authorship, and/or publication of this article.

Acknowledgments

This work was supported by the Beijing Municipal Natural Science Foundation (4202028), National Social Science Foundation of China (21BYY106), Premium Funding Project for Academic Human Resources Development in Beijing Union University (BPHR2019CZ05), Jiangsu Province Key R&D Program (Industry Prospects and Key Core Technologies) (BE2020047), and National Natural Science Foundation of China (62036001, 61866035, 61966033).

References

[1] X. Zhou, X. Liang, X. Du, and J. Zhao, "Structure based user identification across social networks," *IEEE Transactions on Knowledge and Data Engineering*, vol. 30, no. 6, pp. 1178–1191, 2018.

[2] L. Qiao, Y. Li, D. Chen, S. Serikawa, M. Guizani, and Z. Lv, "A survey on 5G/6G, AI, and robotics," *Computers & Electrical Engineering*, vol. 95, article 107372, 2021.

[3] Y. Su, J. Zhou, J. Ying, M. Zhou, and B. Zhou, "Computing infrastructure construction and optimization for high-performance computing and artificial intelligence," *CCF Transactions on High Performance Computing*, vol. 3, no. 4, pp. 331–343, 2021.

[4] D. Milojicic, "Accelerators for artificial intelligence and high-performance computing," *Computer*, vol. 53, no. 2, pp. 14–22, 2020.

[5] D. Hagan and M. Hagan, "Soft computing tools for virtual drug discovery," *Journal of Artificial Intelligence and Soft Computing Research*, vol. 8, no. 3, pp. 173–189, 2018.

[6] H. Cecotti, "Hierarchical k-nearest neighbor with GPUs and a high performance cluster: application to handwritten character recognition," *International Journal of Pattern Recognition and Artificial Intelligence*, vol. 31, no. 2, 2017.

[7] H. Ju, W. Li, and S. Tighe, "Three-dimensional pavement crack detection based on primary surface profile innovation optimized dual-phase computing," *Engineering Applications of Artificial Intelligence*, vol. 89, article 103376, 2020.

[8] C. H. Lin, X. Zhi-Peng, J. Min-Jun, and W. Guan-Ling, "Thinking on integration of ideological and political education into Human Parasitology teaching," *Chinese Journal of Schistosomiasis Control*, vol. 31, no. 4, pp. 431–433, 2019.

[9] H. Li, J. Sun, Z. Xu, and L. Chen, "Multimodal 2D+3D facial expression recognition with deep fusion convolutional neural network," *IEEE Transactions on Multimedia*, vol. 19, no. 12, pp. 2816–2831, 2017.

[10] N. Qin, X. Hu, and H. Dai, "Deep fusion of multi-view and multimodal representation of ALS point cloud for 3D terrain scene recognition," *Isprs Journal of Photogrammetry & Remote Sensing*, vol. 143, pp. 205–212, 2018.

[11] O. I. Khalaf, C. A. T. Romero, A. A. J. Pazhani, and G. Vinuja, "VLSI implementation of a high-performance nonlinear image scaling algorithm," *Journal of Healthcare Engineering*, vol. 2021, Article ID 6297856, 10 pages, 2021.

[12] C. Li, X. Li, and S. Tian, "Challenges and prospects of risk transmission in deep fusion of electric power and information for energy Internet," *Automation of Electric Power Systems*, vol. 41, no. 11, pp. 17–25, 2017.

[13] M. Karimi, E. Babaians, M. Oelsch, and E. Steinbach, "Deep fusion of a skewed redundant magnetic and inertial sensor for heading state estimation in a saturated indoor environment," *International Journal of Semantic Computing*, vol. 15, no. 3, pp. 313–335, 2021.

[14] Y. Xu, Y. Bao, J. Chen, W. Zuo, and H. Li, "Surface fatigue crack identification in steel box girder of bridges by a deep fusion convolutional neural network based on consumer-grade camera images," *Structural Health Monitoring*, vol. 18, no. 3, pp. 653–674, 2019.

[15] N. Jagiella, D. Rickert, F. J. Theis, and J. Hasenauer, "Parallelization and high-performance computing enables automated statistical inference of multi-scale models," *Cell Systems*, vol. 4, no. 2, pp. 194–206.e9, 2017.

[16] A. Arnald, B. N. Lasseigne, and W. Kelly, "aRNApipe: a balanced, efficient and distributed pipeline for processing RNA-seq data in high-performance computing environments," *Bioinformatics*, vol. 11, pp. 1727–1729, 2017.

[17] D. Hassabis, D. Kumaran, C. Summerfield, and M. Botvinick, "Neuroscience-inspired artificial intelligence," *Neuron*, vol. 95, no. 2, pp. 245–258, 2017.

[18] R. Li, Z. Zhao, X. Zhou et al., "Intelligent 5G: when cellular networks meet artificial intelligence," *IEEE Wireless Communications*, vol. 24, no. 5, pp. 175–183, 2017.

[19] T.-Y. Kim, H. Ko, S.-H. Kim, and H.-D. Kim, "Modeling of recommendation system based on emotional information and collaborative filtering," *Sensors*, vol. 21, no. 6, p. 1997, 2021.

[20] Y. Liu and F. Guifang, "Emotion Recognition by deeply learned multi-channel textual and EEG features," *Future Generation Computer Systems*, vol. 119, pp. 1–6, 2021.

[21] E. Rubin and F. Beuk, "Emotions and spillover effects of social networks affective well being," *Journal of Organizational and End User Computing*, vol. 33, no. 5, pp. 1–24, 2021.

[22] P. Havinga, N. Meratnia, and M. Bahrepour, "Artificial intelligence based event detection in wireless sensor networks," *University of Twente*, vol. 85, no. 6, pp. 1553–1562, 2017.

[23] A. Bundy, "Preparing for the future of artificial intelligence," *AI & Society*, vol. 32, no. 2, pp. 285–287, 2017.

[24] R. Liu, B. Yang, E. Zio, and X. Chen, "Artificial intelligence for fault diagnosis of rotating machinery: a review," *Mechanical Systems & Signal Processing*, vol. 108, no. AUG., pp. 33–47, 2018.

[25] P. Glauner, J. A. Meira, P. Valtchev, R. State, and F. Bettinger, "The challenge of non-technical loss detection using artificial intelligence: a survey," *International Journal of Computational Intelligence Systems*, vol. 10, no. 1, pp. 760–775, 2017.

[26] J. H. Thrall, X. Li, Q. Li et al., "Artificial intelligence and machine learning in radiology: opportunities, challenges, pitfalls, and criteria for success," *Journal of the American College of Radiology*, vol. 15, no. 3, pp. 504–508, 2018.

Hindawi
Mobile Information Systems
Volume 2023, Article ID 9814346, 1 page
https://doi.org/10.1155/2023/9814346

Retraction

Retracted: Influence of Embedded Microprocessor Wireless Communication in the Ankle Joint Proprioception Training on the Prevention of Football Sports Injuries

Mobile Information Systems

Received 1 August 2023; Accepted 1 August 2023; Published 2 August 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] S. Li, "Influence of Embedded Microprocessor Wireless Communication in the Ankle Joint Proprioception Training on the Prevention of Football Sports Injuries," *Mobile Information Systems*, vol. 2022, Article ID 8996453, 13 pages, 2022.

Hindawi
Mobile Information Systems
Volume 2022, Article ID 8996453, 13 pages
https://doi.org/10.1155/2022/8996453

Research Article

Influence of Embedded Microprocessor Wireless Communication in the Ankle Joint Proprioception Training on the Prevention of Football Sports Injuries

Siwen Li

Party and Government Office, Changsha Preschool Education College, Changsha 410116, Hunan, China

Correspondence should be addressed to Siwen Li; 3180811z101@stu.suse.edu.cn

Received 24 March 2022; Revised 20 April 2022; Accepted 28 April 2022; Published 17 May 2022

Academic Editor: Liming Chen

This study synthesizes the relevant publications on the therapy of horizontal joint destabilization of the functional ankle and investigates the effect of anterior motion ankle drills on the inability to cause ankle injuries in soccer teams. We chose university soccer teams as the study population and divided them into five men's and five women's squads and five control groups. Embedded microcontrollers are also called microcontrollers. Generally, we focus on a specific type of microprocessor center, integrating ROM/EPROM, RAM, Bus Logic, Timer/Counter, Watchdog, I/O, Serial Port, Pulse Width Modulation Output, A/D, D/A, and more. *Functions and Devices*. Representative embedded microcontrollers include PSIXA, 8051, MCS-251, MCS96/196/296, and C166/167. With the continuous improvement of the processor's computing power and chip integration, the differences between embedded microprocessors and embedded microprocessors have further increased. *Blurred*. The test subjects experienced force testing and the trial subjects involved in ankle native sensory drilling. The experimental results show that the average direction has a statistically significant effect on the front, back, left, and right running ability, which increases significantly after 0.017, 0.032, and 0.043 P, respectively, providing a more scientific basis for preventing football injuries.

1. Introduction

A severe ankle sprain is considered an ankle ligament injury and usually presents with pain and swelling at the site of the sprain, followed by skin bruising and, in severe cases, immobilization of the affected foot due to pain and swelling. According to the local characteristics and symptoms of pathological ankle instability, it will have a profound negative impact on the athlete's body, life, study, and work.

The resistance of football is very strong, especially of the ankle joints [1, 2]. This study uses pre-ankle training to prevent possible ankle injury in footballers, to monitor their clinical implications, and to study possible mechanisms for ankle training for functional ankle instability [3, 4]. It is difficult right now for 8 and 8 bit microprocessor technology to achieve excellent performance. It will be replaced by 32-bit technology in the near future. Given the enormous market potential of mid-range and low-end microprocessors in the internal electronic database [5], in order to adapt to the development trend of microprocessor technology, design and develop high-cost-effective middle and low-end embedded microprocessors. From demand analysis to design implementation, the design of a 32-bit embedded RISC microprocessor was completed, and a software test platform was established to verify the rationality of the design theory. At the same time, I hope that the ideas and methods in the project design can provide ideas and experience for those who are interested in researching and learning microprocessor design [6, 7].

Erdel Hansi explored the effect of a peculiar concentration training program for varus ankle and dorsiflexors on ankle proprioceptive dysfunction. He studied a total of 13 male athletes and leisure athletes, all of whom had unilateral functional ankle instability. The unaffected bilateral ankle joints acted as restraints. The dysfunctional ankle joints of the subjects were subjected to ankle valgus and isoflexor isokinetic training, in a peculiar concentration combination, 3 days per week for 6 weeks. Prior to and after the isokinetic training program, the ankle joints were evaluated for active

and passive position, kinetics, and isokinetic intensity [8–11]. After 6 weeks of intervention in the unstable ankle joint, the general active and inactive sensitivity error scores were reversed ($P < 0.01 - 0.001$) and the plant flexion is $P < 0.05 - 0.001$. Direction and motor sensitivity scores were reversed ($P < 0.001$) and plant flexibility ($P < 0.01$) was significantly reduced. In addition, the peculiar maximum torque of the ankle curve and posterior arch was significantly increased compared to the normal ankle ($P < 0.001$). The results of his research indicate that it is possible to improve the sensitivity of the ankle proprioception after 6 weeks of peculiar and concentrated isokinetic training in the unstable ankle joint. Ha studied the effects of intense ankle joint exercises on adult patients with ankle instability acting on proprioception and unstable support surfaces [12, 13]. A digital dual inclinometer is used to prevent ankle sprain [14]. The test results showed significant differences in the perception and efficiency of the static dynamic equilibrium before and after introduction in the test group ($P < 0.05$). Heel fitting exercises on unstable wires are a great way to increase ankle performance. Race: Zhi Long studied the effects of CT and AT on ankle block at a full weight functional level. It selected 24 healthy students to participate in the research [15, 16]. He used the Active Distance Detector (AMEDA) to measure proprioception. His test results, video footage of the feet and ankles, may have enhanced emotional input to enhance the proprioceptive impression of bad performers, but this would create input congestion and harm those who initially performed better without video footage. Ankle proprioceptive screening can determine which patients may benefit from proprioceptive and tape treatment [17–19].

This article studies the selection of a college football team and randomly divides the players into two groups [20, 21]. Compare the differences of human balance ability before and after training and different trainings, analyze the effects of proprioceptive training and muscle strength training on human posture stability and stability limit test, and track the entire college football championship [22], a total of eight games; statistics of post-match injury was compared with the previous analysis. In the current research field, there are few studies on the effect of incorporating embedded microprocessor wireless communication into ankle proprioceptive training on the prevention of football injuries. This study aims to prevent and reduce the ankle injury of football players, lay a solid foundation for future scientific research, and provide scientific training basis for professional football players and amateur football enthusiasts [10, 11].

2. Influence of Embedded Microprocessor Wireless Communication in Ankle Proprioceptive Training on Preventing Football Injuries

2.1. Overview

2.1.1. Overview of Ontogeny. Proprioception is the sensation produced by the motor organs themselves, such as muscles, tendons, and joints, in different states, which we usually classify into three different levels.

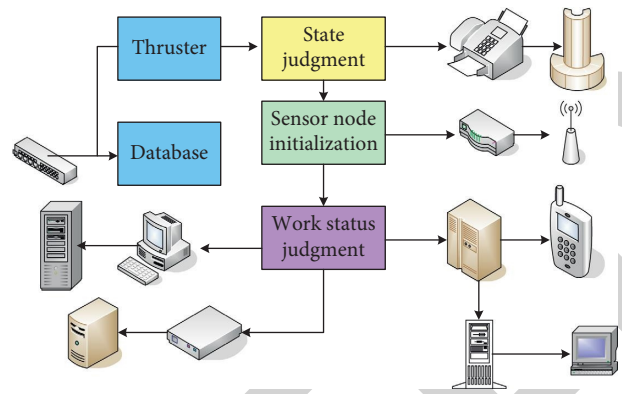


Figure 1: Operation mode of the embedded microprocessor.

The operation mode of the embedded microprocessor is shown as in Figure 1.

2.1.2. Proprioceptive Receptors. The ankle joint is more prone to damage R_{ij} to the lateral ankle ligament caused by excessive varus during exercise:

$$R_{ij} = \left\| W_i - \mathfrak{R}_j \right\|_2^2,$$
$$\mu\phi = \frac{1}{\left| M_j \right|} \sum_{x \in c_j} Y. \tag{1}$$

For the ankle joint balance training device, it needs to bear the weight of the human body and needs to maintain a lighter mass. The purpose of this is to reduce inertia during training:

$$\kappa = \frac{\sum_{i=1}^{n} \varphi r_i, K(l_i))}{N},$$
$$G(S, S_1) = \sum_{c_i \in C, c_j' \in C'} M \log \frac{K(J_i, J_j)}{K(M_i) K(M_j)},$$
$$F(E_1, E_2) = \frac{Q(E_1, E_2)}{\max(M(E_1), M(E_2))}, \tag{2}$$
$$N = \frac{\operatorname{cov}(M, N)}{\sqrt{F(G)} + \sqrt{F(y)}}.$$

2.1.3. Overview of the Ulnar System. The wireless communication of embedded microprocessor in the ankle joint proprioception training is shown in Figure 2.

The functional positioning of the ankle joint trainer and daily training, while providing users with functions and structures that match the ankle joint training method, is

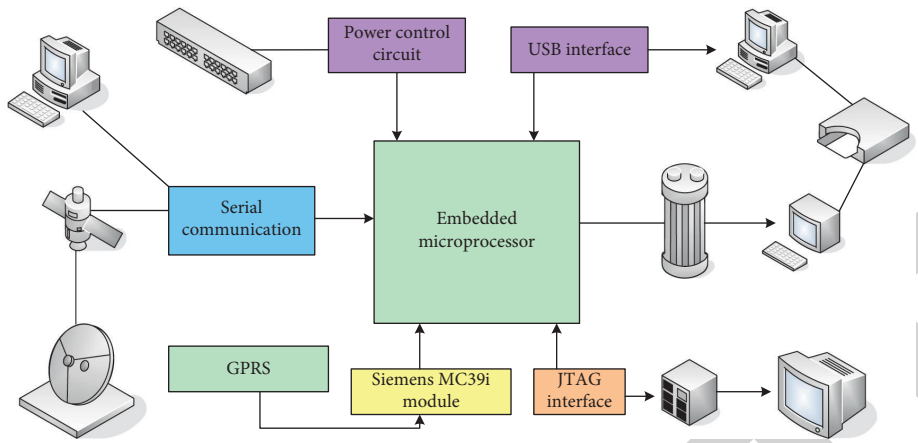


Figure 2: The wireless communication of embedded microprocessor in the ankle joint proprioception training.

$$F = \frac{1}{D}\sum_{i=1}^{D} T_{\{S(x_i)\geq\gamma\}} \frac{f(Y,O)}{f(x,O)},$$
$$N^* = \arg\max_{v} F_u E_{\{S(X)\geq\gamma\}} \ln F(B;G),$$
$$M(X,Y) = \sum_{x,y} w(X,Y)[H(X+u,Y+v) - H(X,Y)]^2,$$
$$K = \sum_{x,y} F(M,N)\begin{bmatrix} G_x^2 & G_xG_y \\ G_xG_y & G_y^2 \end{bmatrix},$$
$$G(C_1,C_2) = \frac{1}{2\pi F^2} e^{-(B^2+V^2/2F^2)}. \tag{3}$$

2.1.4. Interaction Impact. Interaction: reduced property, increased arthritic bone damage, and arthritic bone damage leading to preventive intervention. Heel instability can occur in many ways, for example, during intense training or under prolonged standing, delayed response time to ligament muscle group (PRD) in people with orthostatic trauma, decreased joint position, decreased joint strength and range of motion, decreased reflex nerve velocity, and ankle injuries.

Through the analysis of the plan and the preliminary experience comparison of the production, it was decided to integrate the two plans with each other:

$$S_x(M,N) = \frac{1}{2}(I(M,N+1) - I(M,N) - I(M+1,G)),$$
$$\varpi_y(M,N) = \frac{1}{\beta}(T(M,N) - I(M+1,N+1)),$$
$$G(i,j) = \sqrt{G_x^2(i,j) + G_y^2(i,j)},$$
$$T(I,K) = \sum\left(\frac{G_x(i,j)}{G_y(i,j)}\right),$$
$$S_D = S(T|D) = \frac{S}{(P+Q)}. \tag{4}$$

For the ankle joint balance training device C, because it needs to bear the weight of the human body and needs to maintain a lighter mass to reduce the inertia K_1 generated during the training process,

$$C = \sqrt{\frac{DT}{(M+Q)}},$$
$$K_1 = U(T|Y) = \frac{PU}{(RT-Y)},$$
$$M_1 = \sqrt{\frac{M(1-M)}{(U-H)}}, \tag{5}$$
$$G = E[\log Y(Y)] + A[\log(1-Y(Y))].$$

Ankle training methods are roughly divided into four categories: single-leg standing training $P_p(x)$, unstable plane training χ_1, progressive jumping stability balance training $\xi_t(I,J)$, and comprehensive balance training R_{G1} integrated with other equipment:

$$P_p(x) = \lambda\frac{\prod_{m=1}^{l} Y_{pm}(G)}{\sum_{p=1}^{r}\prod_{m=1}^{l} Y_{pm}(G)},$$
$$\chi_1 = K[\|G-T\|],$$
$$\xi_t(I,J) = P(i_t = J, J_{t+1} = j|Q,\lambda), \tag{6}$$
$$R_{G1} = R\left[\left|R - R_G\right|_{K1}\right],$$
$$\varphi = \sum_{i=1}\left(H_\phi^1(x_i) + H_\phi^{-1}(x_i) - 1\right)^\phi.$$

During this process, the fork muscle group responds quickly. The heel is heavier and the ankle joint function is less. Some people use one-foot tests to test athletes with ankle injuries and find that lower locomotor skills and sensitivity were observed in people with anchor damage. It has been shown that heel drop and the degree of injury are closely related.

2.2. Ankle Joint. The primary function of the ankle was to lift the balance of the body. It is the main part of the body and the point of connection to the earth. It is involved in

important functions of the physical body. Instability due to ankle sprains is divided into lateral instability and medial instability. The incidence of lateral instability combined with articular cartilage injury is 55%. The main damage is to the cartilage of the talus, mostly located on the medial articular surface of the talus.

Fibula muscle: the Fibula is divided into long muscle. The long muscles of the fork extend upwards to the outer side of the fork and are held in the middle distance and at the base of the first metatarsus. The short peroneal muscle is located closer to the outside of the fibula from the bottom to the base of the fifth metatarsal bone. The main task of these two is to make the ankle joint and valve flexible. The long forearm muscle has the function of maintaining the middle and lateral length of the leg and the transverse arches. The short fork can maintain the lateral length of the foot. The long peroneal muscle plays an important role in preventing the development of acne.

3. Experiments

3.1. Research Object. A total of 10 2015 football students were randomly selected from a specific sports college, all of whom were men to explain and prepare for the exams. To pass the stability test, individuals must meet the following two conditions: (1) do not train vigorously for the past 24 hours and (2) physical health, neurological or muscular disorders, visual impairment, and vestibular system under examination. The data of the participating experiments are shown in Table 1.

3.2. Related Investigation Steps

(1) Test site: exercise medicine laboratory

(2) Dataset: leg strength test

  (1) Before testing, ensure the consistency of the lower nodes, familiarize with the test mode and test environment, and do the test

  (2) The object is exposed at the center of gravity of the test path to ensure natural sagging

  (3) Record the results 3.3 Data Statistics and Processing

4. Embedded Microprocessor Wireless Communication in Ankle Proprioceptive Training for Soccer Injury Prevention

4.1. Variation in Consistency. The data obtained during the experiment were evaluated, as shown in Table 2 and Figure 3, and according to the database obtained, it is clear that there is a significant difference ($P < 0.05$) in the data of each indicator, which indicates that the data are valid.

The specific training program is shown in Table 3.

The two groups of research subjects were evenly distributed in terms of age, height, weight, BMI, and CAIT. The two groups of experimental subjects are shown in Table 4.

By paired-sample t-test analysis, the difference in VAS scores in the control group before and after the intervention

Table 1: Overview of experimental subjects.

	Length of time	Altitude (cm)	Power (kg)
Item	23	174	72.1

Table 2: Analysis of test findings.

	Frequency (HZ)	Correlation value (%)	Indicators of accuracy (%)
1	2.2	45	79
2	2.3	54	77
3	−4.7	−3.9	5
4	0.003	0.04	0.03

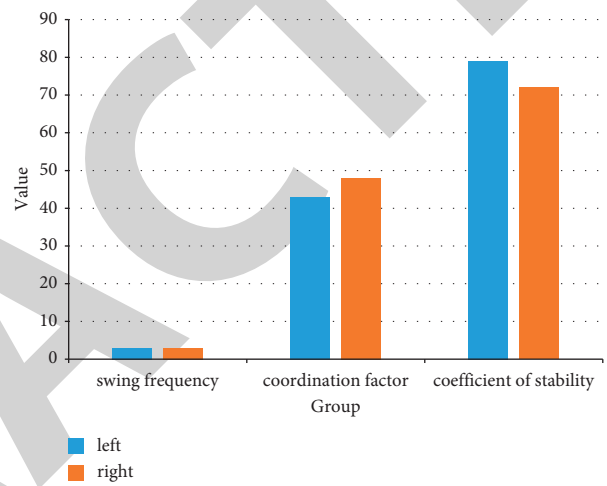


Figure 3: Analysis of test results of trace.

was statistically significant ($P < 0.01$). The detailed results are shown in Table 5.

The difference in CAIT scores in the control group before and after intervention is statistically significant. The comparison of CAIT scores is shown in Table 6.

The relative peak moments of plantar flexion in the experimental group before and after the intervention were (0.63 ± 0.15) and (1.06 ± 0.14), and the relative peak moments of back extension were (0.29 ± 0.04) and (0.39 ± 0.05), respectively. The comparison of speed muscle strength is shown in Table 7.

There were statistically significant differences in the standing time on one foot and the swing area of the center of gravity. The comparison of balance ability is shown in Figure 4.

Through the analysis of paired-sample t-test, the differences in single foot support time, stride length, stride length, stride speed, and step width in the control group before and after the intervention were statistically significant. The comparison of gait parameters is shown in Figure 5.

The analysis of the difference between the medial to lateral pressure ratio before and after intervention training is shown in Figure 6.

From the comparison of absolute impulse and relative impulse, it can be seen that the absolute impulse and relative

Table 3: The specific training program.

Link	Training content	Time	Advanced strength
Strength training	Foot towel	1 minute/group, 3 groups	Stay the same for 1–6 weeks
	Hook foot	1 minute/group, 3 groups	1–3 weeks, training intensity is 1 minute/group, 3 groups
	Tiptoe	1 minute/group, 3 groups	4–6 weeks, training intensity is 2 minutes/group, 3 groups
	Turn inward	1 minute/group, 3 groups	

Table 4: The two groups of experimental subjects.

Grouping	Test group	Control group
Number of cases (n)	19	18
Gender (male and female)	13/6	11/7
Age	26.42 ± 6.69	28.11 ± 8.86
Height (cm)	169.53 ± 7.80	169.00 ± 7.04
Weight (kg)	62.95 ± 6.88	64.56 ± 8.12
BMI (kg/m)	21.84 ± 0.94	22.21 ± 1.37

Table 5: The detailed results.

Grouping	n	Before intervention	After the intervention
Test group	19	4.58 ± 1.00	1.82 ± 0.58
Control group	18	4.31 ± 0.94	2.36 ± 0.51

Table 6: The comparison of CAIT scores.

Grouping	n	Before the intervention	After the intervention
Test group	19	17.32 ± 1.95	25.68 ± 1.06
Control group	18	17.89 ± 1.78	22.39 ± 1.09

Table 7: The comparison of speed muscle strength.

Grouping	Test group	
	Before intervention	After the intervention
Relative peak moment of plantar flexion	0.63 ± 0.15	1.06 ± 0.14
Relative peak moment of back extension	0.29 ± 0.04	0.39 ± 0.05
Relative peak moment of varus	0.20 ± 0.03	0.35 ± 0.04
Relative peak moment of valgus	0.17 ± 0.03	0.34 ± 0.04

impulse of the big toe and the first metatarsal increased after training, while the absolute impulse and relative impulse of the second to fifth metatarsals decreased after training. Except for the difference in the absolute impulse of the fourth metatarsal, the above data have significant differences. Figure 7 shows the difference analysis of absolute impulse and relative impulse before and after intervention training.

The data of 8 subjects were collected and sorted out, and the average value of the reset error angle was calculated. The average value was compared and analyzed before and after training. The average value of reset error after training was not significantly smaller than the average value before reset. It is statistically significant that the ankle balance training device has limited proprioception training in a short period of time. The specific data and analysis results are shown in Figure 8.

Analyzing and comparing the results, it is found that the distance that the subjects can stretch after training is

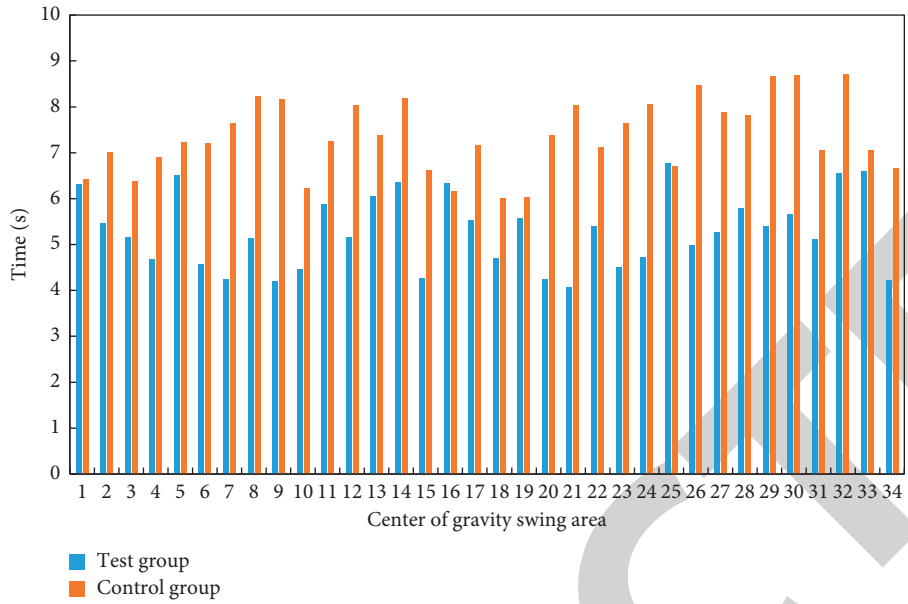


Figure 4: The comparison of balance ability.

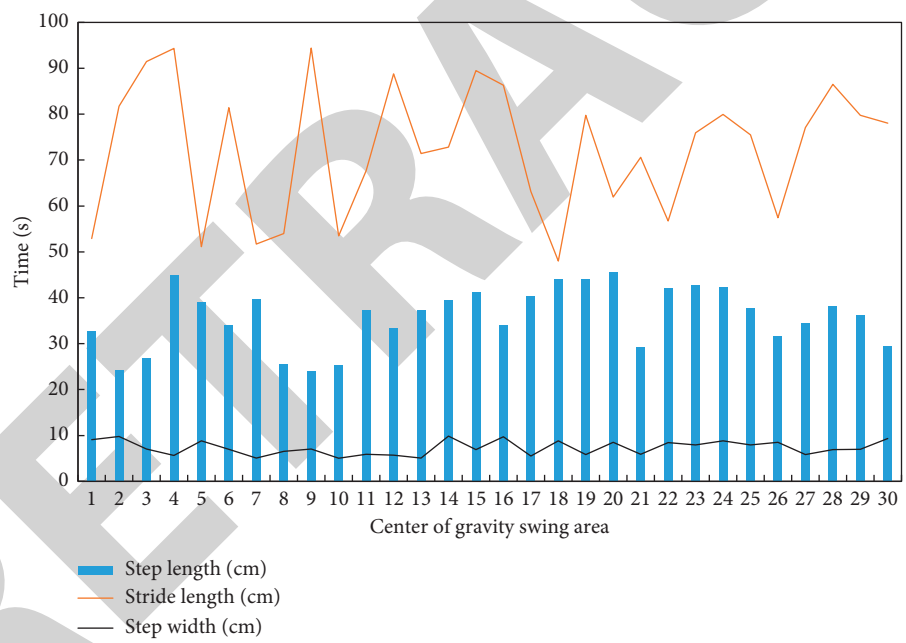


Figure 5: The comparison of gait parameters.

significantly longer than the distance before training, and the difference is statistically significant. The average stellar stretch distance of the subjects before and after training is shown in Figure 9.

4.2. Analysis of Stress Tolerance. According to the data in Table 8 and Figure 10, it can be seen that the data of each index are markedly varied ($P < 0.05$) and the experimental data are relatively stable.

Each module of RISC microprocessor sfmi_cpu performs logic synthesis using the interface of Synplify pro. The synthesis result is shown in Table 9.

After sfmi_cpu is placed and routed, the frequency can reach 64.86 MHz, and the clock cycle is 15.418 ns, achieving the expected goal. The timing analysis results are shown in Table 10.

When participating in this experiment, there was no pain in the ankle joint, and he was able to bear full weight without lameness. The general conditions of the experimental subjects are shown in Table 11.

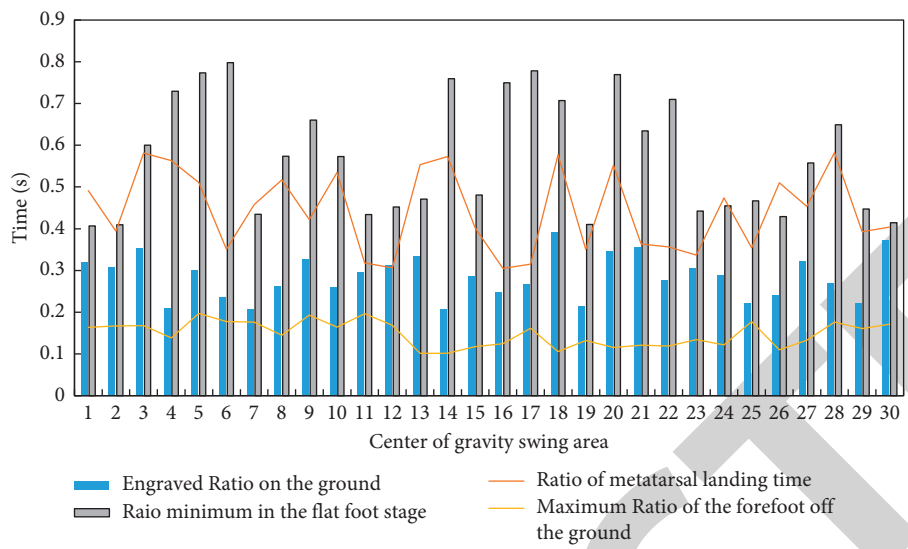


Figure 6: The analysis of the difference between the medial to lateral pressure ratio before and after intervention training.

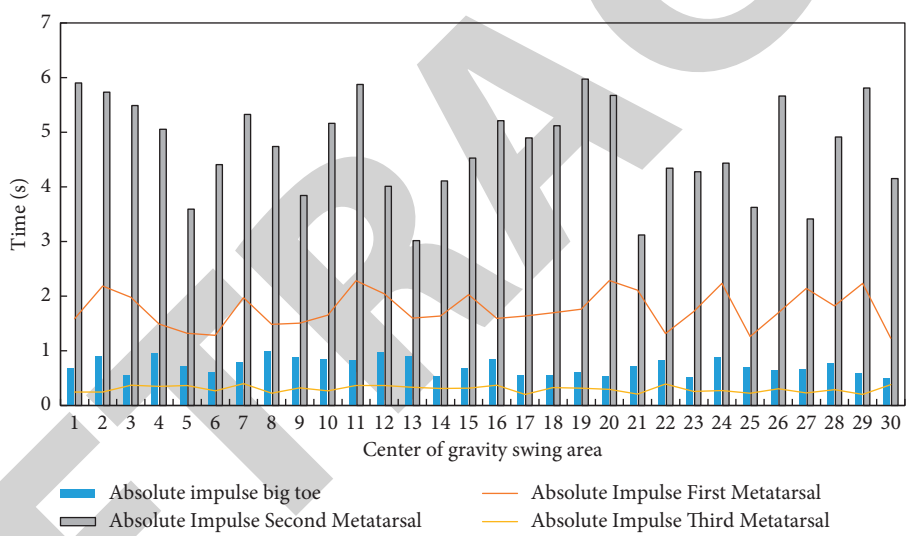


Figure 7: Difference analysis of absolute impulse and relative impulse before and after intervention training.

Compared with pre-exercise, the "ankle exercise" training group reduced the mean value of active and passive reduction of injured ankle joint, and the difference was significant $P < 0.01$. Active and passive reduction defects of the unresolved ankle joints also reduce the mean value of the angles, but do not differ significantly. Figure 11 shows the mean change in the active and passive angle of zero joint defects in the study group before and after the test.

There was a decrease in the mean values of the positive and negative reversion errors of the control arm of the injected ankle compared to the pre-school age, which was a remarkable departure. The average values of the error angles of primary and secondary reductions in the unprotected ankle also decreased. However, there is no significant difference. The final comparison between the two groups is shown in Figure 12.

4.3. Comparison of Muscle Strength between Affected and Healthy Sides of Functional Ankle Instability in Sports Students. As shown in Figure 13, test the strength of the affected ankle muscle and the healthy side of the functional instability of the footballer's ankle.

The physical strength of sports students with functional ankle instability is significantly different from that of the ankle dorsiflexion, plantar flexion, varus, and valgus on the contralateral ankle. The muscle strength on the side is significantly smaller than that on the healthy side. Ankle motion control is random and often has stomps, etc., and even severe ankle pain, etc. These symptoms indicate functional ankle loss of muscle strength in the unstable side of patients with joint instability. The loss of ankle muscle strength and proprioceptive disorder are important factors that cause functional ankle instability, which also reflects the loss of muscle strength in the unstable side of patients.

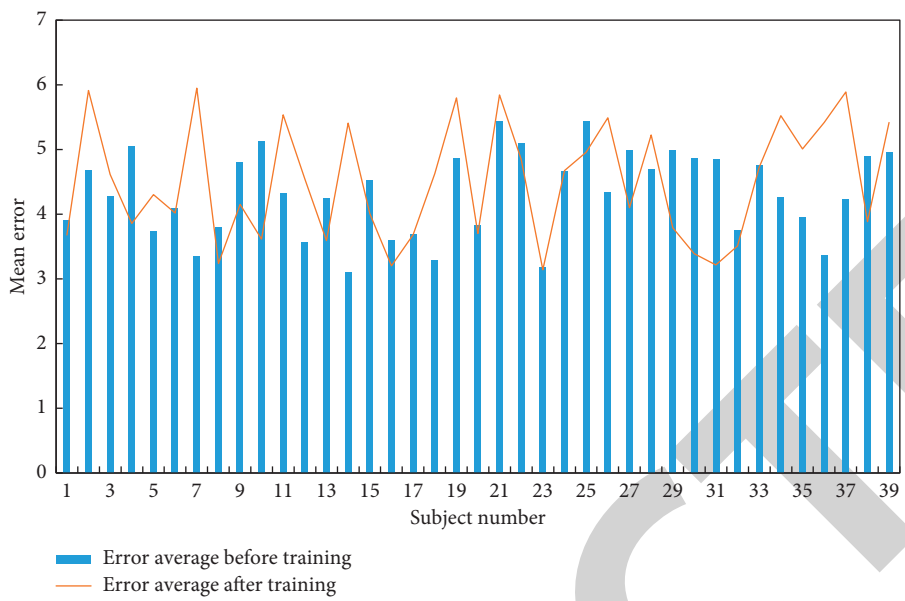


Figure 8: The specific data and analysis results.

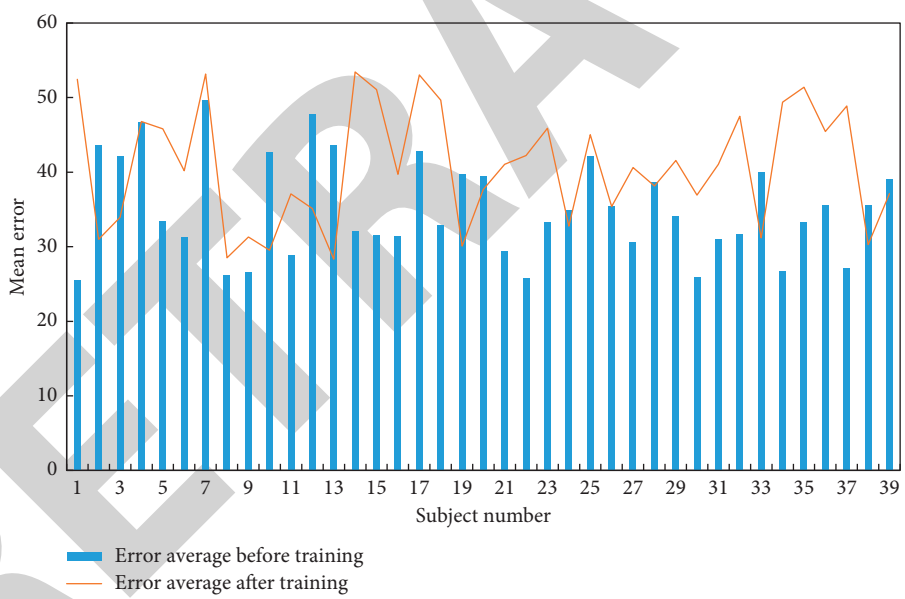


Figure 9: The average stellar stretch distance of the subjects before and after training.

Table 8: Test analysis of train tracks.

	Frequency (HZ)	Correlation value (%)	Indicators of accuracy (%)
1	2.7	209	19
2	2.6	122	49
3	9	39	−30
4	0.0001	0.0001	0.0001

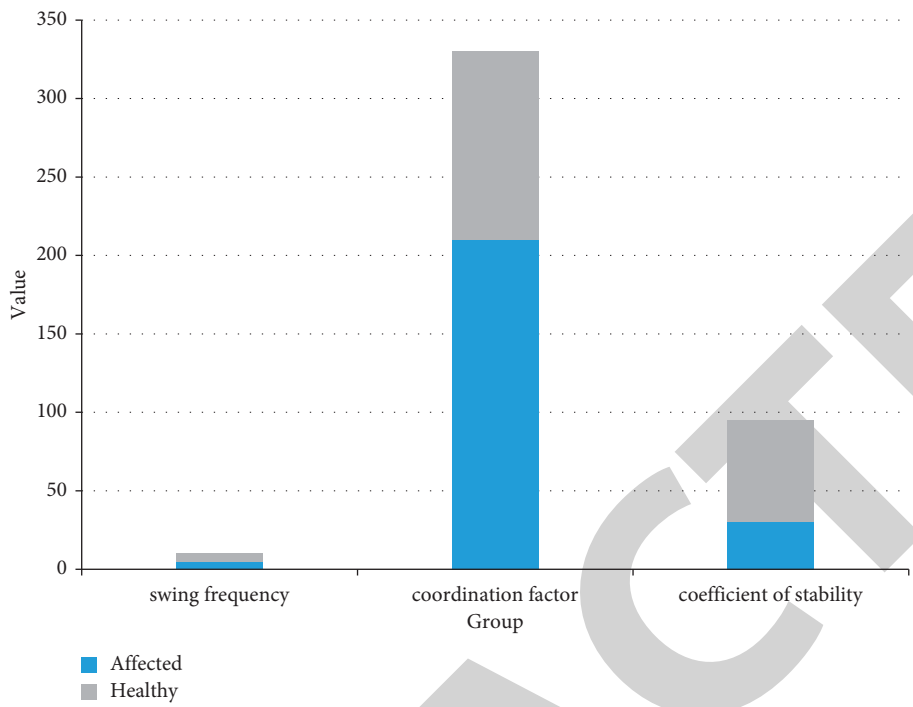


Figure 10: Test analysis of the trail.

Table 9: The synthesis result.

Module name	Equivalent gate number	Percentage
ALU	569	6.6
Mult	2104	24.2
Shifter	496	5.7
Bus_ mux	687	7.9
PC	375	4.3

Table 10: The timing analysis results.

Type	Required time	Slack	Actual time (ns)
Worst-case tsu	None	N/A	8
Worst-case tco	None	NA	10.554
Worst-case lpd	None	NA	20.226
Worst-case th	None	NA	7.761
Clock set-up: “ck”	None	NA	0.362

Table 11: The general conditions of the experimental subjects.

Parameter	Proprioception training exercise training group	Control group
Age	21.8 ± 0.2	21.6 ± 0.2
Height (m)	1.76 ± 0.1	1.75 ± 0.2
Weight (kg)	76.7 ± 1.9	75.6 ± 2.2
Injury time (month)	4 ± 0.6	4.2 ± 0.7

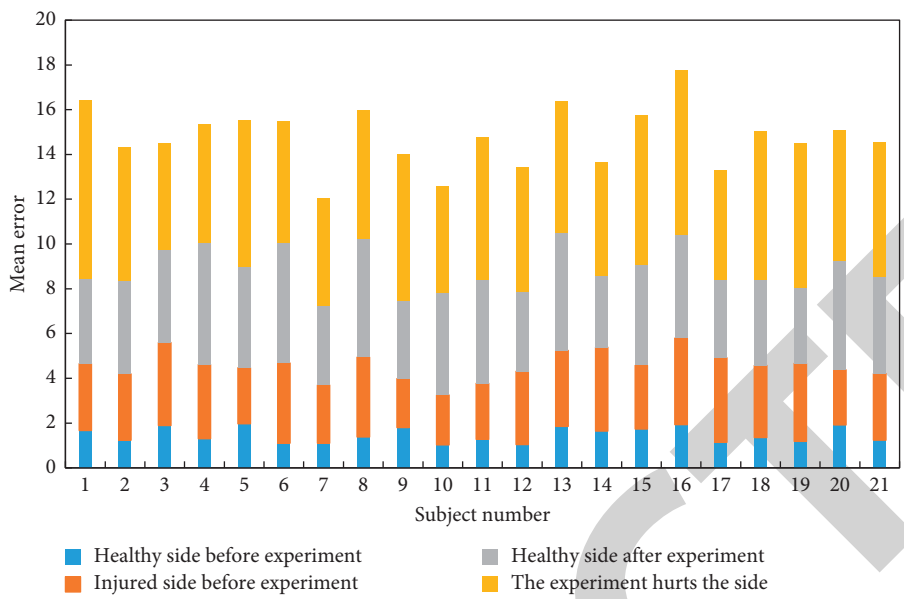


Figure 11: Average change in error angle.

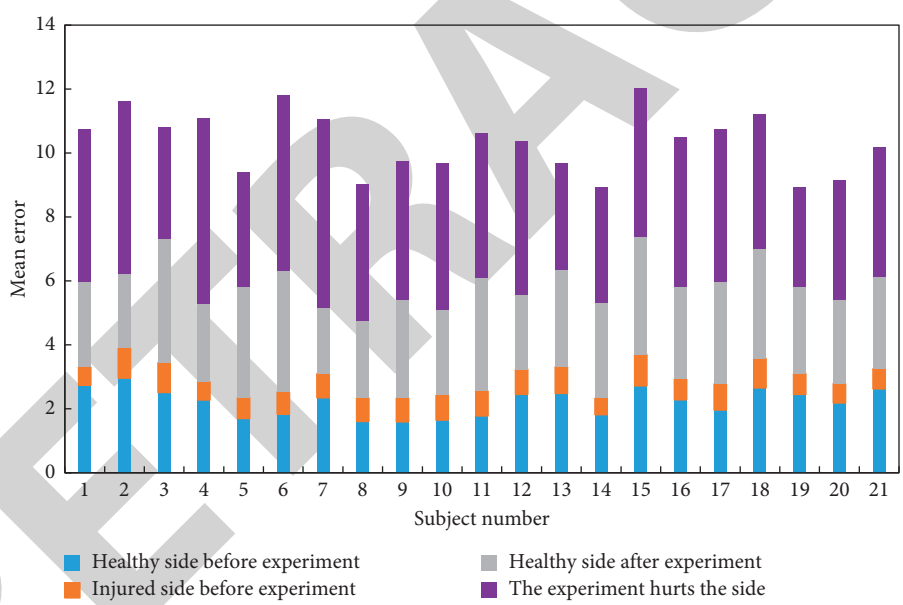


Figure 12: The final comparison between the two groups.

Analyze the difference in muscle strength between the unstable and healthy sides of patients with functional ankle instability from the subjective feedback information of the subjects. Most of the subjects reported that the instability side did not dare to exert force during ordinary sports, especially speed and strength.

4.4. Stability Limit Test Analysis. As shown in Figures 14 and 15, before and after class, average direction had a statistically significant influence on the capacity to travel front and back to the left, and the value increases significantly after 0.017, 0.032, and 0.043P, respectively.

In terms of mean orientation and back/left ability, the test group and the control group had statistically significant differences after training. The test group was significantly larger than the control group, i.e., the test group, before receiving additional property training. Medium steering ability and rear/left steering ability are further improved. One-way difference analysis was used to analyze the control capacity in different directions, and the P value was 0.010. Recent analysis by the LSD method, the front/right direction control ability is the best, which is significantly greater than the left, front/left, rear/right, and rear/left direction control capabilities.

When the human body is standing on both feet normally, in order to keep the body balanced, it is customary to

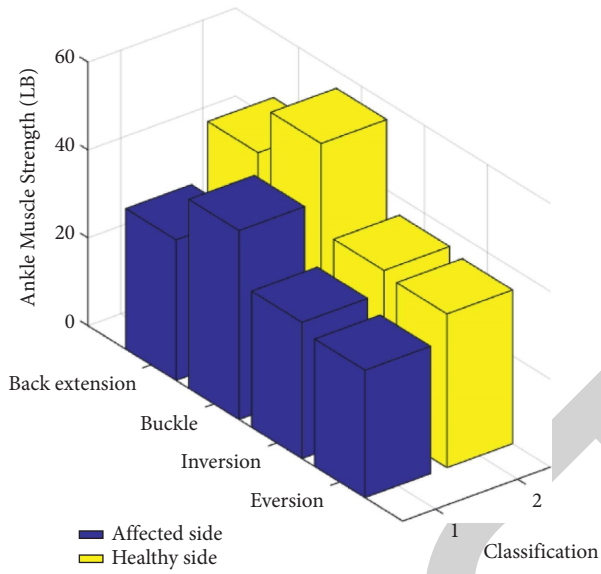


Figure 13: Direction of ankle motion.

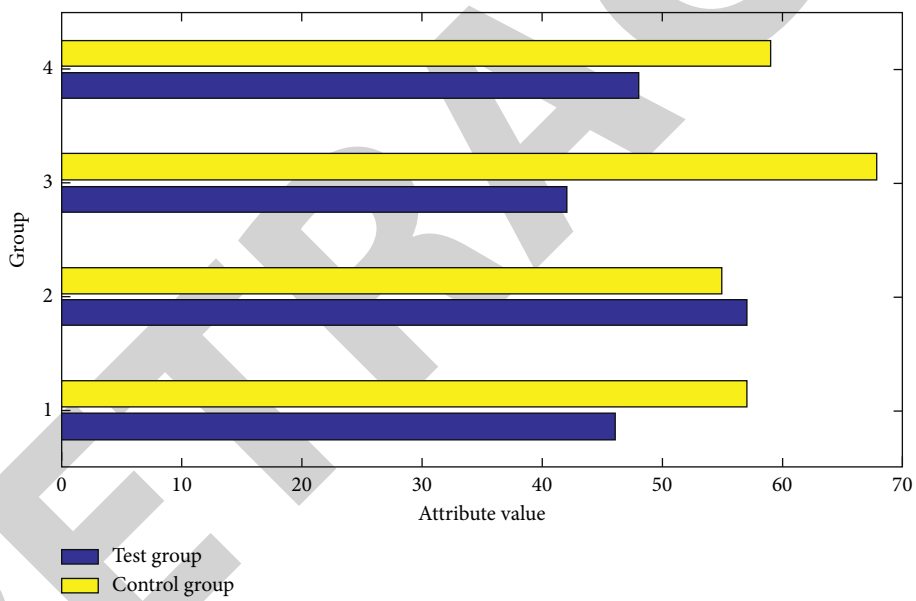


Figure 14: Average direction control ability before and after training.

control the center of gravity between the feet. At this time, the person's center of gravity changes. The subject is required to control the center of gravity on the supporting feet. In order to keep the body in a balanced state, the support legs rely on the ankle joint, knee joint, hip joint, and trunk muscles to coordinate their efforts and mobilize the balance organs throughout the body. Visually collect the surrounding information. The proprioceptors sense space, position, and force. The vestibule collects information and sends it to the central nervous system. The system is to ensure that the body is in a balanced and stable state. The star-shaped offset balance test is a dynamic balance test. In order to extend the unsupported legs as far as possible and maintain body balance, the supporting legs rely on the muscles of the ankle, knee, hip, and trunk to coordinate their efforts. It can be known that the two methods of balancing ability test have high requirements on the lower limb movement ability of the subject, and the lower limb movement ability is an important guarantee for the human body to control the posture balance. Muscle strength + balance training can improve the muscle strength of ankle joints in dorsiflexion, plantar flexion, varus, and eversion and improve the posture control ability of sports students, but the effect of improving the dynamic balance ability of sports students is not obvious. The one-legged standing ball training through continuous control of its own balance may be in increased ankle muscle strength to a certain extent. Balance training can improve the proprioceptive dysfunction of the ankle joint and improve its stability. Therefore, the one-foot stand-to-throw ball

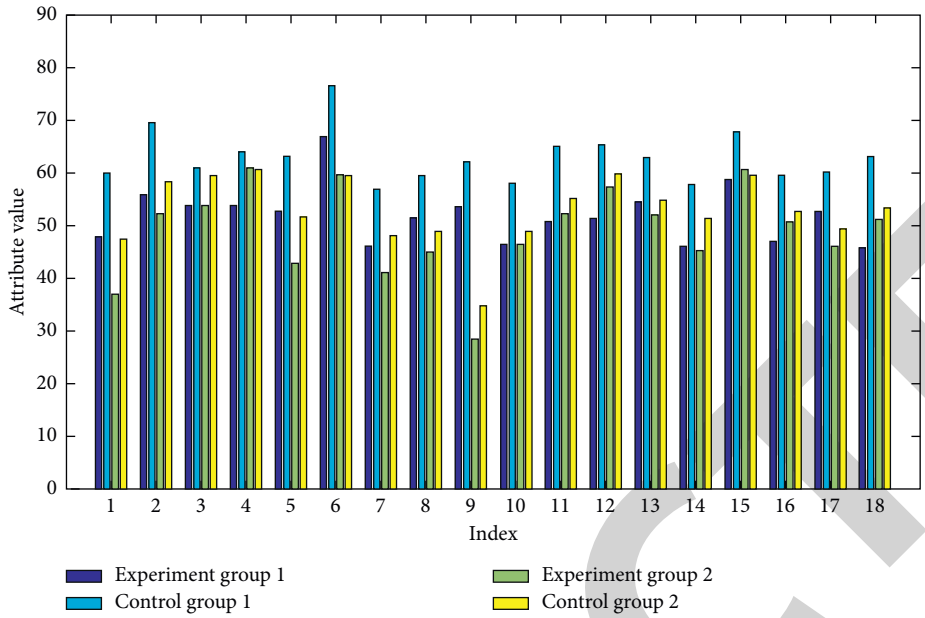


Figure 15: Directional control ability in different directions before and after training.

training can improve the stability of ankle joints of sports students and then improve their balance ability. The ankle joint proprioceptive training is aimed at the overall ability of the lower limbs. The combination of exercises will improve the stability of not only the ankle joint but also the knee, ankle, and trunk.

5. Conclusions

The possible reason and explanation is that the technical movement requirements of men's and women's football are basically similar, and the size of the football field for men's and women's football matches is basically the same difference.

Of course, the choice of coding format is not fixed, and the coding format should be determined according to the design requirements in specific implementation. The number of flip flops used to store the state vector in binary encoding or gray code is less, but the encoding and decoding of the state requires additional logic; while the one-hot code is the opposite. Because CPLD provides more combinatorial logic resources, binary codes or gray codes are often used; while FPGAs provide more trigger resources and more use one-hot code encoding. When the area of the circuit is the main factor, binary coding or gray coding should be used; if the area of the circuit is not a limiting factor, one-hot codes should be used to improve the implementation efficiency.

Athletes' tests in the stability limit are mostly that the ability to control the front/right direction is significantly better than other directions. This may be similar to the fact that these tested athletes have the right foot as the main force and move more to the right and forward, which may suggest that athletes should be trained in other directions on proprioception, so as to balance the development of proprioception and prevent injuries. The prevention of ankle injury should be grasped early to enhance joint strength while cooperating with proprioceptive training. The method adopted in this study is simple, easy, and time-consuming and will not affect the normal class schedule and training time. It is suitable for popularization among school football and amateurs and football players. It is necessary to raise awareness of injury prevention before it happens.

Although this study has carried out a profound study on the prevention of football injuries by using embedded microprocessor wireless communication, there are still many deficiencies. Propose appropriate research methods and means from more perspectives based on the existing technology and level, and continuously improve the quality of research work.

Data Availability

No data were used to support this study.

Conflicts of Interest

The authors declare that they have no conflicts of interest.

References

[1] M. G. Huddle, J. A. Deal, B. Swenor, D. J. Genther, and F. R. Lin, "Association between dual sensory impairment hospitalization and burden of disease," *Journal of the American Geriatrics Society*, vol. 64, no. 8, pp. 1735–1737, 2016.

[2] A. Freeman-Sanderson, L. Togher, and M. Elkins, "An intervention to allow early speech in ventilated tracheostomy patients in an Australian intensive care unit (icu): a randomised controlled trial," *Australian Critical Care*, vol. 29, no. 2, 114 pages, 2016.

[3] J. Köstenbauer and H. Kempton, "Pseudoathetosis and ataxia-a rare presentation of multibacillary leprosy in a non-