Wireless Communications and Mobile Computing

Artificial Intelligence-Based Resource Allocation for RIS-Aided 6G Communication Systems

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Retraction

Retracted: The Application of Multimedia Information Technology in the Moral Education Teaching System of Colleges and Universities

Wireless Communications and Mobile Computing

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This article has been retracted by Hindawi following an investigation undertaken by the publisher [1].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

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

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

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

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

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

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[1] W. Yu, "The Application of Multimedia Information Technology in the Moral Education Teaching System of Colleges and Universities," *Wireless Communications and Mobile Computing*, vol. 2022, Article ID 5309632, 8 pages, 2022.

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Retraction

Retracted: Design of University Educational Administration Management System Based on Sensor Data and Multidimensional Information Fusion

Wireless Communications and Mobile Computing

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Research Article

Research on Multimedia Technology-Assisted College English Grammar Teaching

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The English Curriculum Standard for Compulsory Education lists the specific requirements for the integration of English discipline and information technology to optimize the presentation of education. For college students' English teaching, the most appropriate and effective way is to widely apply multimedia courses to English teaching. Using the rich multimedia knowledge of multimedia courses to expand students' oral English and teaching skills, widen the reading path of reading and writing, multimedia tutoring teaching can concretize and visualize abstract knowledge well, and rich multimedia knowledge can facilitate students' learning and play an important role in understanding knowledge. This paper focuses on multimedia technology-assisted college English grammar teaching. The multimedia technology is analyzed by using the multimedia data hashing algorithm with semantic fusion. Then, the application of multimedia teaching materials in teaching and traditional teaching methods is experimented. By comparing their learning effects, the author draws a conclusion that multimedia technology has been applied in English grammar teaching to a certain extent, and the present situation of its application is relatively good. Most of them have an encouraging attitude, especially in improving students' learning attitude and increasing their interest in learning. Due to the limitations of awareness and conditions, the extent and progress of the integration of information technology and disciplines have lagged behind relatively, and there are many difficulties in the application of multimedia course materials; there are certain difficulties in integrating multimedia course materials and English subjects.

1. Introduction

The purpose of this paper is to explore the practical application of multimedia technology in teaching, explore the application rules and characteristics of multimedia technology, give full play to the advantages of multimedia, make multimedia better serve classroom teaching, and improve teaching effect [1]. The purpose of this study is to evaluate the usability of multimedia software applications. The results show that the software applications have high global usability, and this kind of software can improve the quality of life of family caregivers and their coping ability [2]. This paper is a summary of the research and application of multimedia in China in 1998. Understanding its development will facilitate researchers to consult reference materials and help editors to compile journals and authors to write papers [3]. This paper is one of a series of reports on multimedia research and application in China in 2003. The research results show that multimedia technology and digital earth are the development trends in the world for a long time [4]. This paper describes a suite of multimedia tools for filmless radiology to create multimedia radiology reports with text, images, and sound annotations. The collection of client and server controls the acquisition and processing of multimedia information [5]. The purpose of this paper is to discuss the characteristics of multimedia technology and foreign language teaching and the application of multimedia technology in language teaching and try to find out the related technical problems [6]. This paper studies the cultivation of college students' autonomous learning ability, and the results show that strategy training plays an important role in enriching students' metacognitive knowledge and promoting the

establishment of learners' autonomous learning ability. The development of metacognitive achievement and academic achievement also has high synergistic efficiency [7]. This paper focuses on and attempts to demonstrate that English should be taught as a foreign language in China after 50 years of university education reform. Therefore, reading and writing should be the most important [8]. On the basis of analyzing the present situation of college English teaching in China, this paper points out that college English teaching in China is entering a critical stage of historical transformation, which requires studying individualized teaching and learning requirements and reflecting on the Chinese college English teaching system [9]. This paper discusses the role of language input in college English teaching through theoretical research and empirical research and points out that with the application of modern teaching theories and teaching methods, traditional language teaching methods should not be completely abandoned [10]. The concept of autonomous learning belongs to the category of educational philosophy. This paper discusses the possibility of autonomous learning in Chinese college students' English learning from two aspects: principle and action. Teachers and educational authorities should also be responsible for the development of autonomous learning, just as learners should learn to be responsible for their own learning [11]. This paper further analyzes the background and definition of Ele and holds that the development direction of CET is academic English, not ELEE, and the course is an elective course in college English teaching, which should not be regarded as the mainstream or even the direction of college English teaching [12]. Grammar teaching traditionally provides learners with the opportunity to produce specific grammatical structures. This paper discusses another grammar teaching method: the method based on explanatory input, and discusses the basic principle of this method and the principle of designing explanatory tasks in grammar teaching [13]. This paper reviews the research on how to best teach grammar from four theoretical motivation teaching options. In view of the difficulty in drawing clear conclusions based on this research, based on the difference between teachers' practical knowledge and technical knowledge, some possibilities for teachers to use the information provided by them in teaching are considered [14]. This paper outlines a TD strategy, through which teachers check their theories in grammar teaching and the materials to assist teachers in implementing this strategy. The role of formal teaching itself has always been the focus of debate, and more than 20 years' research has failed to give clear grammar guidelines [15].

2. Definition of Multimedia-Related Concepts

2.1. Multimedia Technology. Multimedia technology is a kind of computer technology that can collect, store, process, or integrate multimedia information such as text, graphics, images, sounds, animations, and videos. It can use computer to process external media data and print it out in the combination of images, texts, sounds, animations, videos, etc., so as to realize multipurpose dynamic performance effects. Multimedia technology has the characteristics of integration, interactivity, real-time, and convenient data use.

2.2. Multimedia-Assisted Instruction. Multimedia-assisted instruction means that in the learning process, according to the characteristics of learning objectives, teaching contents, and learning objects, we choose and use multimedia wisely, combine with traditional teaching methods organically, participate in the whole teaching process and deal with it together, and then use multimedia information to influence students. A reasonable structure of educational process, in order to achieve the best learning effect, can provide a better role for multimedia technology in teaching and at the same time ensure that students get more abundant physical knowledge and broaden their horizons.

2.3. English Classroom Teaching. Teaching is a process of knowledge, knowledge transfer, and specific cognitive activities, which is the whole process of teachers imparting knowledge and skills to students. English classroom teaching means that with the help of classroom teaching, students systematically master the basic vocabulary and language needed by English graduate students and understand the practical application of these English knowledge and strive to cultivate students' oral expression ability and language learning ability, as well as the ability to solve problems through communication in daily life by using English communication.

2.4. Multimedia-Assisted English Classroom Teaching. With the wide application of multimedia technology, information technology characterized by multimedia and intelligence has exerted great influence on traditional curriculum concept, curriculum content, and curriculum implementation. As a teaching method, multimedia technology is integrated into English classroom teaching and becomes an integral part of the curriculum, which makes English teaching resources integrate into the classroom and integrate with each other, optimizes English classroom teaching, and enhances the influence of English language teaching.

2.5. The Role of Multimedia Technology in Assisting English Teaching. Compared with the traditional English classroom, English teaching in the application of multimedia technology is livelier and interesting, which can change the stereotype of monotonous and boring in the traditional language learning classroom. Multimedia can realize both pictures and texts, audio and video; through video and pictures, students' interest and thirst for knowledge are stimulated. Multimedia can also simulate virtual reality and create classroom teaching situations, which brings many advantages to English classroom teaching. It has a special application to English classroom teaching. Multimedia technology has excellent processing ability to sounds and images. With this unique characteristic, it can be from abstract to concrete, from static to dynamic microprocess macrosimulation, to microprocessing macroscene, as well as boring life changes. Thus, the problem that knowledge is too abstract in traditional education is solved, and the abstract knowledge content is transformed into vivid and realistic concrete forms

of virtual scenes, which are presented to students so that students can understand and relax more easily.

3. Multimedia Data Hashing Algorithm Based on Semantic Integration

3.1. Hash Algorithm for Cross-Modal Retrieval. It is assumed that the multimedia data training set $o = \{o_i\}_{i=1}^{n}$ contains n groups of multimedia data training samples. For the sake of simplicity, this paper defaults to considering two modal data of image [16] and text for each set of multimedia data, and the method proposed in this paper can be extended to multimedia data containing more modal features in theory. For each multimedia data sample $o_i = (x_i^{(1)}, x_i^{(2)}, y_i)$, $x_i^{(1)} \in R^{d_1}$ is the i-th image feature vector, $x_i^{(2)} \in R^{d_2}$ is the i-th text feature vector, d_1, d_2 is the dimension of image and text features, respectively, $y_i = \{0,1\}^c$ is the corresponding category label, and c is the total number of semantic categories. Image mode and text mode attribute matrix are $X^{(1)} = \{x_i^{(1)}\}_{i=1}^{n} \in R^{d_1 \times n}$ and $X^{(2)} = \{x_i^{(2)}\}_{i=1}^{n} \in R^{d_2 \times n}$, and the category label matrix is $Y = \{y_i\}_{i=1}^{n} \in R^{c \times n}$. The purpose of discrete latent semantic cross-modal hashing algorithm [17] is to learn two modal-specific hash functions for image modality and text modality, project heterogeneous data features into a common Hamming space, and generate hash code $B = [b_1, b_2, \cdots, b_n] \in \{-1,1\}^{r \times n}$ for skip level search. The formula representation of the two algorithms $f(X^{(1)})$: $R^{d_1} \longrightarrow \{0,1\}^r$ and $f(X^{(2)})$: $R^{d_2} \longrightarrow \{0,1\}^r$, where r is the length of the hash code [18].

3.2. Representation Learning of Subsurface Space. Assuming two matrices X_1 and X_2, the p vector can be obtained such as formula (1) is obtained by Gaussian kernel function [19]. Gauss kernel function, also known as radial basis function, is a commonly used kernel function. It can map finite dimensional data to high-dimensional space, and the Gauss kernel function is a monotonic function of the Euclidean distance of two vectors.

$$\varphi(x_i) = \left[\exp\left(\frac{\|x_i - a_1\|^2}{\varepsilon}\right), \cdots, \exp\left(\frac{\|x_i - a_p\|^2}{\varepsilon}\right)\right]. \quad (1)$$

where $\{a_i\}_{j=1}^{p}$ is P anchor points randomly selected from the training set and ε is Gaussian kernel parameter. Learn latent semantic representations of image modalities and text modalities separately using common matrix factors, it can be reduced to

$$\min_{U^1} \left\|\varphi x^1 - A^1\right\|_F^2 + \left\|\varphi\left(x^2\right) - U^{(2)}A^2\right\|_F^2. \quad (2)$$

$\varphi(X^{(1)}) \in R^{p \times n}$ and $\varphi(X^{(2)}) \in R^{p \times n}$ are Gaussian kernel projections of image and text feature matrices, respectively, $A^{(1)} \in R^{k \times n}$ and $A^{(2)} \in R^{k \times n}$ are latent semantic representations of image and text modes, respectively, $U^{(1)} \in R^{p \times k}$ and $U^{(2)} \in R^{p \times k}$ are basis matrices of image and text modes, respectively, and K is the dimension of latent semantic representation.

3.3. Discriminative Hash Learning. The DLSCMH algorithm learns two pattern-specific hash functions [20], maps the latent semantic representations of two heterogeneous patterns to a common Hamming space, and generates a binary hash code for that state. The image and text modality attributes corresponding to each multimedia data sample o_i describe the same semantic class and theoretically have the same binary hash code B. DLSCMH algorithm uses a unified binary hash code matrix b_i to construct the correlation between heterogeneous modes, which effectively reduces the semantic gap between heterogeneous modes. The hash functions of the two modes are expressed as

$$f_1\left(A^{(1)}\right): R^{d_1} \longrightarrow \{-1,1\}^r, f_1\left(A^{(2)}\right): R^{d_2} \longrightarrow \{-1,1\}^r, \quad (3)$$

$$f_1\left(A^{(1)}\right) = \operatorname{sgn}\left(W^{(1)}A^{(1)}\right), f_2\left(A^{(2)}\right) = \operatorname{sgn}\left(W^{(2)}A^{(2)}\right). \quad (4)$$

sgn $(\cdot)$ is a symbolic function that converts continuous data to binary form; $W^{(1)} \in R^{r \times k}$ and $W^{(2)} \in R^{r \times k}$ are projection matrices corresponding to two modes, respectively. Learn the unified binary hash code and the loss function of hash function as

$$\begin{aligned} &\min_{W^{(1)}, W^{(2)}, B} \left\|B - w^1\right\|_F^2 + \left\|B - w^2\right\|_F^2 \\ &\text{s.t.} \quad A \in \{-1,1\}^{r \times n} \end{aligned} \quad (5)$$

According to formula (5), the hash code learned from the intrinsic features of the data contains only very limited semantics, since the process is independent of semantic tags. The DLSCMH algorithm improves the semantic expression ability of unified binary hash code by using the rich semantics in explicit class tags. In theory, the closer hash codes are in the same class, the better and vice versa. In this case, the courses taken can simply be classified according to their class ID. Based on the above analysis, the DLSCMH algorithm [21] constructs a term that enhances the discriminant ability, as shown in formula (6). The category label y_i corresponding to each multimedia data sample is directly regressed to the corresponding binary hash code b_i; the specific mathematical form of which is

$$\begin{aligned} &\min_{b_i, Q} \sum_{i=1}^{n} \|b_i - Qy_i\|_F^2 \\ &\text{s.t.} \quad b_i \in \{-1,1\}^r \end{aligned} \quad (6)$$

where $Q \in R^{r \times c}$ is the semantic transfer matrix. The formula generates a unified binary hash for each data sample from the by the semantic transformation matrix Qy_i. The

matrix form of formula (6) is expressed as

$$\begin{aligned} &\min_{B,Q}\|B-QY\|_F^2 \\ &\text{s.t.} \quad b_i \in \{-1,1\}^{r\times n} \end{aligned} \tag{7}$$

Next, the unified binary hash code matrix B can be obtained by a simple sgn $(\cdot)$ function [22]. In addition, this strategy of direct regression of supervised category labels can well support discrete hash optimization. Combined with the above calculations, the objective function of the DLSCMH algorithm is as follows:

$$\begin{aligned} &\min_{U^{(1)},U^{(2)},A^{(1)},A^{(2)},W^{(1)},W^{(2)},Q,B} \sum_{m=1}^{2} \left\|\varphi\left(X^{(m)}\right) - U^{(m)}A^{(m)}\right\|_F^2 \\ &\text{s.t.} \quad B \in \{-1,1\}^{r\times n} \end{aligned} \tag{8}$$

where β and δ are the correlation parameters and y the regularization parameter.

3.4. Discrete Algorithm Optimization. The discrete constraints of binary arithmetic cause problems with NP-hard; the existing hash methods adopt the "relaxation + rounding" hash optimization strategy. Firstly, the discrete constraint of binary hash code is simply relaxed, then the continuous solution is solved, and finally the continuous solution is thresholding to approximate binary code [23]. Although this "relaxation + rounding" hash optimization strategy can easily solve hash codes, it will lead to large quantization errors and limit the retrieval accuracy. In contrast, DLSCMH algorithm proposes an iterative discrete hash optimization strategy to update binary hash codes directly and efficiently. Each optimization step adopts the strategy of fixing other variables and optimizing one variable. The specific solution process is as follows.

Step 1. Fix the other variables and update the latent semantic representation of the two modes to

$$\min_{A^1}\left\|\varphi\left(x^1\right) - U^1\right\|^2 + \beta\left\|B - W^1\right\|_F^2, \tag{9}$$

$$\min_{A^2}\left\|\varphi\left(x^2\right) - U^2\right\|^2 + \beta\left\|B - w^2\right\|^2. \tag{10}$$

Constraints, mathematical terms, in mathematical programming the constraints on decision schemes often appear in the form of inequalities or equations. In economic problems, the objective function often has to find the maximum value (or minimum value) under certain constraints, and they contain the variables used to represent the decision-making scheme, to impose a limited range on the decision-making scheme. If the derivative of objective function formula (8) with respect to $A(1)$ and $A(2)$ is 0, formulas (11) and (12) can be obtained

$$A^{(1)} = \left(U^1 + w^1\right)^{-1}\left(U^2 + w^2\right), \tag{11}$$

$$A^2 = \left(U^2 + w^1\right)^{-1}\left(U^1 + B\right). \tag{12}$$

Step 2. Fixing other variables, semantic transformation matrix Q, and obtaining

$$\min_{U^{(1)}}\left\|\varphi\left(X^{(1)}\right) - U^{(1)}A^{(1)}\right\|_F^2 + \gamma\left\|U^{(1)}\right\|_F^2, \tag{13}$$

$$\min_{U^{(2)}}\left\|\varphi\left(X^{(2)}\right) - U^{(2)}A^{(2)}\right\|_F^2 + \gamma\left\|U^{(2)}\right\|_F^2, \tag{14}$$

$$\min_{Q}\delta\|B - QY\|_F^2 + \gamma\|Q\|_F^2. \tag{15}$$

The solution results are

$$U^{(1)} = \varphi\left(X^{(1)}\right)A^{(1)T}\left(A^{(1)}A^{(1)T} + \gamma I\right)^{-1}, \tag{16}$$

$$U^2 = \varphi x^2\left(A^T + \gamma B\right), \tag{17}$$

$$Q = \delta B Y^T\left(\delta Y Y^T + \gamma I\right)^{-1}. \tag{18}$$

Step 3. Fix other variables, update $W^{(1)}$ and $W^{(2)}$, and get

$$\min_{W^{(1)}}\beta\left\|B - W^{(1)}A^{(1)}\right\|_F^2 + \gamma\left\|W^{(1)}\right\|_F^2, \tag{19}$$

$$\min_{W^{(2)}}\beta\left\|B - W^{(2)}A^{(2)}\right\|_F^2 + \gamma\left\|W^{(2)}\right\|_F^2, \tag{20}$$

where I is the identity matrix.

Step 4. Fix other variables and update unity binary, which is expressed as

$$\begin{aligned} &\min_{B}\beta\left(\left\|B - W^{(1)}A^{(1)}\right\|_F^2 + \left\|B - W^{(2)}A^{(2)}\right\|_F^2\right) + \delta\|B - QY\|_F^2 \\ &\text{s.t.} \quad B \in \{-1,1\}^{r\times n} \end{aligned} \tag{21}$$

It can be rewritten as

$$\begin{aligned} &\min_{B}\beta Tr\left(B^T - A^{(1)T}W^{(1)T}\right)\left(B - w^1\right) + \beta Tr\left(B^T - w^2\right) \\ &\quad + \delta Tr\left(B^T - Y^T Q^T\right)(B - QY) \\ &\text{s.t.} \quad B \in \{-1,1\}^{r\times n} \end{aligned} \tag{22}$$

Since is a constant, the above formula can be converted into

$$\min_{B} - Tr\left(A^1 + \beta^2\right) \in \{-1,1\}^{r\times n}. \tag{23}$$

Finally, the unified binary hash code can be solved as follows, such as

$$B = \operatorname{sgn}\left(w^1 + \beta^2 + YQ\right). \tag{24}$$

By equation (26), all bits of the binary hash code can be

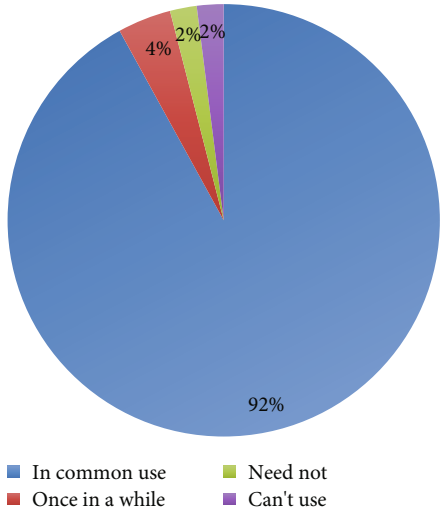

Figure 1: Teachers' use of multimedia courseware.

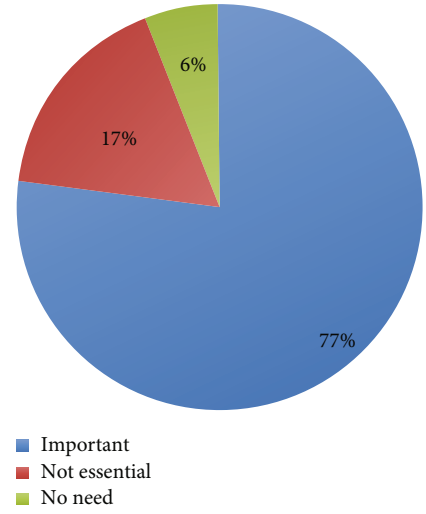

Figure 2: Teachers' understanding of the importance of multimedia courseware.

learned at one time from the solution. Binary code is obtained by sgn $(\cdot)$ function. The iterative discrete hash optimization strategy proposed by the DLSCMH algorithm avoids quantization error and significantly accelerates the whole training process.

3.5. Hash Function Learning and Extended Sample Coding. Once the latent semantic representation $A^{(m)}$ and projection matrix $W^{(m)}$ of the image and text patterns are obtained, the hash function is defined as $f^{(m)}(A^{(m)}) = \mathrm{sgm}(W^{(m)}A^{(m)})$. Using the new query example, hash codes can be generated using prebuilt hash functions. In a modal condenser search scenario, query examples typically contain only one modality that retrieves the database from another modality. To generate binary hash codes for query samples, a latent semantic representation of the query samples must be obtained, and a modality-specific hash function generates binary hash codes. In query example $\tilde{x}^{(1)}$ or $\tilde{x}^{(2)}$, the latent semantic representation is captured in the form of matrix factors, as in

$$\min_{\tilde{a}m} \left\| \tilde{x}_m - U^{(m)}\tilde{a}m \right\|_F^2, \quad m = 1, 2. \tag{25}$$

Among them, $U^{(m)}$ is from offline training. The hash code $\tilde{b}$ associated with the latent spatial semantic representation can be obtained by the hash function $\tilde{b} = \mathrm{sgn}\left(W^{(1)}\tilde{a}^{(1)}\right)$ or $\tilde{b} = \mathrm{sgn}\left(W^{(2)}\tilde{a}^{(2)}\right)$ of the corresponding modal.

3.6. Convergence Analysis and Complexity Analysis of Algorithm. At each stage of iterative optimization, a strategy is built to link other variables together and optimize one variable to ensure that the objective function is convex with respect to the variable. Therefore, each step of optimizing the DLSCMH algorithm results in a smaller or constant value of the objective function (8); i.e., each update of the binary code monotonically decreases the value of the objective function. In theory, after many iterations, the algorithm reaches a stable value, which can be considered as effective convergence. The complexity of the DLSCMH algorithm is related to nonlinear embedding [24] and iterative discrete optimization. The time complexity of nonlinear immersion is $O(nkd_m)$, where n is the number of training samples and k is the number of anchors. Discrete hash optimization is achieved through iteration, and the computational complexity of this process is $O(\mathrm{iter}(d_1 n + d_2 n + d_1 r + d_2 r + rn))$, where iter is the number of iterations and r is the length of the hash code. Assuming $n \gg d_m > r$, the iterative discrete hash optimization process is linearly related to the number of learning samples n. Learning latent semantic representations is a linear process with time complexity $O(n)$. The calculation of the hash function solves a linear problem with time complexity. This indicates DL. During out-of-sample coding, the generation of spreading codes for new query samples can be done in the F-complexity domain.

3.7. Discussion on Multiple Modal Conditions. In theory, the DLSCMH algorithm extended from two modes to more modes. The general function is shown in

$$\begin{aligned} &\min_{U^{(m)},A^{(m)},W^{(m)},Q} \sum_m \left\| \varphi\left(X^{(m)}\right) - U^{(m)}A^{(m)} \right\|_F^2 \\ &\text{s.t.} \quad B \in \{-1, 1\}^{r\times n} \end{aligned} \tag{26}$$

As with these two patterns, it is necessary to learn the latent semantic representation of each pattern and reflect it into a common Hamming space using a state-specific hash function [25]. Diverse hash searches are possible by learning binary hash codes and hash functions using separate hash optimization methods similar to the previous one. The optimal solution for each variable is expressed as follows. The optimal solution of $U^{(m)}$ is

$$U^{(m)} = \varphi\left(X^{(m)}\right) A^{(m)T} \left(A^{(m)}A^{(m)T} + \gamma I\right)^{-1}. \tag{27}$$

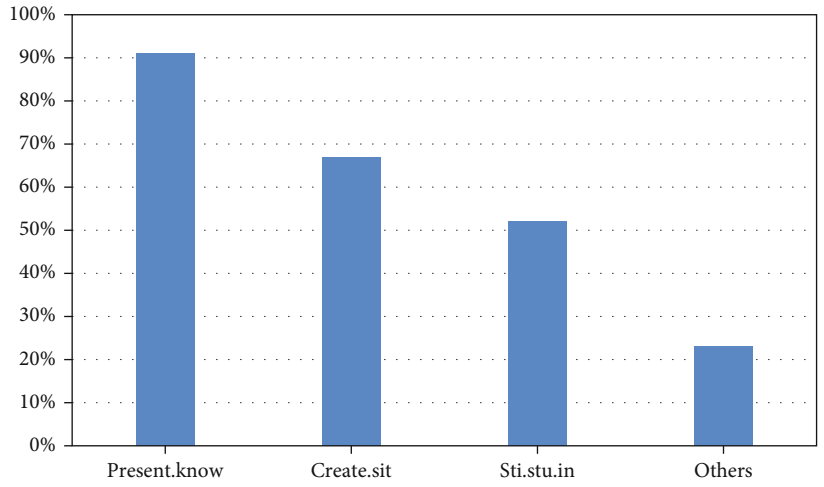

Figure 3: The purpose of applying multimedia courseware in classroom teaching.

The optimal solution of Q is

$$Q = \delta B Y^T \left(\delta Y Y^T + \gamma I\right)^{-1}. \tag{28}$$

The optimal solution of $W^{(m)}$ is

$$W^{(m)} = \beta B A^{(m)T} \left(\beta A^{(m)T} A^{(m)T} + \gamma I\right)^{-1}. \tag{29}$$

The optimal solution of B is

$$B = \operatorname{sgn}\left(\beta \sum_m W^{(m)} A^{(m)} + \delta Y Q\right). \tag{30}$$

4. Experimental Results and Analysis

4.1. Experimental Data Collection. Multimodal English classroom teaching enables teachers to make use of multimedia curriculum materials and other resources to better create a real learning situation, provide students with various sensory stimuli such as sight, hearing, and touch, and truly act as students. In this study, 48 senior high school English teachers were selected from the first and second grades of senior high school, and they were investigated. Eight local teachers were selected for interviews, which were observed six times in 12 grades from grade one to grade three in two months. The observational research mainly focuses on two aspects: on the one hand, teachers' use of multimedia materials in teaching, on the other hand, the influence of students' classroom learning.

4.2. Present Situation and Management of Teachers' Multimedia Course Application. In the computerization of English teaching, the design, development, and teaching application of multimedia teaching materials are important ways and forms of computer training. In English classroom teaching, most teachers have taken the application of multimedia teaching materials as a traditional teaching method.

Table 1: Specific application of multimedia courseware in English classroom teaching.

App link	Frequency	Proportion
Introduce new	Conformity	50%
Sen practice	Conformity	75%
Situ conver	General conformity	50%
Assign tasks	Conformity	75%
Others	General conformity	45.80%

Table 2: Multimedia courseware making and auxiliary tools commonly used in English subjects.

Making tool	Frequency	Proportion
PPT	Conformity	91.70%
Flash	Nonconformity	79.20%
PS	Nonconformity	58.40%
Focusky	Nonconformity	94.60%

The specific survey data of this study (or multimedia course materials applied to English classroom teaching) are shown in Figure 1.

The results in Figure 1 show that most (92%) English teachers consider and apply multimedia education courses when designing and implementing education. Many teachers say that multimedia courses are often used for teaching their own courses, and their vocational training is inseparable from supporting multimedia courses.

The survey results also confirm that English teachers have understood the importance of multimedia courses. The survey asked: "I think multimedia courses play an inestimable role in today's English grammar education," as shown in Figure 2.

As shown in the figure, 77% of English teachers recognize the important role of multimedia textbooks in English teaching, but different teachers often have different views

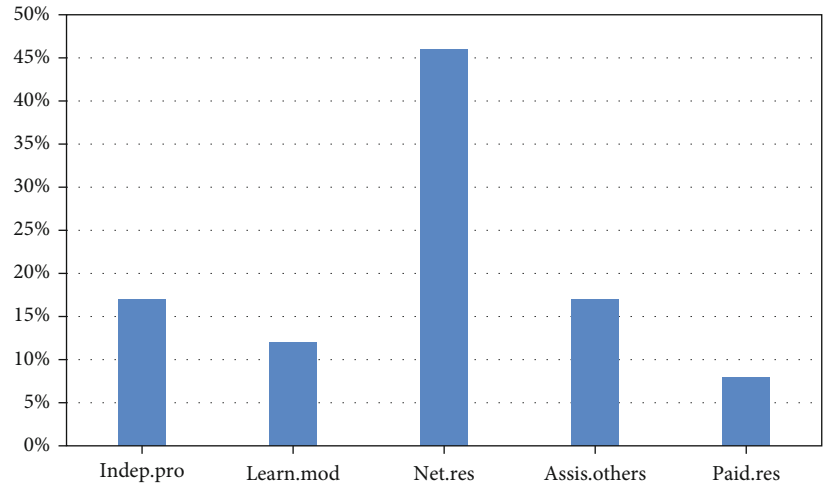

Figure 4: Source of multimedia courseware.

on the role of multimedia textbooks in classroom teaching. From this point of view, this paper studies the role of English teachers' multimedia curriculum programs in terms of questions (the purpose of applying teachers' multimedia curriculum programs). The specific data results are shown in Figure 3.

The results in Figure 3 show that more than 90% of teachers use multimedia curriculum programs to present information, 66.7% use multimedia curriculum programs to create classroom teaching situations, and 52.1% use multimedia education courses in classroom teaching. Classroom is mainly to attract students. In the study, we also examine the application of multimedia courses in teachers' English classroom teaching, as shown in Table 1.

As shown in Table 1, the most widely used multimedia course materials in English teaching are sentence exercises and situational discussions. Among them, sentence practice is an important starting point for using multimedia course materials in English subjects. It is precisely because language learning requires a lot of "listening and reading," so it is necessary to use the voice and video information in multimedia textbooks as tools and support to complete the classroom.

4.3. Multimedia Application Data Analysis. This study also examined the multimedia curriculum production tools commonly used by educators, which are described in more detail in Table 2.

The actual survey results show that rural English teachers manage the best and use the most widely PPT; among the respondents; the auxiliary tools in teaching material production, such as image editing software, video editing software, and audio editing software, are relatively few in application. As for the range of other "new" tools that can be used to make multimedia courses, the tools chosen by English teachers in rural middle schools are relatively simple, and PPT is less selected except for the rest of the multimedia production platform courses. Practical management is not particularly ideal when it comes to managing production tools, and most teachers do not have enough control over software—many people do not know how to apply it. This study also examines the sources of multimedia curriculum programs used by teachers in the classroom, and the exact results of the study are shown in Figure 4.

Table 3: Common problems in the making and application of multimedia courseware commonly used in English subjects.

Problem	Options	Proportion
Poor tech	Conformity	65.40%
Nowhere to learn	Conformity	95.80%
Lack of materials	Conformity	93.80%
No processing	General conformity	95.80%
Unable to express	Nonconformity	68.80%
Unable to merge	Conformity	83.30%
Poor effect	General conformity	75%

The results in Figure 4 show that only 17% of teachers' course materials can be completed independently. This also shows that some English teachers have some problems in multimedia production and design. At the same time, the teacher survey also focuses on the specific difficulties and problems in the production and application of multimedia curriculum programs for English teachers: "What difficulties have English teachers encountered in the production and practical application of multimedia curriculum programs," as shown in Table 3.

The ratios in Table 3 represent the frequency share of common problems in the production and application of commonly used multimedia courses in English subjects among teachers; and each share is measured with a separate population as a sample, so the proportions are different from each other related. It can be seen from Table 3 that the main problems in the production of multimedia training programs are "poor production technology," "inability to learn from others," "lack of materials," "no processing," and so on. This is the biggest problem of multimedia courses produced by English teachers. In other words, apart from the

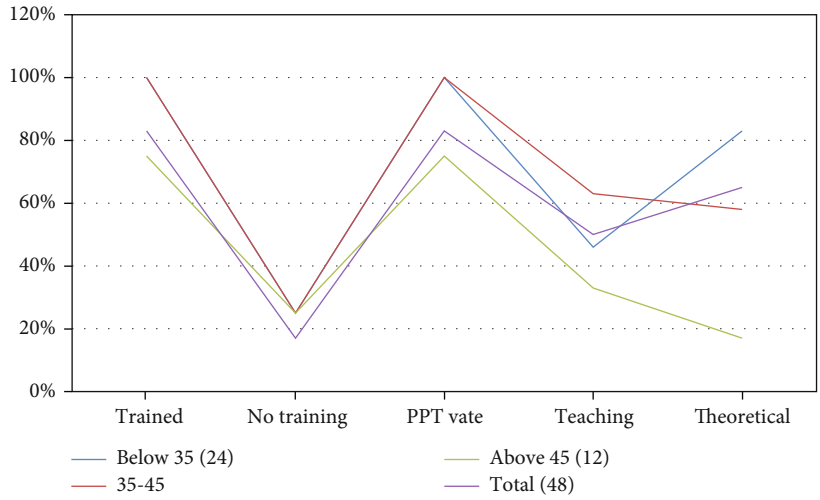

Figure 5: Training of English teachers in making and applying multimedia courseware.

Table 4: Teaching awards of teachers' multimedia courseware and related evaluation courses.

Species	Have	None
Multimedia	91.70%	8.30%
Integrating lesson examples	22.90%	6.30%
Original	14.60%	10.40%
Others	39.60%	60.40%

lack of technical control over the textbook production software (PPT), the related technology and the ability to process multimedia materials are also the fundamental bottlenecks that restrict teachers' ability to produce multimedia courses. In recent years, systematic training has become an effective means to improve teachers' information application level, and the training for all teachers, including English teachers, in the production and application of multimedia teaching materials has also increased. In fact, the exact results of the impact study of this training are shown in Figure 5.

Figure 5 shows that most of the teachers interviewed have received training in making and applying multimedia courses. Among these teachers, basic application (83%) receives the most, but other software training, such as image processing and video editing, only accounts for 50%, and this training is still mainly for young teachers. The vertical axis in Figure 5 represents the percentage of training in the production and application of multimedia course materials in the total population of each age group. A longitudinal comparison shows that the proportion of young teachers who have been trained is higher and that the content of the training is more extensive.

4.4. Application Effect of Multimedia Courseware. As a matter of fact, students have the most say in the effect of the application of English multimedia curriculum software, and students' feelings about the effect of teachers' use of multimedia curriculum programs in teaching are relatively objective. In fact, one of the most important issues in teaching and learning supported by multimedia courses is the frequency of use, and its production level is constantly improving. The educational impact of multimedia curriculum projects is often reflected in the form of rewards, IT integrated courses, and open courses. In this experiment, we also studied these situations, and the exact results of the study are shown in Table 4 and Figure 6.

As can be seen from the table, 91.7% of teachers have won similar awards in multimedia teaching materials; 22.9% of teachers won similar awards in the information technology integration course through multimedia teaching materials; 14.6% of teachers received similar awards from original sources.

Figure 6 shows that 70.8% of teachers have won district and provincial teaching materials for comparable computerized achievements, 22.9% of teachers have won district and provincial teaching awards for integrating teaching examples, and 33.3% of teachers have won district and provincial teaching materials. Among the original resources for teachers to receive provincial and municipal awards, 68.8% of teachers received district and provincial awards, 22.9% received provincial and municipal awards, and 2.1% received national awards. Although some achievements have been made in the application of multimedia curriculum, there is still much room for improvement. This study collected the opinions and suggestions of educators on improving multimedia curriculum, and the exact results are shown in Figure 7.

Figure 7 shows that most teachers believe that the application of multimedia courseware in current English vocational education to further improve the learning effect still needs a certain amount of latitude. As for teachers, 38% of teachers believe that multimedia course materials can further integrate the teaching content of English subjects, which corresponds to the educational needs of course material production and application. Among them, teachers hope to have richer media expression (23%) and artistic beauty of

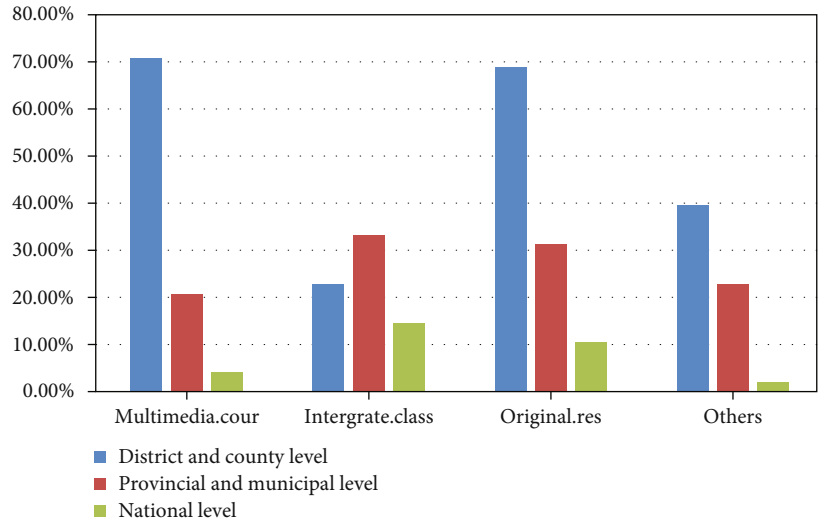

Figure 6: Award-winning level of teachers' informatization.

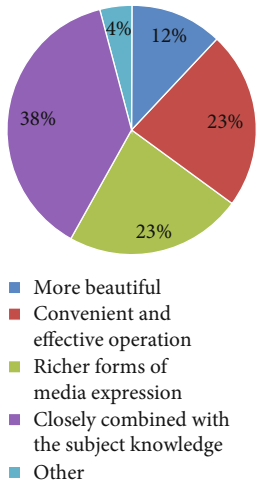

Figure 7: What can be improved in the application of multimedia courseware.

curriculum materials (12%), which is a hope and need for the improvement of technology and art. Of course, more teachers are in favor of it. Curriculum program can be more convenient and agile. After all, the simplicity and efficiency of teaching application and design are the factors that directly affect the application effect of curriculum program.

5. Concluding Remarks

With the passage of time, multimedia technology has been used in English teaching to a certain extent. The application situation is generally good, and multimedia equipment can basically meet the educational needs, but there are still some problems in teachers' English ability, mastery of multimedia and information technology, and effectiveness of multimedia courses. Multimedia software is a classroom teaching aid based on textbooks and higher than textbooks. It can not only help teachers explain but also make it easier for students to learn, embrace, and relearn. At the same time, it also expands the teaching content, making the teaching content deeper, wider, more comprehensive, and more systematic. Teachers' lectures are boring. Multimedia can combine multimedia information such as words, images, audio, and video into one, stimulate students' senses in multiple directions, overcome the abstract and boring shortcomings of traditional education, and make the educational content more vivid and intuitive. First, the content of the survey and interview is not comprehensive enough, and the persuasiveness of the study is still somewhat insufficient and may not fully reflect the difficulties that exist in the application of multimedia course materials to English subjects. The use of multimedia in any education is inevitably influenced by other factors, which are not considered in this study. The number of classes observed by the observation method is too small, and the representativeness of the observed classes is not strong.

Data Availability

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

Conflicts of Interest

The authors declared that they have no conflicts of interest regarding this work.

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Retraction

Retracted: Design of University Educational Administration Management System Based on Sensor Data and Multidimensional Information Fusion

Wireless Communications and Mobile Computing

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.

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[1] K. Qin, "Design of University Educational Administration Management System Based on Sensor Data and Multidimensional Information Fusion," *Wireless Communications and Mobile Computing*, vol. 2022, Article ID 6708033, 10 pages, 2022.

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Research Article

Design of University Educational Administration Management System Based on Sensor Data and Multidimensional Information Fusion

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Academic Editor: Yongjun Xu

With the rapid development of education informatization, especially the promotion and reengineering of education business processes by big data and artificial intelligence, how to participate in this major change is the main issue that needs to be considered. Therefore, under the guidance of multisource sensor data fusion technology, this paper adopts the traditional cloud computing operation method, that is, centralized data center processing, which is difficult to adapt to the rapidly expanding data scale. We also propose a new perceptual adaptive data processing method. By designing an edge node adaptive data type sensing mechanism based on counting bloom filter, we can automatically identify the ubiquitous University Internet of things data categories and corresponding fields. The simulation results show that this method improves the recognition accuracy of different data categories in university management by more than 1.3%, which can help teachers use educational technology to do well in the teaching work before, during and after class, and promote the practical application of new teaching modes such as inquiry teaching.

1. Introduction

Education management in colleges and universities is the key to the construction of educational technology facilities, application promotion, business training, and technical support in schools [1]. As educational information technology has entered a new era, the work undertaken is bound to change, so how we can do a good job in the innovative practice of educational technology in colleges and universities is a natural question for those in charge of our educational technology institutions to consider [2].

In the past 40 years, China's education has undergone fundamental changes. Digital campuses have been built to varying degrees at all levels and in all types of schools across the country; the coverage of multimedia classrooms in developed regions has basically reached 100% [3]; teaching resource platforms have been gradually applied as teaching aids in daily teaching; the state has concentrated on building a large number of high-quality courses, high-quality course resources and online courses, discussion-based, flipped classrooms, and blended learning are emerging in campus classrooms, and information technology and educational practices are continuously integrating [4]. It can be seen that education will become more dependent on computers and other technologies.

Information technology is an advanced tool that mainly emphasises the deep integration of information technology with the curriculum and teaching practice. Information technology enhances the teaching environment and facilities on campus, improves the form of teaching and learning, and is a means to improve teaching efficiency and quality [5]; information technology will change the mode of talent training, education service mode, and social governance mode and will build a new education ecology, which is an essential part of the education system [6]. It is an essential component of the education system [7].

In the information age, massive amounts of data is generated every day, which provides us with the possibility of finding certain real situations or analyse changing trends. If the massive amount of data collected is classified and

analysed in a certain dimension, we will find the valuable information we want [8].

The comprehensive use of big data in education is an important feature of the era of education informatization 2.0 and will become one of the grasping hands to promote equity, improve the quality of education, and accelerate education reform in China [9]. Big data can reflect the real situation of education and teaching from different dimensions [10]. Analysing macro data can check the status of implementation of national education policies so that precise policies can be implemented; analysing individual data can paint a portrait of students so that teaching can be tailored to their needs; analysing changes in data can reveal new trends in education and teaching; analysing data on the learning situation of a large number of students, correlating influencing factors, and applying guidance strategies can explore new laws of education and teaching [11].

Compared to traditional classrooms, smart classrooms have distinctive features. The new smart classroom should have no podium area, so that teachers can easily move around and mingle with students; the desks and chairs in the smart classroom should be movable, and the combination is flexible and variable, so that teachers can facilitate group discussions [12]; the blackboard (whiteboard) in the classroom has a memory function and can upload the teacher's notes to the server in the form of vector graphics, so there is no need for students to take notes in class, and students only need to pay attention to the lesson or interact with the teacher; there should be a main display (main projection) and several auxiliary display screens for students to use in group discussions. The classroom should have a main display (main projection) and a number of auxiliary screens for students to use in group discussions, and the switching of signals on the screens must be convenient for teachers and students [12]. The smart classroom provides practical and convenient functions for teachers and students. There are wireless screen casting functions to facilitate teachers' and students' laptops and mobile phones to easily cast their files onto the large screen; Wi Fi coverage in the classroom; electronic class signs installed at the classroom entrance to display the classroom's scheduling situation, which can also be used as an attendance facility for students to sign in, and if face recognition technology is used in the classroom to achieve perception-free attendance, it is more convenient for teachers and students [13–15]. This design is adapted to the characteristics of teaching.

2. Edge Nodes in Intelligent University Management

2.1. Adaptive Data Classification Mechanism. The bloom filter is an information retrieval method specifically designed for information retrieval [16]. The bloom filter criterion is in IoT, let the bloom filter be b, which consists of a string of n feature bits and k hash functions. The bloom filtering operation consists of two processes, as shown in Figure 1.

2.1.1. Placement Process. Initially, the bit string is set to 0. For a known data set, the hash number {0, 1} is used for marking, where the IoT data set is recorded as S_I and marked with 1; the non-IoT data set is recorded as S_{NI} and marked with 0. For an unknown data set $S = \{x_1, x_2, \cdots, x_n\}$, for each element $(1 \le i \le m)$, k hash functions are computed to obtain k values in the range $x_i\{1, 2, \cdots, n\}$, which are mapped to k positions in the feature bit string. If the bit is 0, it is set to 1, if the bit has already been set to 1 by a previous element, it remains unchanged [17]:

$$f = \left(1 - \left(1 - \frac{1}{F_{\text{data}}}\right)^{k(S_I - S_{NI})}\right)^k \approx \left(1 - e^{-k(S_I - S_{NII})/(S_I - S_{NI})}\right)^k. \tag{1}$$

The bloom filter has the smallest probability of forward false detection when and only when $k = F_{\text{data}}/S_T - S_N \ln 2$ is $f = 0.5^k$.

Therefore, the probability that the counter plus 1 operation is performed j times for the i-th element is

$$P(c(i) = j) = \binom{(S_I - S_{NI})k}{j} \left(\frac{1}{F_{\text{data}}}\right)^j \left(1 - \frac{1}{F_{\text{data}}}\right)^{(S_I - S_{NI})k - j}, \tag{2}$$

where $c(i)$ is the counter value corresponding to element x_i; $\binom{(S_I - S_{NI})k}{j}$ denotes the combined number solution.

2.2. Data Processing Methods. As shown in Figure 2, a data file File consists of the file type (IoT/non-IoT), the file length, and the associated flag bits. Since files are not contiguously stored on physical hardware on physical hardware, the end-of-file EOF is used to flag data calls from top-level advanced applications for both IoT data and non-IoT data. Generally speaking, there are the following 3 steps.

In this study, the functionality and practicality of the blockchain application technology for agricultural products trading process will be initially extended and improved by adopting the multichain blockchain technology in conjunction with the P2P agricultural product trading method. The multichain blockchain trading platform for agricultural products has three main functional applications: credential registration and management, financial transactions, and supply chain management. The main applications of credential registration and management include providing information such as user DCs, equity credentials, and proof of qualification (authority). The main applications of financial transactions include the use and transaction of transaction funds, payment, clearing, and settlement of financial assets. The main applications of supply chain management include logistics management, product traceability and anticounterfeiting, and procurement and inventory management. In the blockchain network, different channels are automatically assigned to different transaction systems, and the transaction information and user information in the channel are only visible to the nodes participating in the transaction. Each channel runs an independent smart contract script, and the

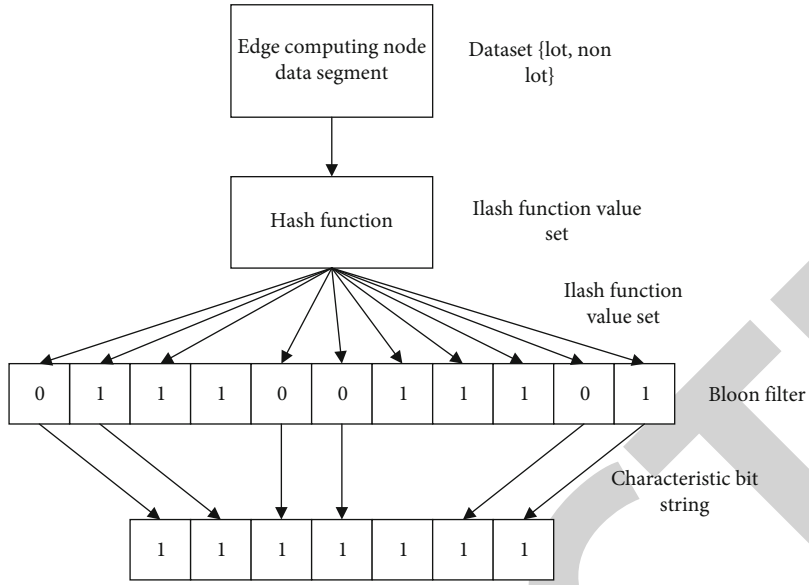


Figure 1: Adaptive classification mechanism for edge node data.

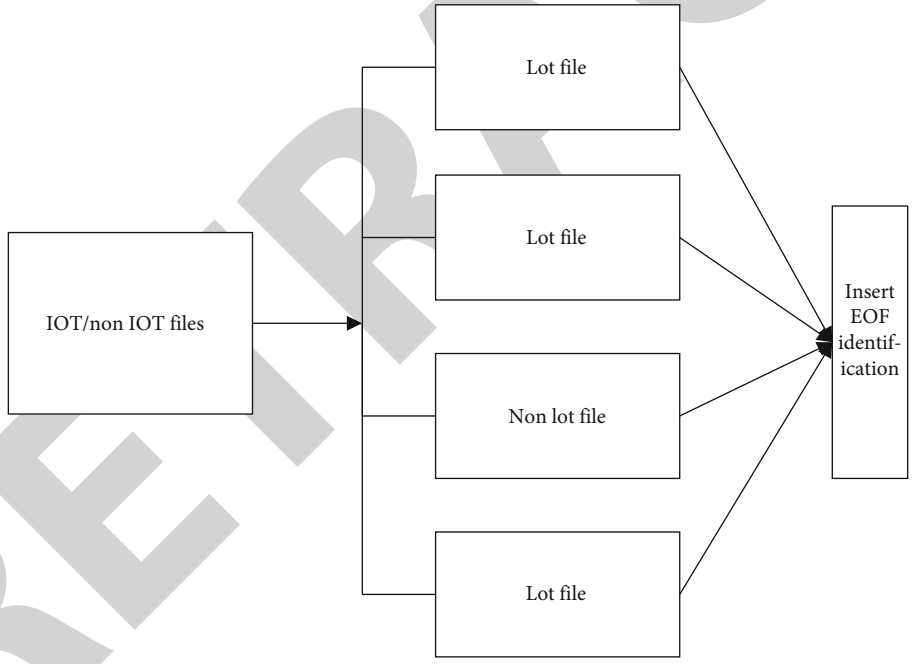


Figure 2: Data file structure.

consensus of the transaction is established by all user nodes participating in the transaction.

Each channel runs an independent smart contract script, and all user nodes participating in the transaction establish the consensus information of the transaction, with higher consensus efficiency, while providing privacy protection of transaction-related information, as shown in Figure 3.

Based on the idea of genetic algorithm, a large number of purely numerical function optimization experiments have been conducted on computer. Based on a series of research work, the basic framework of genetic algorithm was summarized by Goldberg in the 1980s. Change the gene value on one or some motifs to other alleles with a certain probability (called mutation rate).

The basic flowchart is shown in Figure 4.

3. Algorithm Validation and Analysis

To verify the effectiveness and feasibility of the proposed edge node adaptive-aware data processing method, this chapter evaluates the data classification performance, end-

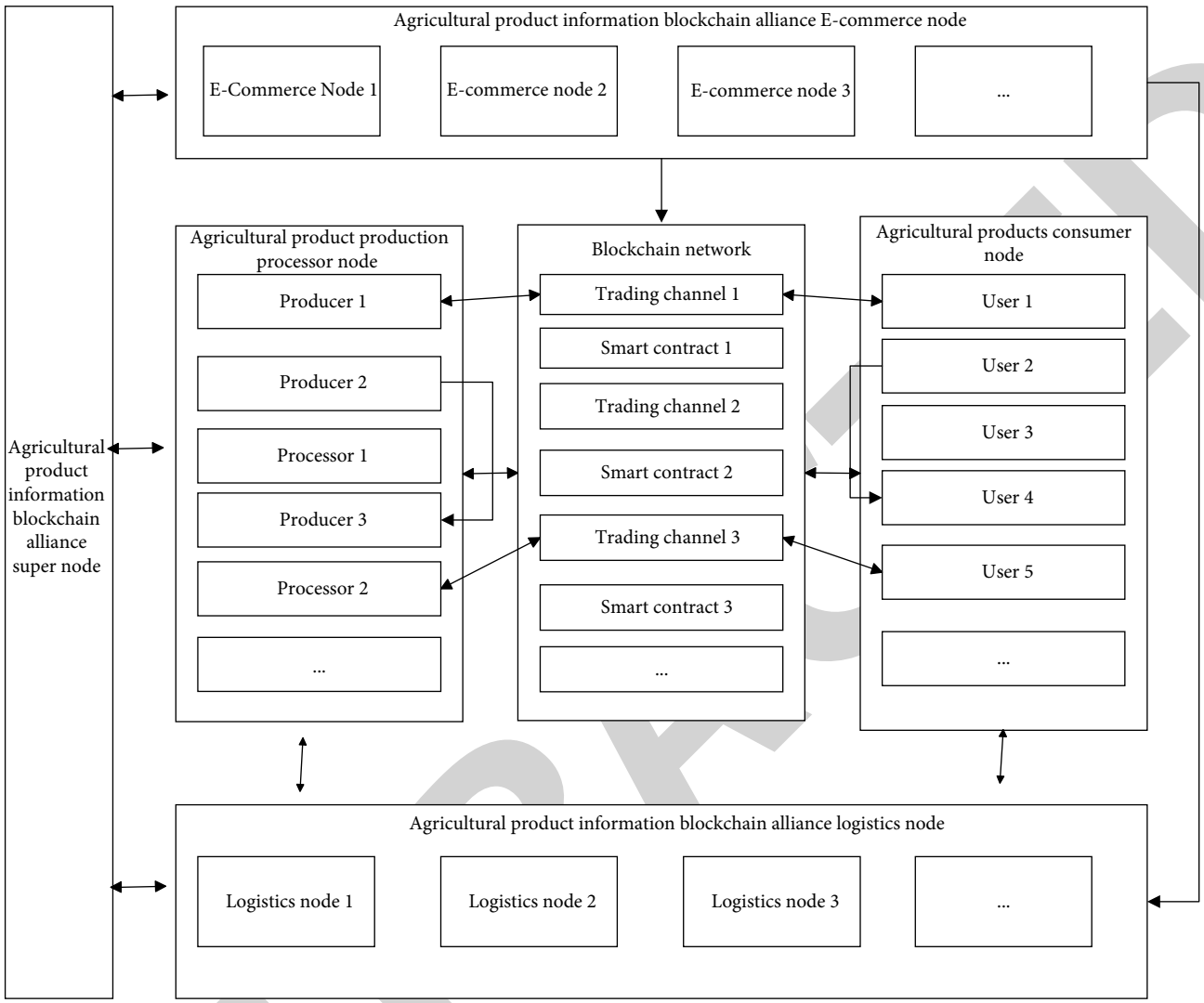


Figure 3: Transaction process of agricultural products with multiblockchain.

of-file EOF tagging, and copy management performance in three aspects.

3.1. Experimental Platform and Test Dataset. Simulate each computing node in edge computing, as shown in Table 1.

The test dataset uses operational data from a distribution network in a city in Jiangsu province, with a total of 495 nodes containing measurements on 1,000 lines, with 400 MB of IoT and non-IoT data.

3.2. Results and Analysis

3.2.1. Data Classification Performance. To verify the classification performance of the proposed counting bloom filter on IoT data, the conventional bloom filter in the literature [18] and the proposed extended bloom filter in the literature [19] are used for comparison.

Figures 5 and 6 show the classification results of the conventional bloom filter and the proposed counting bloom filter for the same dataset and the corresponding false detection rates, respectively [20].

3.2.2. End-of-File EOF Plug-In Marker. For both sorted IoT and non-IoT data, the EOF [21] plug-in first opens it in protected mode (e.g., by calling the mask function in Hadoop) and calls the read_seg function to analyse the length of the file and the associated identification bits. Further, the EOF plug-in ensures that the sorted IoT and non-IoT data has full parity bits by calling the ASM_File function. Finally, an additional marker bit is added to the file data to ensure that the data is not tampered with during transfer sharing before the file is copied for management [22].

The further processing of the file after classification using EOF is shown in Figure 7, with the final file being divided into 3,000 segments. The amount of IoT data, non-IoT data, and other file data after classification using counting bloom filtering in Section 3.2.1 were 320, 70, and 10 MB, respectively, where the other file data contained some error data such as missing data and miscoded data. For those

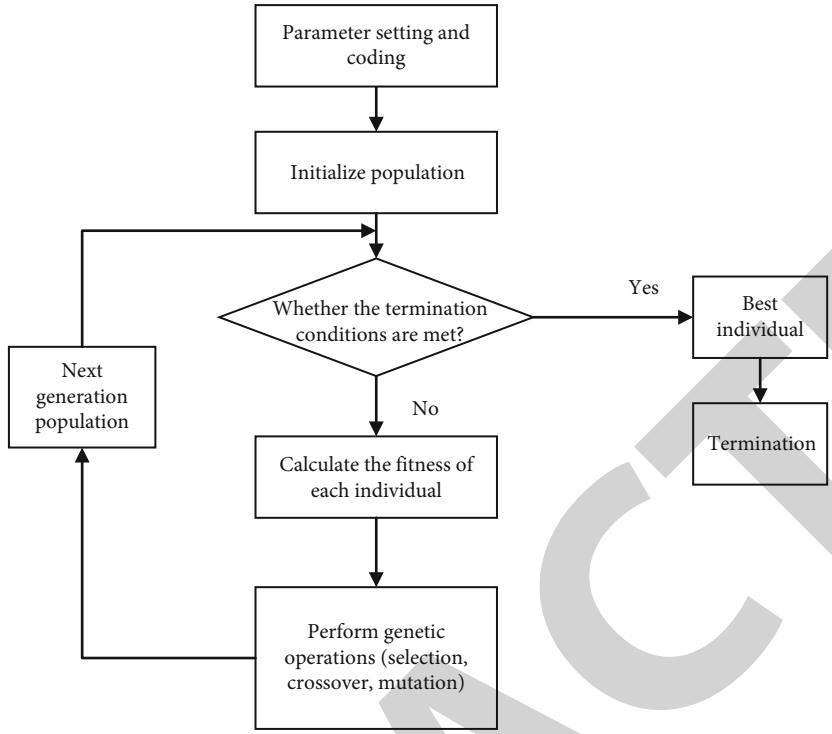


Figure 4: Basic flowchart of genetic algorithm.

Table 1: Hadoop-based virtual machine configuration.

Node	CPU kernel configuration	Memory/GB	Hard disk	To configure
Master node	6	32	HDD/SSD	InterXeon
Slave node 1	2	3	HDD/SSD	InterXeon
Slave node 2	2	3	HDD/SSD	Inter Core i5
Slave node 3	2	3	HDD/SSD	Inter Core i5
Slave node 4	2	3	HDD/SSD	Inter Core i5

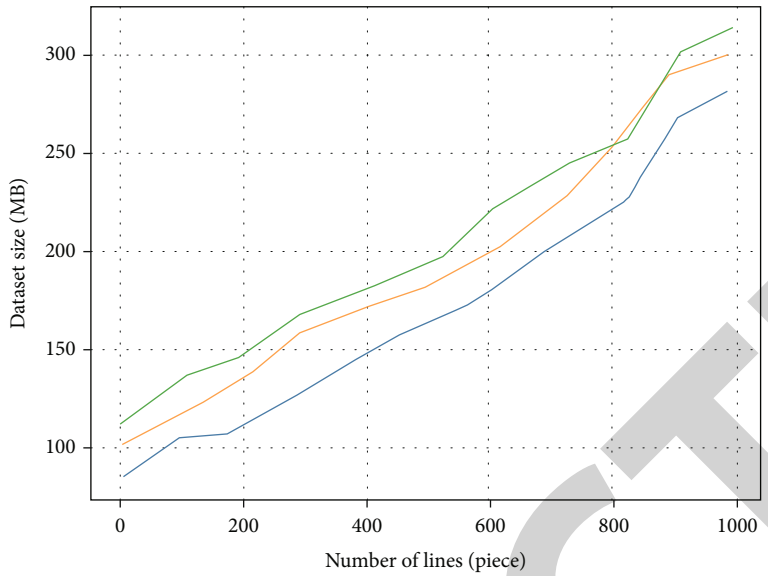
erroneous data, Hadoop puts them into a dedicated stack for indexing and discards them when new data files arrive.

3.2.3. Data Copy Management Performance. To compare and validate the performance of the proposed data copy management method, the centralized copy management method proposed in the literature [23] was used for comparison. Figure 8 shows the response times of the two methods for 3000 data fragment [24].

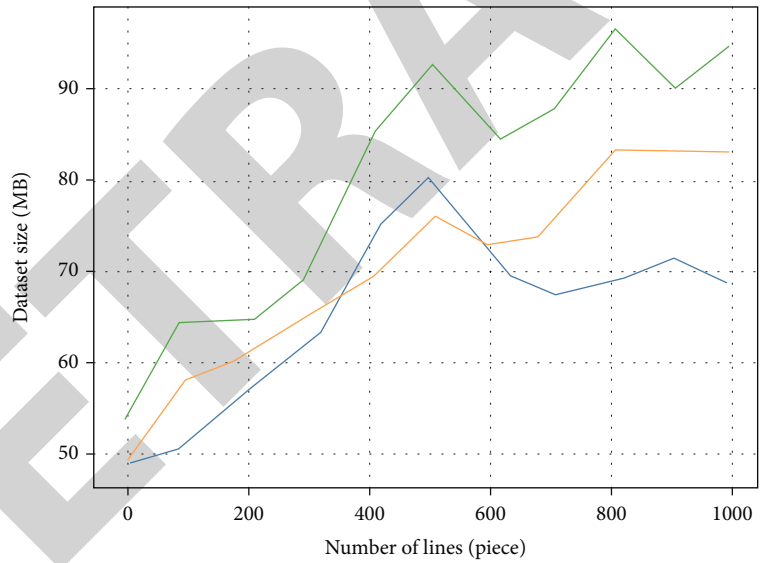
4. Discussion

All school work should be people-oriented, educational technology work is no exception, and it is necessary to adhere to the concept of student development as the center. In education, the teacher is the leader and the student is the main subject, and "all for the development of each student" is the core concept of education for students. In the Information Technology 2.0 era of education, students can use information technology to help improve their learning efficiency, students can use information technology to live more conveniently, and schools can use information technology to manage more finely.

Information technology facilities should be "applied as king." In the past 10 years, such information systems and facility utilization rate are not high, and esome schools or areas of information technology construction goals and positioning are somewhat vague, built for the sake of having, built for show, and built after the application of how to do not do in-depth planning and deployment, eventually becoming ornamental. In the past 10 years, the utilization rate of such information systems and facilities is not high, the information technology construction goals and positioning of some schools or regions are somewhat vague, and how to do in-depth planning and deployment after the application has become ornamental. To change the status quo, we must be

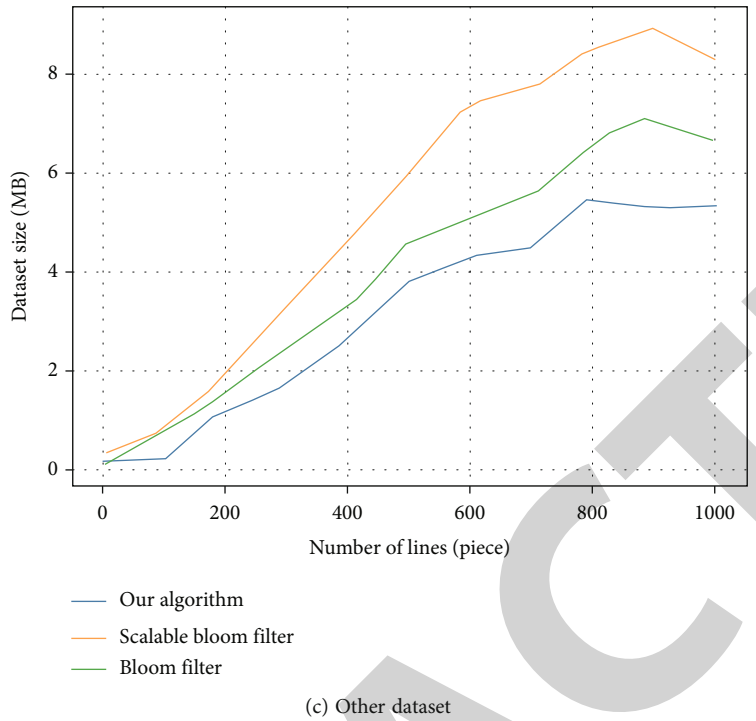


(a) IoT data



(b) Non-IoT dataset

Figure 5: Continued.



(c) Other dataset

Figure 5: Classification results of the conventional bloom filter and the proposed counting bloom filter for the same data set.

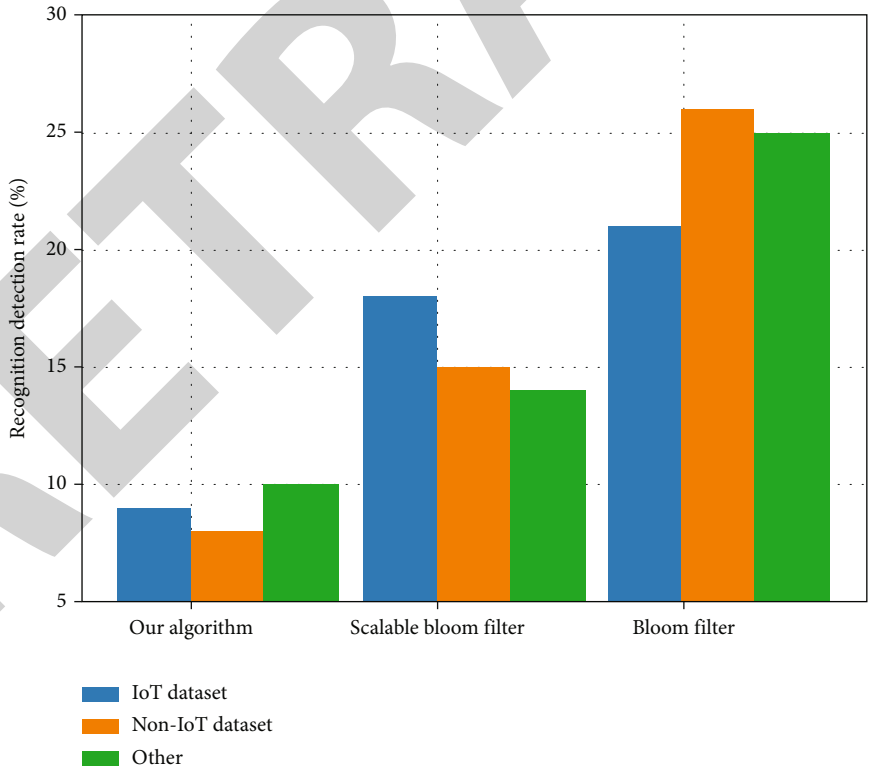


Figure 6: False detection rate of data classification.

solution-oriented and application-driven; when building the software platform, we must fully consider the experience of teachers and students and conform to their habits and styles, so as to achieve the goal of "letting data run more and teachers and students run less;" after completion, the information technology department should strengthen training for teachers

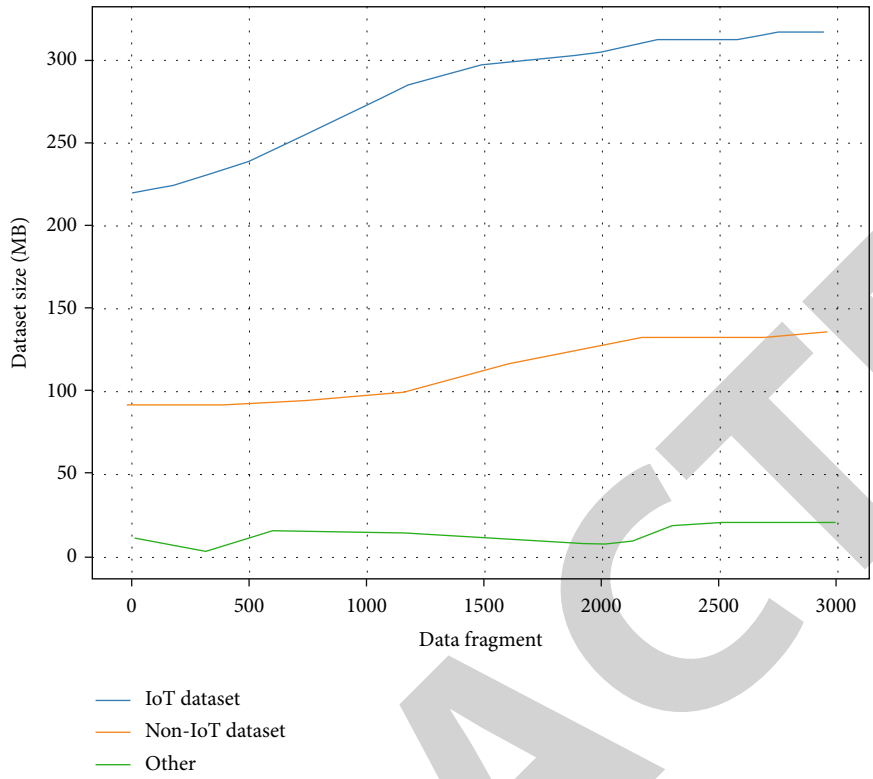


Figure 7: EOF plug-in processing results.

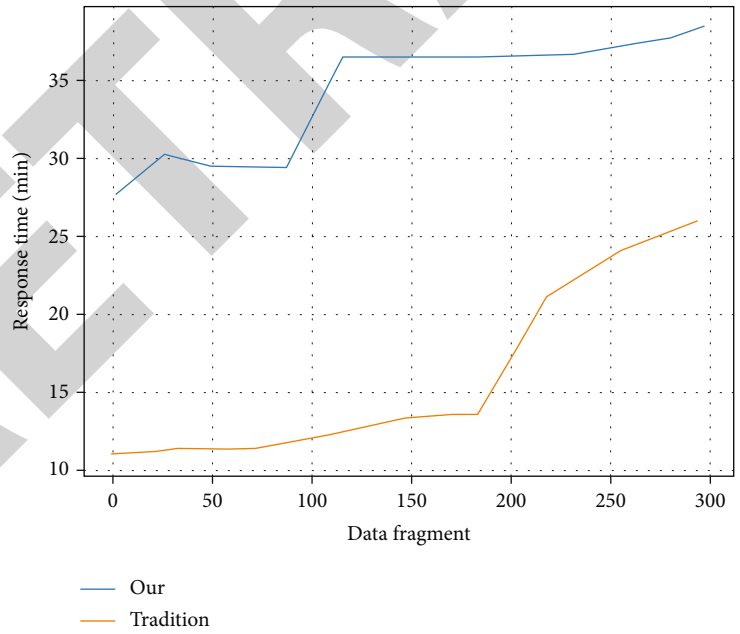


Figure 8: Copy operation response time.

and students, and schools should formulate. After the project is completed, the informatization department should strengthen the training of teachers and students, and the school should formulate policies to encourage teachers and students to apply it, so as to achieve "better use than idle," so that the state's investment in education is most effective.

5. Conclusions

We should further explore teaching evaluation and education management models, track learning data, and integrate multidimensional and accurate assessment of the effectiveness of teaching and learning. In addition, we will make full use of new technologies such as cloud computing, big data, artificial intelligence, and the Internet of Things to build an all-round, whole-process, and all-weather assessment support system; use big data to support the ability to safeguard education management, decision-making, and public services; and to help teaching management and services, which is of constructive significance for the development of the future education management system. Education informatization is an inherent need to achieve new leaps based on historical achievements and an effective way to accelerate the modernization of education. The "Internet + Education" and artificial intelligence will change the way education is produced and reorganise and reengineer the business processes of education. With the perfect combination of education and information technology, there will be a comprehensive reform of the university education management system in the near future.

Data Availability

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

Conflicts of Interest

The author declared no conflicts of interest regarding this work.

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Retraction

Retracted: The Application of Multimedia Information Technology in the Moral Education Teaching System of Colleges and Universities

Wireless Communications and Mobile Computing

Received 26 September 2023; Accepted 26 September 2023; Published 27 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.

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[1] W. Yu, "The Application of Multimedia Information Technology in the Moral Education Teaching System of Colleges and Universities," *Wireless Communications and Mobile Computing*, vol. 2022, Article ID 5309632, 8 pages, 2022.

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Research Article

The Application of Multimedia Information Technology in the Moral Education Teaching System of Colleges and Universities

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The rapid development of multimedia technology provides technical support for higher education and makes higher education move towards automation and informatization. Multimedia technology has been widely used in the teaching of colleges and universities in China, and the traditional teaching mode will be gradually replaced. Multimedia education is the product of the combination of multimedia technology and modern educational technology. It can create a broader space for the future of education and help education achieve diversified development. This technology can not only improve the teaching efficiency but also further complete the comprehensive training of students' quality. The popularization of multimedia information technology in the classroom is also a main direction of today's education reform. The application of multimedia technology in moral education teaching system is highly valued by teachers. Students have a strong autonomy to understand and accept the network education mode. Therefore, network multimedia information technology can be widely used. In particular, for moral education, network education is more feasible and scientific. It can widely cover every student through the construction of network platform and integrate moral education teaching into campus culture for gradual development. This paper discusses multimedia information technology. This paper discusses the design of moral education teaching system under the environment of multimedia information technology, including the design of various functions, in order to improve the integrity of moral education teaching in colleges and universities.

1. Introduction

As the main channel of ideological education in domestic colleges and universities, moral education not only plays an important role in leading students to establish correct values but also helps students to be able to face the difficulties arising from their future development with a more correct and healthy world view [1]. With the support of modern technology, moral education has undergone radical changes, the teaching mode has been transformed, and the teaching concept has gradually changed [2]. In order to be able to maximize the effect of moral education, make students' ideological and moral cultivation significantly improved, and fully reflect the value of college education in the development of talents, colleges and universities should take advantage of the teaching advantages of advanced technology to help promote the moral education of students [3].

In terms of specific teaching practice, most of the contents and objectives set by teachers in classroom teaching are to speed up the teaching process, and it is difficult to cover all students in the classroom [4]. In this case, it is difficult for students who do not interact with teachers to effectively integrate into the classroom atmosphere. At the same time, this teaching mode is difficult to be effective for students who are at the upper middle level of learning and have a high level of subject knowledge application [5]. In addition, in the ideological and political classroom in colleges and universities, teachers are leaders, and students passively accept knowledge, showing a strong one-way. Students are in a passive state in the learning process and rarely take the initiative to ask questions in the classroom [6]. This too teacher led teaching method runs counter to the student led teaching concept, and it is difficult to improve students' initiative in the process of classroom learning. Students cannot really participate in the teaching process, which leads to

their inability to establish a correct awareness of active learning and independent thinking and has a negative impact on their future development [7].

In the context of exam-oriented education, in the process of promoting the teaching of ideological and political courses in colleges and universities, teachers often adopt the indoctrination teaching method, and students are very passive to accept new knowledge when teaching through reading the text in the ideological and political class [8]. This cannot create a lively classroom atmosphere; students will lose interest in learning this ideological and political course. In addition, some contents of ideological and political courses in colleges and universities are logical and theoretical, and students will find it difficult to learn. Only a few students with good self-awareness can keep up with the pace of the teacher and memorize mechanically. However, there are few such students, and most of them are still finding it difficult to concentrate, leading to boredom. It can be seen that the traditional teaching mode still has drawbacks, requiring teachers to innovate teaching mode, adopt new teaching methods, select the content close to students' actual life according to the actual teaching content, and create teaching situations so that students have a familiar sense of knowledge in learning [9]. Only in this way can students have the idea of active learning, so as to improve teaching efficiency.

People are receiving a lot of information anytime, anywhere. The development of information technology has also brought about great changes in human lifestyle and learning style [10]. The emergence of multimedia education technology has really promoted the reform and development of higher education. The arrival of the information age makes multimedia teaching the objective material basis of classroom teaching, and the compatibility of information technology provides a large number of moral education teaching resources [11]. The abundant teaching materials make the moral education courses in colleges and universities closer to the actual life. The ideological and moral education is carried out through the actual cases in life so that students have the ability to correctly handle various events. The application of this technology not only brings impact to the traditional teaching mode but also brings certain advantages to the development of university teaching [12]. Therefore, it is necessary to explore the application of multimedia information technology in college moral education teaching system in order to make better use of this technology to promote the improvement of college teaching.

Multimedia technology has brought great convenience to school teaching, which can improve teachers' teaching quality and stimulate students' learning motivation [13]. However, its shortcomings are also emerging. The imbalance between the investment and benefit of multimedia leads teachers to break away from the positive attitude of using multimedia technology. Many researchers have considered the effect of multimedia technology application and explored the real effect of multimedia technology [14]. The following is a comprehensive analysis of the application of multimedia educational technology in colleges and universities.

For the use of multimedia teaching methods, different schools have different characteristics, but there are also some common factors [15]. In view of the current situation of the application of multimedia technology in colleges and universities in China, the following points are summarized. First, establish infrastructure. Higher vocational colleges first establish computer networks on campus. Such infrastructure is conducive to the establishment of multimedia teaching network system, paving the way for the establishment of school LAN in the future [16]. Higher vocational colleges generally set up multimedia teaching pilot in the campus, considering the overall development of the school, and gradually promote it according to the pilot situation. At the same time, the university will train computer-related professionals according to the needs of market development and the current technical level, which is conducive to improving the use of multimedia technology in colleges and universities. Secondly, establish a multimedia classroom, which can directly use multimedia technology for teaching activities and can use computers to search information at any time, so as to better assist them in teaching [17].

In the past ideological and political education, classroom was almost the only way and place of teaching, but under the influence of network technology, moral education knowledge becomes a part of campus culture, and students can receive moral education knowledge at any time, and while learning moral education knowledge, they can realize online interaction with teachers, which helps students build positive cognitive thinking and establish socialist core values in a subtle way [18]. In order to maximize the positive value of the network platform in moral education, it is necessary not only to improve the network multimedia information technology but also to optimize and integrate the network teaching content, realize the network interaction with students, understand the students' learning process and thinking situation in time, and help students gradually realize self-improvement and self-growth [19]. This paper mainly analyzes how multimedia information technology affects moral education teaching in colleges and universities and provides several suggestions on how to make use of the strengths and avoid the weaknesses to give full play to the value of multimedia information technology in moral education.

2. The Significance of Constructing Moral Education Teaching System in Colleges and Universities

2.1. Multimedia Information Technology. The emergence of multimedia information technology is to use information technology to provide assistance for the development of teaching. Computer-based multimedia information technology has the characteristics of vividness, image, and intuition and has good interactivity, which can better solve the problem of increasing and updating course contents. As a form of multimedia-assisted teaching, multimedia education technology belongs to the category of modern education technology. Specifically, it is the use of multimedia computer

processing capabilities for the processing of media materials such as sound, text, and images involved in teaching. And according to certain teaching objectives and presentation forms, it can realize the organization of various materials, so as to complete the corresponding teaching objectives. Therefore, the application of multimedia education technology has led to changes in traditional teaching methods and means. By adopting this technology, the effectiveness of teaching can be enhanced by vivid and imaginative teaching forms, and students' enthusiasm for learning can be stimulated.

Multimedia teaching mainly includes the combination of video, audio, picture, text, animation, and other forms of media. Its various and multidimensional teaching modes have enriched and improved the teaching contents, teaching styles, and teaching methods of moral education teaching in colleges and universities. Teachers fully exploit the material of teaching materials and enrich the classroom content when they carry out multimedia teaching.

2.2. Application of Multimedia Information Technology

2.2.1. The Development of Networked Teaching. In the educational work of colleges and universities, multimedia educational technology was initially used for the collection and processing of teaching information. Using the communication function of multimedia, colleges and universities can establish a system containing educational information from all over the world and use the system for classroom teaching. Higher education teachers can use the system to search information through the website. After creating and processing information, knowledge and information can be spread to students. Therefore, the use of multimedia education technology can improve the flexibility of college teaching.

Therefore, the use of multimedia education technology can help learners understand objective things from multiple perspectives and channels. At the same time, using multimedia education technology for network learning can also shorten the distance between teachers and students so that teachers can better help students learn and understand knowledge and then effectively improve the efficiency of classroom teaching. In addition, using multimedia education technology to carry out network teaching can change the teaching organization form of a single course in the past and build a teaching organization form integrating network communication, classroom learning, and writing learning.

2.2.2. The Development of Efficient Teaching. By using multimedia production technology, teachers can finish processing various teaching contents such as text, sound, image, and animation and can make a reasonable choice of teaching materials by summarizing their own experience. Based on this, students will be more interested in the teaching contents and the efficiency of classroom teaching will be improved effectively. At the same time, by creating multimedia courseware, teachers can make comprehensive use of teaching methods and complete the effective integration of teaching contents.

2.2.3. Development of Comprehensive Teaching. On the one hand, using multimedia to display various teaching resources can help students learn much difficult knowledge in textbooks. On the other hand, with the help of multimedia education technology, teachers are no longer limited by the limited teaching resources. This is because teachers can use multimedia tools to show students chemical experiments, physical experiments, and mathematical experiments so that students can better learn the content. For example, using various multimedia tools, such as 3D virtual reality technology and video playback technology, teachers can realistically simulate experimental phenomena. Through the online tutoring of experts, the simulation experiment made by teachers will have strong authenticity and vividness, thus saving a lot of teaching funds and achieving a certain practical teaching effect. In addition, using multimedia education technology, teachers can realize two-way communication with students. In the multimedia phonetic classroom, teachers and students can use teaching equipment for interactive teaching. Using network monitoring equipment, teachers can understand the learning situation of each student, understand the learning situation of students through communication, and then carry out targeted teaching to improve the overall quality of students.

2.3. Promote Moral Education Teaching in Colleges and Universities Based on Multimedia Information Technology

2.3.1. Build a Scientific and Perfect Network Platform. Firstly, we focus on the interactivity of the platform, moral education is a matter for both teachers and students, instead of teachers giving knowledge and students receiving it passively, interactivity is not only required at the technical level but also at the practical level, that is, teachers should support the interaction with students through high quality courses, including images, videos, audio, and text to support interaction with students, such as uploading a complete moral education curriculum, receiving feedback and questions from students at any time, and monitoring students' progress in the form of punch cards. Secondly, we should pay attention to the quality of teaching resources. Moral education knowledge is not a big pile of uninteresting theories, so teachers need to link theory to practice when uploading courseware. That is to say, specific moral education knowledge is integrated into practical problems and phenomena for explanation so that theoretical knowledge comes alive and inspires students' willingness to receive moral education.

2.3.2. Innovative Way of Education. Under the mode of network multimedia information technology, moral education should be a happy process, moral education knowledge gradually removes the boring coat and shows its own brilliant side, the teaching ground is not only limited to classroom and books, and moral education gradually becomes a part of students' life. In order to achieve such efficient teaching goals, teachers need to take multimedia platform as an opportunity to gradually expand the way of moral education teaching. First, the network platform provides very useful technical support in classroom teaching, teachers can upload

the knowledge content to the network platform in advance to facilitate students' prestudy of moral education knowledge. Second, teachers should gradually expand the educational functions of the online platform, set up relevant modules about moral education, and enrich the relevant educational contents, present the knowledge in a diversified way to meet students' learning interests and learning needs so that students can receive moral education at their own pace and use fragmented time.

2.3.3. Developing Teachers' Information Literacy. Generally speaking, teachers' information literacy includes many dimensions, not only basic information technology but also the ability to integrate and analyze teaching resources and information, as well as the ability to integrate network information that can integrate and analyze specific moral education knowledge and social topics. Teachers should not only master how to apply the network platform and have the basic information literacy but also to recognize the value and significance of the network platform for moral education and gradually improve their information literacy so that they can creatively apply multimedia information technology and deeply explore richer moral education resources.

2.3.4. Pay Attention to the Quality of Online Courses. With the support of network information technology, classroom teaching is only one form of moral education. First, to ensure the systematicity and integrity of the course, teachers should be scientific and reasonable in the arrangement and selection of course content and try to streamline the course content and pay attention to the way the course is presented, which requires certain technical support and has high requirements for teachers' information literacy. Second, to avoid the course content is too single, teachers can use hot topics or other topics of students' concern as the entry point for teaching, pay attention to the integration of theory and practice, and enhance the interesting and practical nature of the course content. Third, to ensure the openness of the course, on the one hand, to ensure that the course is open to all students, on the other hand, we can cooperate with other universities, integrate quality moral education online courses from outside the university into the online platform, provide the best teaching resources for students, and give students enough freedom and space for learning.

2.4. The Influence of Multimedia Information Technology on Moral Education Teaching in Colleges and Universities

2.4.1. Multimedia Technology Promotes the Renewal of Moral Education Concept. The reasonable use of multimedia in moral education teaching can strengthen the guidance of students' ideological ideas, guarantee that the updating of ideas can meet the needs of moral education, so that the two form a mutually coordinated relationship, and also realize the online interaction of multiple clients.

First of all, the diversity of multimedia technology makes moral education activities have more space to carry out, both in form and in content, which provides more ways to update; the most obvious performance is that multimedia technology can realize the full use of the network of Shanghai teaching resources, laying a good foundation for the update of moral education content, effectively avoiding the misalignment between the content of moral education and the current situation of social development problem. Secondly, multimedia technology breaks the limitations of the implementation process of traditional moral education and makes it implemented under a more long-term and planned planning and constructs personalized educational goals for students at different stages so that the educational concept can be updated with a higher frequency.

2.4.2. Multimedia Technology Promotes the Optimization of Moral Education Methods. As a technical form relying on the network, multimedia technology has realized the diversified processing of information exchange methods and used diversified information channels to ensure the articulated relationship between teaching resources. In addition, compared with traditional teaching methods, multimedia technology has completely changed the limitations of teaching in specific space and local areas and realized the orderly connection between moral education methods through the "online + offline" method. This connection is also conducive to the implementation and optimization of ideological education practice and makes up for the lack of boring moral education. This coordinated teaching method improves students' interest in the content of moral education, makes them participate in practical activities with a more positive attitude, and makes the training effect reach a new height.

First of all, multimedia technology has expanded the way of moral education practice. The effective combination of theoretical knowledge and practical activities has greatly improved the scientificity of teaching. Use multimedia technology to guide students to "cross" the learning situation and improve their understanding of the teaching content through more intuitive feelings and experiences. Through the application of multimedia technology, teachers can use multimedia to increase the richness of the course and can present some fuzzy principles in the form of pictures and animation so that students with learning difficulties can understand them. This kind of moral education optimization can make students participate more and learn moral education more actively.

2.4.3. Multimedia Technology Promotes the Change of Moral Education Mechanism. Multimedia technology plays a huge role in promoting the reform of moral education mechanism. In the process of implementing moral education activities, it is extremely important to fully integrate the current situation of social development. The traditional education mechanism focuses more on the transmission of core contents and lacks the fission of teaching contents, which leads to the lack of connection between moral education teaching and the times. In the face of this problem, the implementation of effective education mechanism reform is the fundamental solution. The flexibility of multimedia technology allows effective integration between teaching activities and social current affairs, and under this mechanism, the content of educational assessment is more diversified. Secondly, with the support of multimedia technology, the relationship

between classroom learning and extracurricular activities is formed, and this more comprehensive teaching method makes the results of moral education more concrete. The diversified, personalized, and flexible information expression greatly makes up for the deficiencies in students' moral education knowledge structure, makes their moral education knowledge reserves more modern, and establishes a closer relationship with the social environment. Again, the integration of multimedia technology in the field of moral education greatly expands students' thinking space and makes them more autonomous and active in the process of moral education teaching. With the support of multimedia communication platform, the communication between students and teachers is more convenient, and teachers can achieve a comprehensive understanding of students' creative ability and comprehensive quality, and the teaching work based on this has better effect.

2.4.4. Multimedia Technology Expands the Scope of Moral Education Dissemination. Multimedia technology can make the dissemination of moral education information more flexible and facilitate students to receive various forms of educational information using various clients and so on, helping students to stay away from the clutter of society in the campus and at the same time understand the information related to moral education in society in real time. Students can use their cell phones and computers in school to learn about hot current events and express their personal opinions through communication social media such as microblogs, WeChat, and QQ. This way, students can quickly learn about moral education information and add different views from others. Students enhance their own moral education awareness by learning about others' views and expressing their personal ideas. In addition, there is also negative information in multimedia technology, although in the initial state some people will be misled, but under the positive guidance of most people, they can identify the wrong information in time and correctly identify when they get similar negative information in the future, which can improve the students' ability to distinguish the true from false information in a subtle way.

2.4.5. The Influence of Multimedia on Moral Education of College Students. Multimedia has a double impact on moral education of college students. On multimedia, any individual can express his or her opinion freely without being restricted by identity, system, status, property income, or education anymore; thus, multimedia strongly enhances students' democratic consciousness. Students can also gradually develop civic consciousness and then enhance their sense of responsibility and mission during the discussion in the multimedia opinion forum. At present, there is a serious division between the rich and the poor in China, which is reflected in colleges and universities, where the percentage of poor students among all students has exceeded 20% (even up to 25%). When these poor students see triad bosses strutting out of jail in luxury cars on the multimedia or see uneducated rich kids spending money like dirt, they are likely to have psychological imbalance and then develop negative emotions such as pessimism and resentment. Individual students may even advocate a money-worshiping lifestyle and become slaves to money. For example, the "Naked Loan Gate" incident was caused by multimedia.

3. Moral Education Strategies in Colleges and Universities under Multimedia

3.1. Construction of Evaluation System. The summary evaluation of the specific performance of teaching sessions in classroom teaching and its application effect can guide students to clarify their own shortcomings in the process of learning moral education courses and facilitate their self-improvement, while at the same time, teaching evaluation can be carried out to guide students to better integrate into the classroom atmosphere, enhance their enthusiasm to participate in teaching sessions and think actively about issues, and stimulate their enthusiasm for learning. Therefore, the political and educational administrators should strengthen the evaluation by giving immediate, extended, and motivating evaluations of students' specific performance while learning.

3.2. Applying Case Teaching. The application of case teaching method to ideological and political classroom teaching in colleges and universities requires teachers to study teaching materials carefully. Case teaching should be carried out around the teaching contents of teaching materials. After that, students can ask questions in the learning process, teachers can answer questions, and finally return to the textbook theory. In the process of ideological and political teaching in colleges and universities, teachers can combine cooperative group teaching with case teaching to ensure the efficiency of classroom teaching. The use of case teaching method can improve the interest of classroom teaching, strengthen the cooperation with groups, and fully mobilize the enthusiasm of students to participate in classroom learning so that every student can participate in the ideological and political classroom learning and stimulate students' learning enthusiasm. Using case teaching method can better connect theoretical knowledge with students' actual life and help students carry out practical activities. In the process of learning professional role models, teachers can encourage students to discuss relevant issues in groups, such as "what do you think is a professional role model?" Then, teachers can use multimedia technology to play the video of Chinese captain Liu Chuanjian so that students can more intuitively feel the spirit of the airport staff in the process of watching the video.

3.3. Constructing a Team of Teachers. To enhance the timeliness of students' ideological and political education, it is necessary to build a team of teachers with high comprehensive quality, which requires teachers. Firstly, teachers should have innovative functions, learn about the ideological methods of historical materialism and dialectical approaches, and finally carry out efficient ideological and political courses so that students can establish correct ideological concepts. Second, teachers should have a high level

of political literacy. Teachers should look at issues from a political perspective and keep a clear political mind at all times. Again, teachers should constantly broaden their horizons. As teachers engaged in teaching ideological and political education courses, they should have an international perspective and a historical perspective. In the process of teaching, they can carry out in-depth longitudinal and horizontal comparisons and make the relevant knowledge points of the ideological and political courses clear and understandable.

3.4. Create Teaching Situations. At this time, teachers can create teaching scenarios to simulate some scenes in the work process of students. Teachers can also use multimedia technology to show students programs such as the host competition so that students can feel the professional ability of the host in the process of speech in the process of watching the video and in the classroom to carry out professional simulation. Students play the role of contestants, teachers play the role of judges, and encourage students to play on the spot so that students in the process of contextual teaching fully appreciate the importance of professional etiquette for personal development [20–22].

3.5. System Function Design. The large amount of information brought by multimedia technology cannot be fully accepted by students. At present, the introduction of multimedia technology in higher vocational colleges has indeed solved the problems of lack of teaching resources and backward teaching methods, but there are some obstacles in students' ability to absorb knowledge. Teachers show all the classroom information in front of students. Many students cannot fully understand the main points of classroom knowledge. There is a phenomenon of half-knowing and half-understanding, and the learning effect has not been significantly improved. In view of the deficiency of multimedia teaching in colleges and universities, the relevant departments conducted a detailed questionnaire survey in order to understand the views of modern and efficient students on multimedia teaching. See Figure 1 for details.

According to Figure 1, a large number of students think that the classroom content is presented too fast and it is difficult to finish taking notes in time. Concentration. If this situation continues, it will affect the interest of students in higher education institutions in learning and then affect their learning efficiency. According to Figure 1, nearly 35% of the students think that multimedia teaching has reduced the interaction between teachers and students [23].

The system design of multimedia moral education teaching system is mainly used by students and teachers in large numbers, so combined with the actual moral education teaching, the main function of the teaching system's appeal is the sharing of moral education teaching resources, the development and use of moral education courseware, and the interaction of the teaching classroom. In the teaching system class intelligent according to the actual needs of the teacher classroom combined with the characteristics of the classroom content for the assignment and personalized settings. At the same time, the system's functions also allow the information system to constantly update and upload new course videos and special courseware.

4. Client-Side Function Design

(1) The design of client-side functions is designed to supply the needs of students and teachers, and the functions of which are mainly divided into resource management, courseware editing, moral education course preparation, and classroom interaction. The specific content division is based on different functions. In resource management, the main purpose is to organize the data of classroom teaching and students accordingly and establish a good database. The moral education curriculum is also the focus of the data arrangement, must respect the differences of students, each student to different education, and each student moral education is not the same degree, the teacher should do to the students according to their needs. The use of modern technology (multimedia technology, computer technology, etc.) in such a process is to allow teaching to achieve the integration of different data, to manage the data in an accurate and scientific way, and to meet the requirements of personalized development education on moral education. Respect for differences and personalized, scientific teaching is the ultimate goal that teaching must now achieve, and for the better development of students [24–26]

(2) This function of courseware editing is to enable students to face teaching more intuitively during class time, to increase students' motivation to learn by using courseware case studies and video presentations, to save teachers a lot of time, to use sufficient time to interact and quiz students, and to teach students systematically in available time again while also quizzing each student in class. This allows students to have more time to understand the content expressed in the course and to combine it with practice

(3) The client-side lesson planning system saves teachers a lot of time in preparing lessons on paper and only needs to fully explain to students on electronic files and to prepare scientific lesson plans for the teaching problems raised by students, thus saving a lot of resources and time for students to give feedback to teachers' teaching, which is beneficial for teachers to make relative adjustments to their own deficiencies in moral education teaching and helps teachers of the course test topics and content of a reasonable deployment, such a lesson preparation system is the consequence of the traditional teaching, only after a semester to get a comprehensive improvement has a good help, with a strong real-time and interactive, better achieve the communication and exchange between students and teachers, adjusting the time

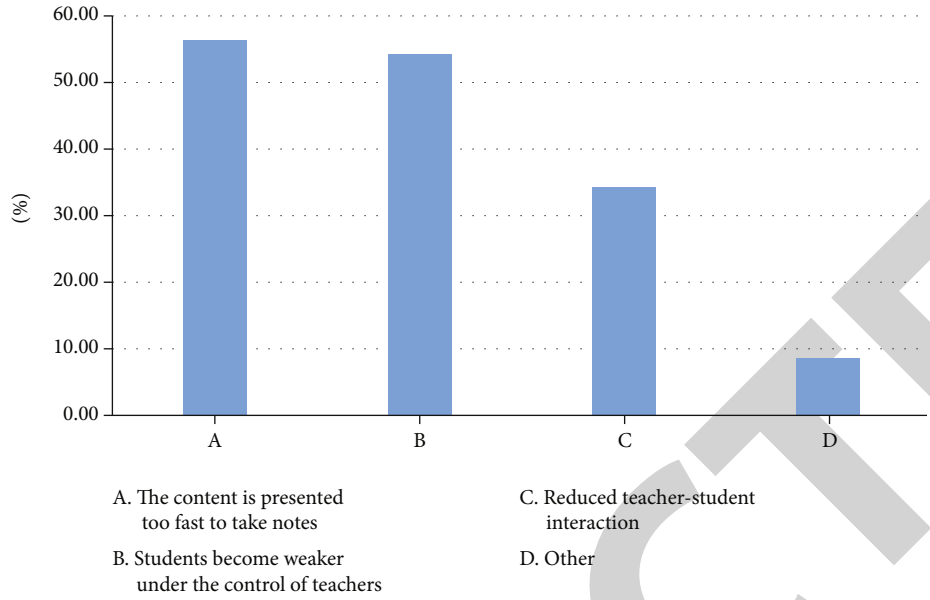

Figure 1: Deficiencies of multimedia teaching in practical application.

of teachers in the record and the changing thinking of students

(4) Classroom teaching system is for the original realistic teaching environment for virtual teaching, through the modern multimedia technology and computer technology on the modern platform teaching unification, which is conducive to teachers to get more teaching resources and information, and in the teaching at the same time for the sharing of resources. It also allows students to participate in the suggestions, and students are greatly increased, which will have a very good interaction

5. Key System Technologies

The system is designed to include a lot of classroom management, classroom editing, and other roles, while the existing materials and teaching resources for data integration, in the system using ADO.NET technology, to achieve the management of the database, to reach the connection between different text and database, in the classroom teaching used in a variety of database editing and data collection is to achieve the core of classroom management. This will allow the students to learn and understand the course better and at the same time to teach the students to quiz and advocate students to ask questions, which will allow the teacher and students to interact better and to test the content of teaching better.

6. Conclusion

Through the research of this paper, teachers can use multimedia education technology for network, efficient, and comprehensive teaching. The construction of moral education teaching system is the innovation and development of teaching methods.

To sum up, with the application of network multimedia information technology, the concept and mode of moral education in colleges and universities are gradually changing. This new educational model has opened up new ideas for moral education teaching. By creating an interactive network platform, we can expand the scope of moral education, facilitate classroom teaching, and eliminate the space-time distance between education and teachers. With the help of teachers, we can provide students with the best moral education resources through the online platform so that students can learn high-quality course content online and interact with teachers and students. It is more guaranteed in this online and offline education mode.

Data Availability

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

Conflicts of Interest

The author declared that there are no conflicts of interest regarding this work.

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Research Article

Multipath Cluster-Assisted Single Station Localization Based on SSA-GA in Outdoor NLOS Environment

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In this paper, we propose a novel multipath cluster-assisted single station localization method based on a genetic algorithm-based improved salp swarm algorithm (SSA-GA) to improve localization accuracy in an outdoor non-line-of-sight (NLOS) propagation environment. The scattering area model is presented which scatterers are considered Gaussian distribution for outdoor NLOS environments. The geometrical properties of propagation paths, such as angle of arrival and time of arrival, are jointly utilized to construct pseudoscatterer distribution. In order to filter the interference scatterers distributed outside the scattering region, the Gaussian kernel-based algorithm is developed. Furthermore, SSA-GA is proposed to solve the positioning objective functions constructed by pseudoscatterers clustering accurately. Results confirm the practicability of our newly proposed method, and the positioning error is less than 5% in outdoor NLOS propagation environment.

1. Introduction

In recent years, position location (also called localization or positioning) is a key application for the fifth generation (5G) of mobile communication technology, which has been a growing interest for a variety of applications such as navigation, industrial mines, rescue operations, and traffic management [1–3]. By measuring the range and the angle of the received signals between the mobile device and base stations based on the known locations of other reference points, the precise location knowledge of the transmitted source signal from a mobile station (MS) can be determined. Unfortunately, the majority of outdoor scenarios are characterized by the non-line-of-sight (NLOS) propagation conditions, due to specular reflections from obstacle surfaces such as mine cars, roadways, and buildings. Consequently, the localization environment is even more complex, which compromise the localization accuracy of current positioning technologies. Accurate and quick position location of MS is critical in urban environments under NLOS propagation conditions, especially for the implementation of the Federal Communications Commission's (FCC) E-911 [4].

In NLOS propagation environments, accurate single-site localization using a single base station (BS) for a wireless source signal is an attractive technique due to its convenience in deployment and operation compared with multiple-site localization techniques. A large number of researchers are actively working towards achieving an acceptable accuracy of single base station localization methods by using the measured parameters of multiple path

signals, such as time of arrival (TOA), angle of arrival (AOA), and received signal strength (RSS). Details may refer to [5–10]. Time difference of arrival (TDOA) has been widely used in localization due to its low time synchronization requirements. In reference [11], the target position is estimated by using the transmission time difference between multiple different nodes and the target. Considering that three nodes can locate the target, a weighted average location algorithm based on Cramér–Rao lower bound (CRLB) is proposed to weight the average target positions estimated by different nodes. The weight is determined by the CRLB corresponding to the estimated target position. The simulation and measurement results show that the positioning error is less than 1 m in the indoor scenario. In addition, since TOA and RSS are both efficient over long and short distances, respectively, it is studied recently that with the combination of TOA and RSS, the spatial geometric distribution among the source, scatterers, and reflectors is used to construct the positioning objective function. In order to use multipath RSS-TOA to locate the target, an iterative generalized trust region subproblem (GTRS) framework is proposed in [12] to approximately solve the nonconvex maximum likelihood problem. The performance of GTRS model is further improved in [13] by considering that the directivity of the target will have a great impact on RSS measurements in different directions. Moreover, in reference [14], a second-order cone programming (SOCP) framework with convex hull constraints and soft regularization is proposed to solve the RSS-TOA localization problem, and the unknown transmission time and power information are considered to improve the robustness of the localization algorithm. Even though the method in literature [11–14] can use multipath information to locate target in NLOS propagation scenarios, however, it requires some assumptions or a priori conditions. For example, in [11], it is assumed that there are sight distance paths between multiple nodes and targets, and in [12–14], it is assumed that the NLOS measurement error of each multipath is the same, resulting in that the positioning algorithm is not applicable to actual NLOS propagation scenarios. Under NLOS propagation conditions, estimating the target positions accurately is challenging and has not been fully studied yet.

The motivation of this paper is threefold. First, we use the Gaussian kernel-based algorithm to filter interference scatterers outside the scattering region. Second, an improved salp swarm algorithm (SSA) is proposed to determine the accurate location of source signal by enhancing the global search performance and robustness in NLOS environments. Last, we evaluate the performance of the proposed method, Levenberg-Marquardt (LM) algorithm, and SSA algorithm.

2. Scattering Region Model

The present problem is aimed at determining the location of source signal, e.g., a mobile station (MS), in a NLOS environment by using a single base station (BS) based on scattering area model. The Gaussian-based scattering area model is introduced to describe spatial geometric distribution of scatterers and MS, which can be used in achieving high precision under NLOS propagation conditions [15], compared with the conventional ring of scattering (ROS) model and the disk of scattering (DOS) model [16]. The MS-BS geometry is given in Figure 1.

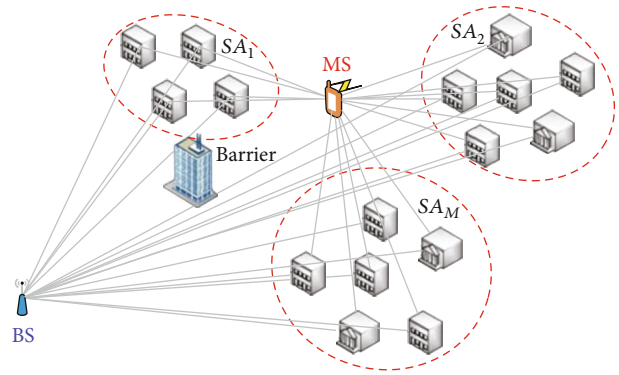

Figure 1: Illustration of the MS-BS geometry based on the scattering area model.

Although the NLOS propagation environments might involve multiple-bound reflection and refraction paths, single-bounce reflection is assumed in this paper due to well-fitting for modelling the multipath propagation in outdoor areas. Furthermore, we assume that the source signal is scattered by the scatterers $S_1, S_2, \cdots, S_N$ in the scattering area $SA_1, SA_2, \cdots, SA_M$ to reach the base station (BS), where each multipath signal corresponds to a scatterer. The i-th path can be parameterized by the propagation distance L_i (measured as the propagation distance between the MS and the BS) and the azimuth AOA θ_i (measured from the positive x-axis). The propagation distance of the i-th path from MS to BS is $L_i = c \times t_i, i = 1, 2, \cdots, N$, where c denotes the speed of light and t_i is the TOA of the i-th multipath signal. The objective is to determine the unknown MS position, denoted in the Cartesian coordinate as (x, y).

In order to take full advantage of multipath information, pseudoscatterers are introduced. The pseudoscatterer is equivalent to the transmitter position corresponding to the received multipath signal in LOS propagation environment, and each available multipath corresponds to a pseudoscatterer. A certain geometric relationship between the distribution of pseudoscatterer and scatterers and target is depicted in Figure 2, where S_i' denotes the pseudoscatterers corresponding to the i-th multipath and r_i represents the signal propagation distance from the i-th scatterer to MS. The target positioning process is as follows.

2.1. Step 1: Extraction of Pseudoscatterer Centres. In this paper, the BS is deployed at a known position, denoted as (x_B, y_B) in the Cartesian coordinate in Figure 2. Use the propagation distance L_i and the AOA θ_i of the i-th path to determine the pseudoscatterers location (x_i', y_i'), which can be expressed in available information form as

$$\begin{aligned} x_i' &= L_i \times \cos(\theta_i) + x_B \\ y_i' &= L_i \times \sin(\theta_i) + y_B. \end{aligned} \tag{1}$$

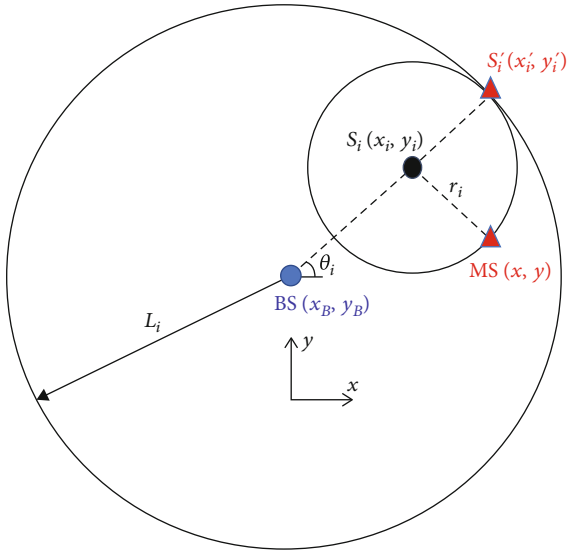

Figure 2: Pseudoscatterers distribution.

Let $(\hat{x}_j, \hat{y}_j), j = 1, 2, \cdots, M$ represent the centres of the scattering area. Note that if in the azimuth AOA, the propagation distance parameters for all paths corresponding to the scattering centres have already been estimated in advanced, the positioning objective function can be constructed to estimate the target position.

The clustering algorithm can be used to obtain the pseudoscatterer clustering centres of $S_1', S_2', \cdots, S_M'$. After that, the multipath parameters of the scattering area centres can be obtained from the pseudoscatterer clustering centres by (1). The corresponding parameters (L_j, θ_j) are given as follows:

$$\begin{cases} L_j = \sqrt{\hat{x}_j'^2 + \hat{y}_j'^2} \\ \theta_j = \arctan\left(\hat{y}_j'/\hat{x}_j'\right), \end{cases} \tag{2}$$

where $(\hat{x}_j', \hat{y}_j')$ is the cluster centre of the pseudoscatterer.

2.2. Step 2: Construction of Positioning Objective Function. In this paper, it is assumed that the scattering area centres in the urban environment are known to be $(\hat{x}_j, \hat{y}_j), j = 1, 2, \cdots, M$. The centre of the scattering area can be obtained with the aid of satellite map or the distribution of surrounding buildings. The signal propagation distance is equal to the sum of the distance of the signal from BS to the scatterer and from the scatterer to MS, which can be calculated as

$$\sqrt{(x-\hat{x}_j)^2 + \left(y-\hat{y}_j\right)^2} = L_j - \sqrt{\left(\hat{x}_j - x_B\right)^2 + \left(\hat{y}_j - y_B\right)^2}, \quad j = 1, 2, \cdots, M, \tag{3}$$

where (x_B, y_B) and (x, y) are the locations of BS and MS, respectively. l_j, i.e., the distance from MS to the centre of each scattering area, is shown as

Input $(x_i', y_i'), i = 1, 2, \cdots, N, \sigma, s_1, s_2, \cdots, s_N = 0$
for $i = 1, 2, \cdots, N$ do
  for $j = 1, 2, \cdots, N, j \neq i$ **do**
    Calculate d_{ij} by (8)
  end for
end for
Calculate d_{ave} by (7)
for $i = 1, 2, \cdots, N$ **do**
  for $j = 1, 2, \cdots, N, j \neq i$ **do**
    if $d_{ij} < d_{\text{ave}}$ **then**
      $s_i = s_i + 1$
    end if
  end for
end for
Select $4/5N$ scatterers (x_i', y_i') with large s_i
Output $(x_i', y_i'), i = 1, 2, \cdots, 4/5N$

Algorithm 1: Interference scatterers filtering.

$$l_j = L_j - \sqrt{\left(x_j - x_B\right)^2 + \left(y_j - y_B\right)^2}, \quad j = 1, 2, \cdots, M. \tag{4}$$

Taking the M-th scattering centre as the reference, the distance difference between the other scattering centres and the M-th scattering centre to the MS can be expressed as

$$\sqrt{(x-x_M)^2 + (y-y_M)^2} - \sqrt{(x-\hat{x}_j)^2 + \left(y-\hat{y}_j\right)^2} = l_M - l_j, \quad j = 1, 2, \cdots, M-1. \tag{5}$$

In fact, due to the presence of parameter estimated errors, the target position in (5) does not have a closed-form solution. The solution process needs to be transformed into a nonlinear optimization problem. We can devise the objective equation as a set of errors, which can be defined as follows:

$$\varphi_j(x, y) = \sqrt{(x-x_M)^2 + (y-y_M)^2} - \sqrt{(x-\hat{x}_j)^2 + \left(y-\hat{y}_j\right)^2} - \left(l_M - l_j\right), \quad j = 1, 2, \cdots, M\text{-}1. \tag{6}$$

The MS position can be obtained by minimizing the sum of objective functions for all errors, so the positioning objective function is constructed as

$$\min \psi(x, y) = \frac{1}{M-1} \sum_{j=1}^{M-1} \varphi_j^2(x, y). \tag{7}$$

3. Parametric Clustering of Multipath Signals

In the actual scenario, scatterers are not only distributed in the specified scattering area but also exist far away from the scattering area. These scatterers are called interference scatterers in this paper. When clustering the pseudoscatterer,

Input n, L, p_c, p_m, u, d
Initializing populations $S(l)$
while terminate condition has not been met **do**
  for $i = 1, 2, \cdots, n$ **do**
    Calculate fitness of salp $\mathbf{x}^i(l)$
  end for
  F=the best search salp
  Update c_1
  Divide the population into two parts: leaders $\mathbf{x}^i$ and followers $\dot{\mathbf{x}}^i$
  for $i = 1, 2, \cdots, n/2$ **do**
    Update the position of the leaders by (10)
  end for
  for $i = 1, 2, \cdots, n/4$ **do**
    if $p_c >$ rand $(0, 1)$
      Update the position of $x_i, x_{i+n/4}$ by (12)
    end if
  end for
  for $i = 1, 2, \cdots, n/2$ **do**
    if $p_m >$ rand $(0, 1)$
      Update the position of the x_i by (11)
    end if
  end for
  Set the population after crossover mutation as $H(l)$
  Update populations $S(l+1)$=combine $(H(l), S(l))$
  Calculate the optimal position of leader $\mathbf{x}^{\text{best}}$
  Update the position of the first follower by (13)
  for $i = 1, 2, \cdots, n$ **do**
    Update the position of followers by (14)
  end for
end while
Output The best global solution F

Algorithm 2: Genetic algorithm-based improved salp swarm algorithm.

the pseudoscatterer corresponding to the interference scatterers will affect clustering and the final positioning accuracy. Therefore, it is necessary to identify and filter the interference scatterers. In this paper, the Gaussian kernel function is used to filter interference scatterers.

The Gaussian kernel function describing the distance between two individuals is used to eliminate the effect of interference scatterers. Let the location of the two pseudoscatterers be (x_i', y_i') and (x_j', y_j'), respectively. And then Gaussian kernel function d_{ij} with width parameter σ is defined as

$$d_{ij} = \exp\left(-\frac{\sqrt{\left(x_i' - x_j'\right)^2 + \left(y_i' - y_j'\right)^2}}{2\sigma^2}\right). \tag{8}$$

The larger d_{ij} indicates that the two pseudoscatterers are closer. Since the interference scatterers are distributed outside the scattering area and the number of them is relatively small, the distribution of interference scatterers is sparse. By comparing the distribution density of scatterers, the interference scatterers can be identified and filtered. In this paper, a reference radius d_{ave} is set as the average Gaussian kernel of the pseudoscatterers, which is expressed as

Table 1: Parameter settings.

Parameter	Symbol	Value
Base station coordinates	(x_B, y_B)	$(0, 0)$
Maximum number of iterations	L	100
Number of scattering areas	M	3
Number of scattering points	N	100
Positioning range		500m × 500m
AOA measurement error	$\widetilde{\theta}_i$	5%
TOA measurement error	$\tilde{t}_i$	5%
Width parameter	σ	200

$$d_{\text{ave}} = \frac{1}{A_N}(d_{nm}), n \in \mathbf{X}, m \in \mathbf{X}, n \neq m, \tag{9}$$

where d_{nm} is the Gaussian kernel between any two unequal pseudoscatterers S_n' and S_m', $A_N = C_N^2$ is the number of times for the randomly selected two pseudoscatterers, N denotes the number of pseudoscatterers, and $\mathbf{X}$ is the set of all pseudoscatterers.

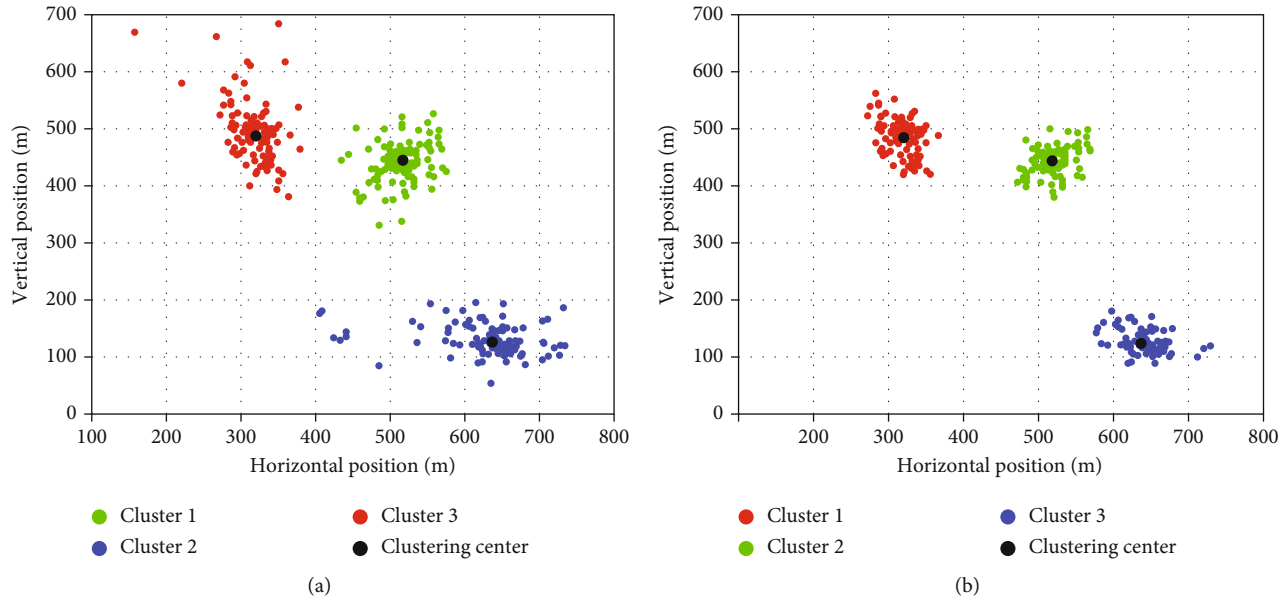

Figure 3: Clustering results with and without filtering out interference scatterers. (a) Unfiltered. (b) Filtered.

The filtering process of interference scatterers is as follows. First a pseudoscatterer S_i' is selected to calculate the Gaussian kernel d_{ij} of this scatterer with another pseudoscatterer S_j'. Second, we compare d_{ij} with d_{ave}. When $d_{ij} > d_{\text{ave}}$, S_j' is an adjacent pseudoscatterer of S_i'. Third, we calculate the number of all adjacent pseudoscatterers for all pseudoscatterers by the above method as $S_1, S_2, \cdots, S_N$. Finally, the $N/5$ scatterers are filtered out by comparing the distribution density. The pseudocode is shown in Algorithm 1.

4. Proposed Location Algorithm

In this section, the problem in (7) is solved using a simple yet computationally efficient iterative algorithm. The salp swarm algorithm (SSA) [17] is often used to solve nonlinear optimization problems; however, the SSA converges slowly and tends to fall into local optimum. In order to solve the above problems, this paper proposes SSA-GA. Firstly, the salp population is divided into two populations, i.e., the leaders $\mathbf{x}^i = (x_1^i, x_2^i, \cdots, x_d^i)$, $i = 1, 2, \cdots, n/2$ and the followers $\dot{\mathbf{x}}^i = (\dot{x}_1^i, \dot{x}_2^i, \cdots, \dot{x}_d^i)$, $i = 1, 2, \cdots, n/2$, respectively, and n is the number of individuals. The leader finds the food position based on the population information iteratively, which is the optimal solution for the objective function. The followers follow the leader to reach the optimal solution position. The quality of each position is evaluated by calculating fitness which is the value obtained by bringing the individual position into the objective function. In the l-th iteration, the j-th position of the i-th leader x_j^i can be obtained as follows:

$$x_j^i = \begin{cases} F_j + c_1\left(\left(u_j - d_j\right)c_2 + d_j\right) & c_3 \geq 0 \\ F_j - c_1\left(\left(u_j - d_j\right)c_2 + d_j\right) & c_3 \leq 0 \end{cases} \quad i = 1, 2, \cdots, n/2, \tag{10}$$

where F_j denotes the j-th position of the food, $c_1 = 2e^{-(4l/L)^2}$ is the parameter that can be used to adjust the movement range of the leader, and L corresponds to the maximum iteration. c_2 and c_3 are random numbers uniformly generated in the interval of $[0, 1]$. Moreover, u_j and d_j indicate the upper bound and lower bound of j-th position. To effectively enhance the global search capability of the optimization algorithm, inspired by the genetic algorithm, crossover mutation is introduced to update the leader position, which can be expressed as follows:

$$x_j^i = \begin{cases} x_j^i & P_{\text{m}} < \text{rand}\ (0, 1) \\ \text{rand}\ (0, 1) \times \left(u_j - d_j\right) & P_{\text{m}} \geq \text{rand}\ (0, 1), \end{cases} \tag{11}$$

where p_{m} is the variation probability of the leader. When p_{m} is greater than the random value within $(0, 1)$, the x_j^i is randomly assigned to a value in the range u_j to d_j. For crossover cases, the leader position can be updated as follows:

$$\begin{matrix} x_1^n, x_2^n, \cdots, x_d^n \\ x_1^m, x_2^m, \cdots, x_d^m \end{matrix} = \begin{cases} x_1^n, \cdots, x_{d'}^n, x_{d'+1}^m, \cdots, x_d^m \\ x_1^m, \cdots, x_d^m, x_{d'+1}^n, \cdots, x_d^n \end{cases} \quad p_{\text{c}} \geq \text{rand}\ (0, 1), \tag{12}$$

where p_{c} represents crossover probability of the leader. The subscript d' is the starting position of crossover. $(x_1^n, x_2^n, \cdots, x_d^n)$ and $(x_1^m, x_2^m, \cdots, x_d^m)$ are the position of two random leaders. When p_{c} is greater than the random value within $(0, 1)$, two individuals start crossover at the d'-th position.

The fitness of the crossed and mutated leaders is calculated to compare with the corresponding old leaders, and a new population of leaders is created using the better leaders (in the sense of fitness function). The optimum leader is first

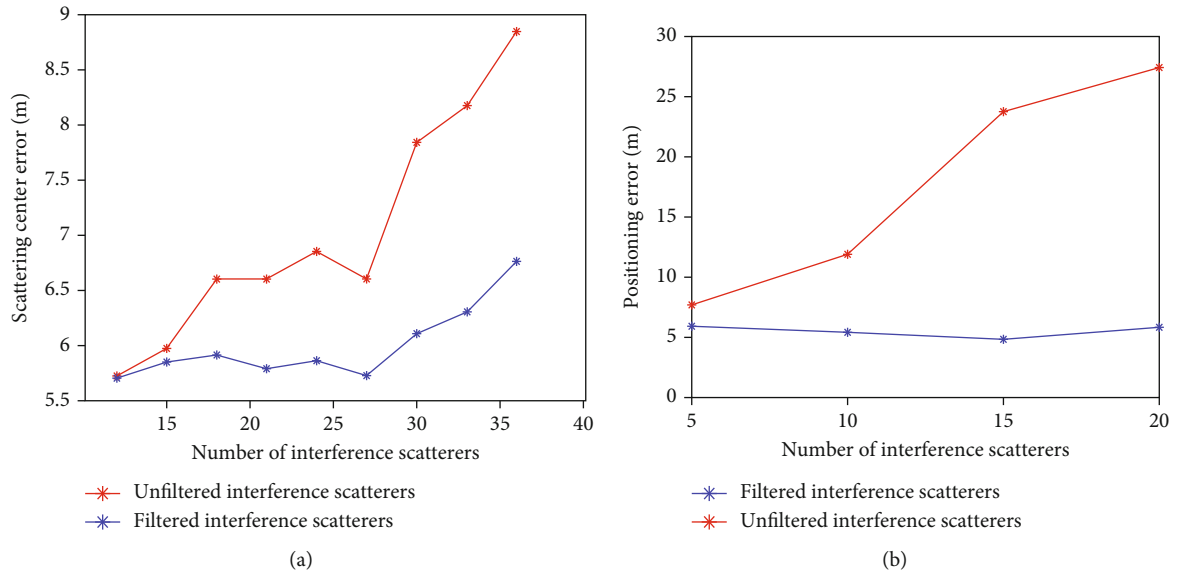

Figure 4: Influence of filtering interference scatterers. (a) Clustering centre error. (b) Positioning error.

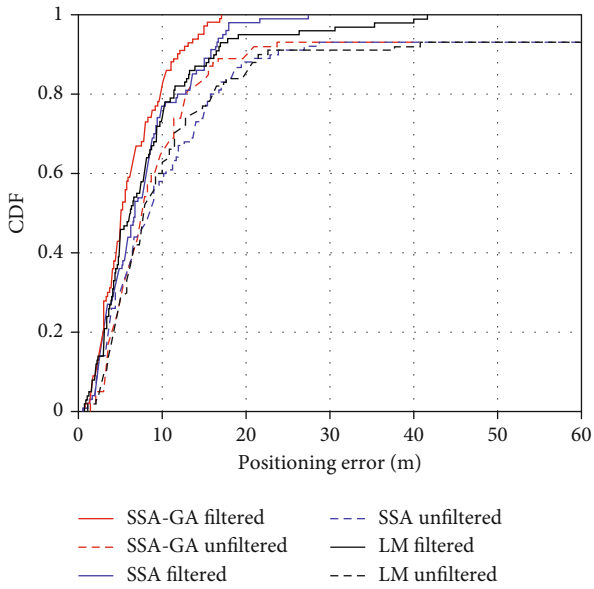

Figure 5: CDF of positioning error using different methods.

selected by calculating the fitness function, and then the position of the first follower can be calculated by

$$\dot{x}_j^1(l+1) = \frac{1}{2}\left(\dot{x}_j^1(l) + x_j^{\text{best}}(l)\right), \tag{13}$$

where x_j^{best} represents the j-th position of the best fitness leader. $\dot{x}_j^1$ is the j-th position of the first follower. Finally, combined with the position of oneself and other individuals, the position of followers can be iterated by

$$\dot{x}_j^i(l+1) = \frac{1}{2}\left(\dot{x}_j^i(l) + \dot{x}_j^{i-1}(l)\right) i = 2, 3, \cdots, n/2. \tag{14}$$

The pseudocode of SSA-GA is shown in Algorithm 2.

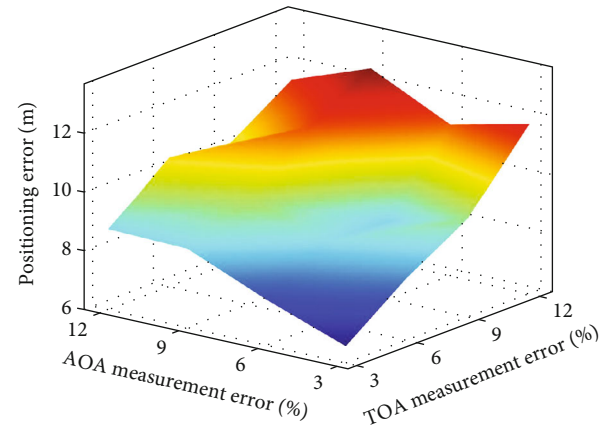

Figure 6: Influence of parameter error on the positioning result.

5. Algorithm Complexity Analysis

In this paper, SSA-GA is used to estimate the target location. We analyse and compare the average computing time complexity of SSA-GA and traditional SSA. This paper assumes that the population number of each iteration in SSA-GA and SSA is N_1, the number of iterations is $\bar{L}$, and the update time of position iteration for each leader and follower is T_1 and T_2, respectively. In the iteration process, $T_1 \approx T_2$. And the time for calculating individual fitness is T_3. When SSA-GA runs for the maximum time, the leader population will cross-mutate each time. Because the time of individual cross-mutation is much less than that of calculating individual fitness, the time of cross-mutation can be ignored. After cross-mutation, the leader will recalculate the fitness. So, the total operation time of SSA-GA can be calculated as $T' = \bar{L} \times (N_1 \times T_1/2 + N_1 \times T_1/4 + N_1 \times L_1/2 + N_1 \times T_2/2)$. The total operation time of SSA is $T'' = \bar{L} \times (T_1 + (N_1 - 1) \times T_2)$. The above two formulas are simplified to obtain that the average computational

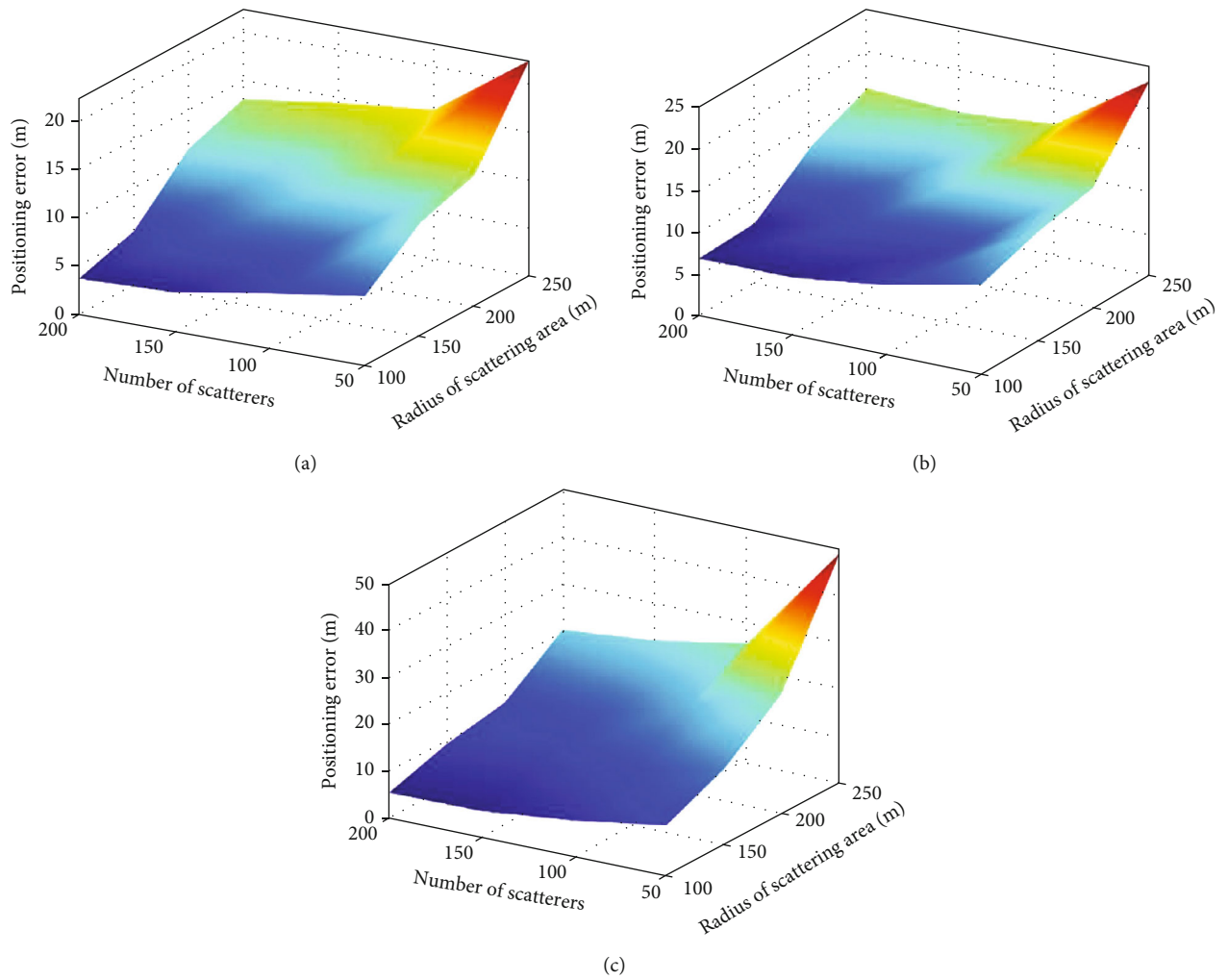

Figure 7: Effect of optimization algorithm on positioning performance. (a) SSA-GA. (b) SSA. (c) LM.

time complexity of SSA-GA and SSA is $O(7 \times L_1 \times N_1/4)$ and $O(L1 \times N1)$, respectively.

6. Results and Analysis

In this section, the performance of the proposed method is analyzed comprehensively through Monte Carlo simulations under various parameter settings. Consider a typical outdoor NLOS propagation environment, let the positioning range be 500 m × 500 m, and the position of the BS is $(0, 0)$. The measurement errors of AOA $\widetilde{\theta}_i$ and TOA $\tilde{t}_i$ are taken to be Gaussian distributed with a mean value of 5%. The scatterers obey the Gaussian distribution in the scattering region with known radius and centre, in which the mean value is the centre of the scattering region. Each positioning results are the average of 100 Monte Carlo simulations. The specific simulation setup parameters are shown in Table 1.

First, we study the performance scatterer filtering. Figure 3 depicts the clustering results with and without filtering out interference scatterers. It can be seen that the interference scatterers are thinly distributed and filtered out. Furthermore, the number of interference scatterers increases from 12 to 17. Figure 4(a) shows the cluster centre error with and without filtered interference scatterers. As shown in Figure 4(a), filtering scatterers can effectively decrease the clustering centre error for different numbers of interference scatterers. In order to comprehensively evaluate the effect of filtering interference scatterers on positioning accuracy, Figure 4(b) presents the positioning error with and without filtering out interference scatterers.

The cumulative distribution functions (CDF) of positioning errors for the SSA-GA, SSA, and LM algorithms [18] are represented in Figure 5. Here, the maximum number of iterations is set to 50. The results show that the localization results using the SSA-GA are better than those solved by the other two optimization algorithms; it is because the proposed SSA-GA has better global search ability and avoids the occurrence of local optimization, and the target position is more accurate.

In the actual positioning scenario, there are measurement errors in the multipath parameters. Figure 6 illustrates the influence of the test errors of AOA and TOA on positioning accuracy. It is shown that with the increase of AOA and TOA errors, the positioning performance decreases. During localization, AOA is only used for scatterer filtering. TOA is used to construct the target equation,

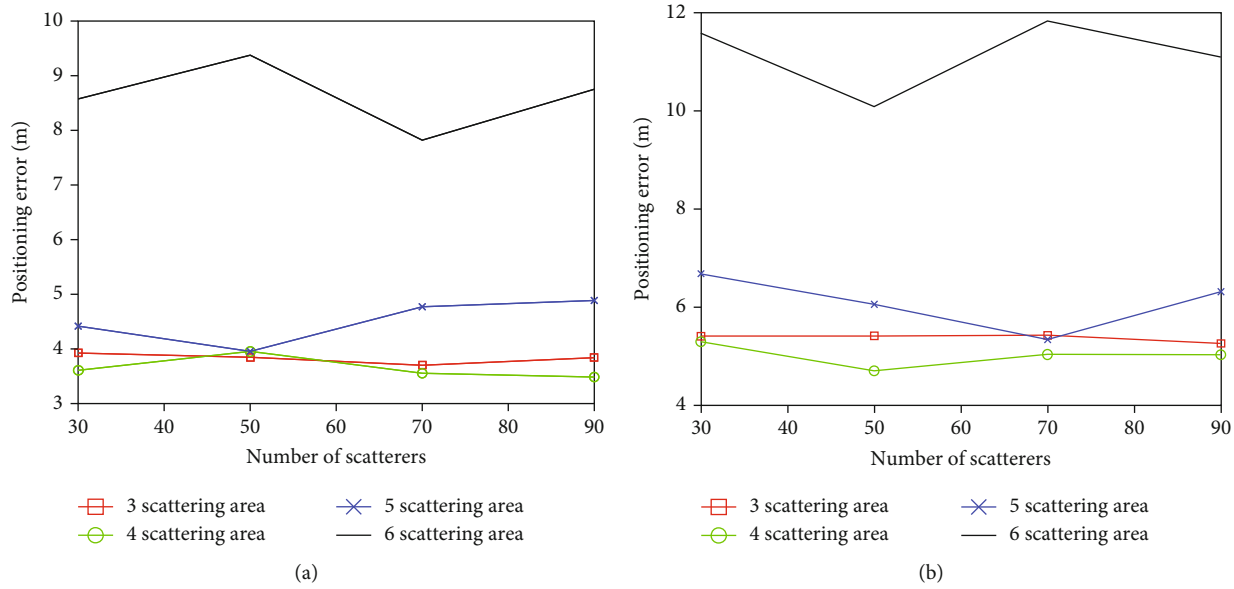

Figure 8: Influence of the number of scattering regions on positioning performance. (a) The range of positioning area is 300m × 300m. (b) The range of positioning area is 400m × 400m.

so the localization performance decreases more rapidly with the increase of TOA error.

For three scattering regions with a given radius and number of scatterers, Figure 7 shows the positioning error using three optimization algorithms. We can derive that the proposed SSA-GA has higher localization accuracy compared to the SSA and LM algorithms in Figure 7, and the positioning error is less than 5%. The positioning error becomes larger as the radius of the scattering area increases. And when the number of scattering scatterers increases, the positioning error becomes lower.

In order to further study the factors affecting positioning accuracy, we simulate the proposed method in a different number of scattering regions. We obtained the positioning errors of the proposed method under the conditions of 3, 4, 5, and 6 scattering regions, respectively, as shown in Figure 8. Figures 8(a) and 8(b) show the positioning error when the positioning range is 300m × 300m and 400m × 400m, respectively. It can be seen that when the number of scattering areas is less than 6, the positioning error fluctuates in a small range, and with the increase in the number of scattering regions, the aggregation of scatterers decreases, resulting in the obvious increase in positioning error.

7. Conclusion

In this paper, the problem of target localization in outdoor NLOS propagation environment is addressed by fused AOA and TOA measurements. Firstly, the Gaussian kernel function is used to judge and filter the interference scatterers to improve the clustering accuracy of multipath parameters. Furthermore, a heuristic optimization algorithm SSA-GA is proposed to solve the target localization function. The algorithm expands the leader population in SSA and iterates the leader position through cross and mutation, which overcomes the local optimal problem of traditional algorithms and improves the positioning accuracy. Finally, the simulation results verify the effectiveness of the proposed localization method in a NLOS propagation environment and show that the positioning error is within 5% of the positioning range. The main direction of future work is to verify the applicability of the proposed positioning algorithm in a three-dimensional NLOS environment and carry out multipath measurements in the actual scenario to verify the positioning accuracy of the proposed positioning method.

Data Availability

The author can provide all the original data involved in the research.

Conflicts of Interest

The author indicates that there was no conflict of interest in the study.

Acknowledgments

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Research Article

Analysis and Application of Gymnastics Sports Characteristics Based on Artificial Neural Network and Intelligent Optimization

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Gymnastics has attracted people's attention in various competitions by virtue of its beautiful movements and difficult technical performances. The research and exploration of neural network theory are to make the process from receiving instructions to completing actions in one go while sending instructions. Compared with the previous competitive gymnastics, it mainly relies on personal understanding and coach's guidance to get high-scoring movements. Through intelligent calculation, it can decompose and calculate each movement in detail and adjust its strength, so as to further improve its excellent characteristics. We combined artificial neural network and intelligent optimization method to achieve more scientific and reasonable guidance for gymnastics, so that people can get better performance in performance and competition. The experimental summary of this paper is as follows: (1) Under the analysis of sample data 5000, it shows that the right segmentation curve is superior to the left segmentation curve and is relatively stable. (2) The BP neural network is obviously higher than the other two algorithms in the experimental test under different dimensions, and the qualified dimension value is controlled within the standard range. (3) In the experimental diagram of mean square error, the ideal error value is about 0.005, and it is possible to reach this target value only under the condition of perfect performance. (4) Convergence function is to explore the gracefulness of action analysis, and the convergence of its artificial peak group greatly shows the performance of global exploration.

1. Introduction

Gymnastics is actually a project to explore beauty. No matter from that point, it is a perfect fusion of physical and mental beauty. From the difficult movements of competitive sports to the flexibility of the body combined with the rhythm of music, it is the embodiment of aesthetics. In order to show this sport perfectly, this purpose is achieved by designing excellent calculation means. The global balance judgment is obtained. Combined with the specific analysis of related research fields, we can get balanced aesthetic characteristics without violating moral spirit. At present, sports events still need to go a difficult way in practice, so it is necessary to attach importance to the soul beauty of gymnastics development. This paper combines the development trend of gymnastics in algorithm skills. The purpose of making detailed goal planning is to make people who love this sport full of love. Combined with the background of the new era and in the context of governance modernization, this paper discusses the logical implication and practical strategy of comprehensively deepening the reform of professional sports in China [1]. It is pointed out that individual sports associations should improve their income-generating ability, aiming at promoting the smooth progress of the reform of individual sports associations in China [2]. The process investigation and logical analysis of the management mechanism of sports associations in China, combined with the reality, analyze the realistic challenges of the reform of the management mechanism of sports associations in China [3]. Through the interview method, the managers of multi-item sports associations were interviewed, and abundant first-hand research materials were obtained [4]. This paper

combs three modes of the current reform of national individual sports associations and puts forward countermeasures from the aspects of reform objectives and top-level design [5]. This paper probes into the historical evolution and contradictions of the development mode of competitive sports in China at present and provides theoretical ideas and operational suggestions for the new round of competitive sports reform and development [6]. This paper makes an in-depth study on the materialization development of Chinese Basketball Association and puts forward the path and policy suggestions to further promote the materialization development of Chinese Basketball Association [7]. This paper describes the "due" appearance of the reform and development of national individual sports associations from the perspective of national governance, examines the realistic prospect of the reform of project associations, and puts forward countermeasures [8]. It is pointed out that the perfection of sports governance system depends on the organic unity theory of government embeddedness and individual sports association autonomy, and the embeddedness governance theory puts forward the analytical framework of government embeddedness and association autonomy [9]. This paper combs the reform of China's sports management system and puts forward some ideas for the new round of sports management system reform [10]. Put forward the standard construction of "four modernizations" of sports associations, and then put forward the development and implementation path of sports associations, introduce relevant policies, and improve the corporate governance structure of associations [11]. This paper makes an in-depth analysis and research on the development of competitive gymnastics in China in recent 10 years, which shows that the development of competitive gymnastics in China presents significant regional characteristics and imbalance [12]. This paper discusses the problems existing in gymnastics textbooks at present, and it is of great significance to enrich the basic theory of gymnastics [13]. This paper probes into the continuation of the dominant position of competitive gymnastics in China and seeks the strategy of getting rid of the development dilemma of competitive gymnastics in China [14]. This paper reviews the traditional research on the evaluation index system of competitive sports and should adhere to the principles of sustainable development, self-organization, and operability [15].

2. Introduction of Intelligent Optimization and Artificial Neural Network

2.1. Basic Theory of Intelligent Optimization Algorithm. According to the behavior of animals and the statistics of a large number of random samples, scientists have concluded that the population needs special physiological and psychological changes when taking certain behaviors. That is to say, in random search, a calculation range is determined, and the modeling process can be calculated by function calculus. An intelligent optimization algorithm is easy to implement, simple in theory, and excellent technology verified by experiments, which is a common skill for people to deal with complex problems.

2.1.1. Firefly Algorithm. It is suggested that the relationship between absolute brightness of fireflies and objective function should be expressed as follows:

$$I_i = f(X_i), X_i = (x_{i1}, x_{i2}, \cdots, x_{iD}), \tag{1}$$

where N and D are group size and problem dimension, respectively.

To calculate the attraction between firefly populations, the mathematical formula is

$$\beta(r_{ij}) = \beta_o e^{-\gamma r_{ij}^2}. \tag{2}$$

It indicates the attraction between firefly x_i and x_j, and the light attraction at $r = 0$ is β 0. It is

$$r_{ij} = \left\| X_i - X_j \right\| = \sqrt{\sum_{d=1}^{D} \left(x_{id} - x_{jd}\right)^2}. \tag{3}$$

The distance D between the two is the darker firefly's movement to the brighter, achieving better light absorption. The moving formula [16] is as follows:

$$xid(t+1) = xid(t) + \beta(rij) \cdot (xjd(t) - xid(t)) + \alpha\tau. \tag{4}$$

T is the number of iterations, and $D = 1, 2, \cdots, D$.

2.1.2. Process Demonstration of Algorithm. In order to show the evolution process of the algorithm more intuitively, it is realized through repeated experimental data support and iterative optimization. Detailed Figure 1 is shown.

The final parameters of this time are judged by the initial position and brightness of fireflies, and then the position and brightness of the next movement are updated.

(1) Fireflies have no gender distinction and attract each other mainly through light intensity

(2) The intensity of illumination is directly proportional to the attraction and inversely proportional to the distance between them, indicating that fireflies with darker brightness will move to brighter ones, thus realizing the dominant brightness of the group

(3) Its brightness is determined by physiological reflection and also affected by the environment

2.2. Basic Theory of Artificial Bee Colony Algorithm

2.2.1. Biological Theory of Bee Colony Algorithm. The biological process significance of honey collection by bees lies in pollinating plants. In the process of honey collection, the work is carried out at three levels: food source, employment bee, and wandering bee. The implementation of the work should control any information to avoid omission, which can effectively improve the viscosity of bee sugar. The position transmission between bees and the emission of their own odor can cover all flowers in all aspects, so that each flower can pollinate.

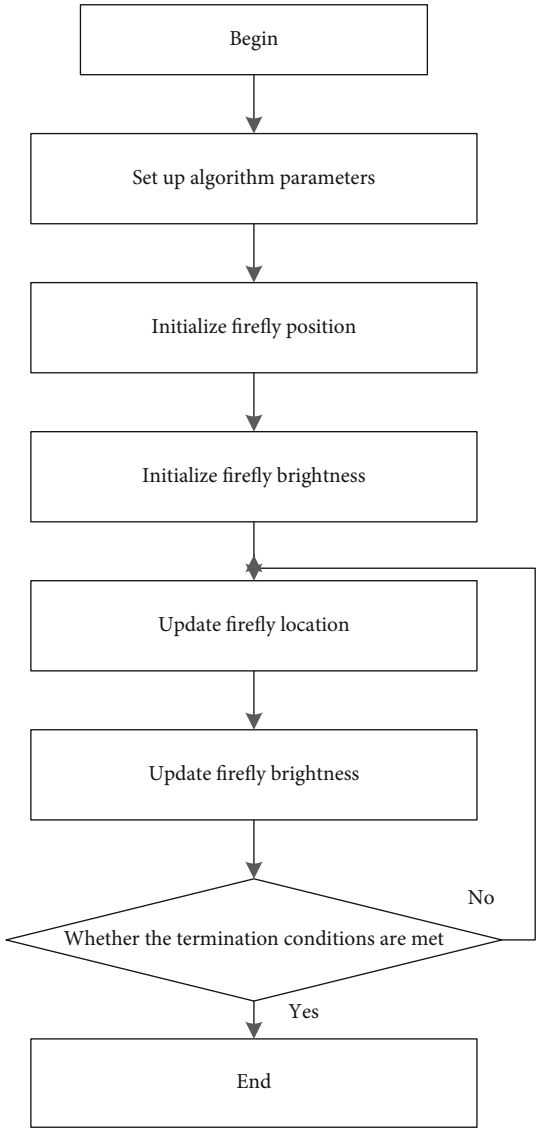

Figure 1: Flow chart of firefly algorithm.

2.2.2. Basic Principles of Calculation. Initialize the population [17]. The definition is

$$x_i = \left(x_i^1, x_i^2, \cdots, x_i^d\right). \tag{5}$$

Among them,

$$x_i^j \in \left(x_{\min}^j, x_{\max}^j\right), \quad i \in 1, 2, \cdots, N, \tag{6}$$

It represents the upper and lower bounds of the search space on the J dimension and obtains the dimension of D. In the process of initial population formation, it is necessary to divide the population according to the honey harvesting ability, which is aimed at not only rationally distributing the work but also effectively improving the quality and efficiency of honey harvesting.

The initial equation of population [18] is as follows:

$$x_i^j = x_{\min}^j + \text{rand}\,(0, 1) \times \left(x_{\max}^j - x_{\min}^j\right). \tag{7}$$

Search for food sources

$$v_i^j = x_i^j + \text{rand}\,(-1, 1) \times \left(x_i^j - x_n^j\right). \tag{8}$$

v represents the updated food location, and rand is any value between -1 and 1.

The probability of honey source [19] is as follows:

$$\text{prob}(i) = \frac{\text{fit}(i)}{\sum_{i=1}^{N} \text{fit}(i)}. \tag{9}$$

Fit indicates the fitness of honey source, so as to judge the appropriate value. In terms of value, it is necessary to predict the honey amount that may appear in honey source and judge whether it meets the most basic requirements and whether it meets the daily work of the population. When an individual does not find a better source after searching for many times, he will use the existing resources to collect honey. With good food source information, the best food source can be obtained by iterative optimization for many times, which is the realization significance of this optimization.

The transformation of objective function [20] is as follows:

$$\text{fit}(i) = \frac{1}{1 + fi}, \quad f_i \geq 0, \tag{10}$$

$$\text{fit}(i) = 1 + abs(f_i), \quad f_i < 0. \tag{11}$$

$f_i$is the objective function of the food source, and abs represents the absolute value of f_i.

2.2.3. Basic Flow of Artificial Bee Colony Algorithm. Through the above analysis and calculation, a complete flow chart is constructed, and the experimental diagram is shown in Figure 2.

Through the hard work of hired bees and uninterrupted honey collection as the basic condition, we can find excellent source markers within a reasonable range, so as to get a better collection place.

2.3. Research on BP Neural Network Algorithm. The number vector of nodes between levels is calculated to construct the connection weight, and the output threshold is calculated.

In activating the function [21], the formula is

$$f(x) = \frac{1}{(1 + e^{-x})}. \tag{12}$$

The first-order function [22] is

$$f'(x) = f(x)(1 - f(x)). \tag{13}$$

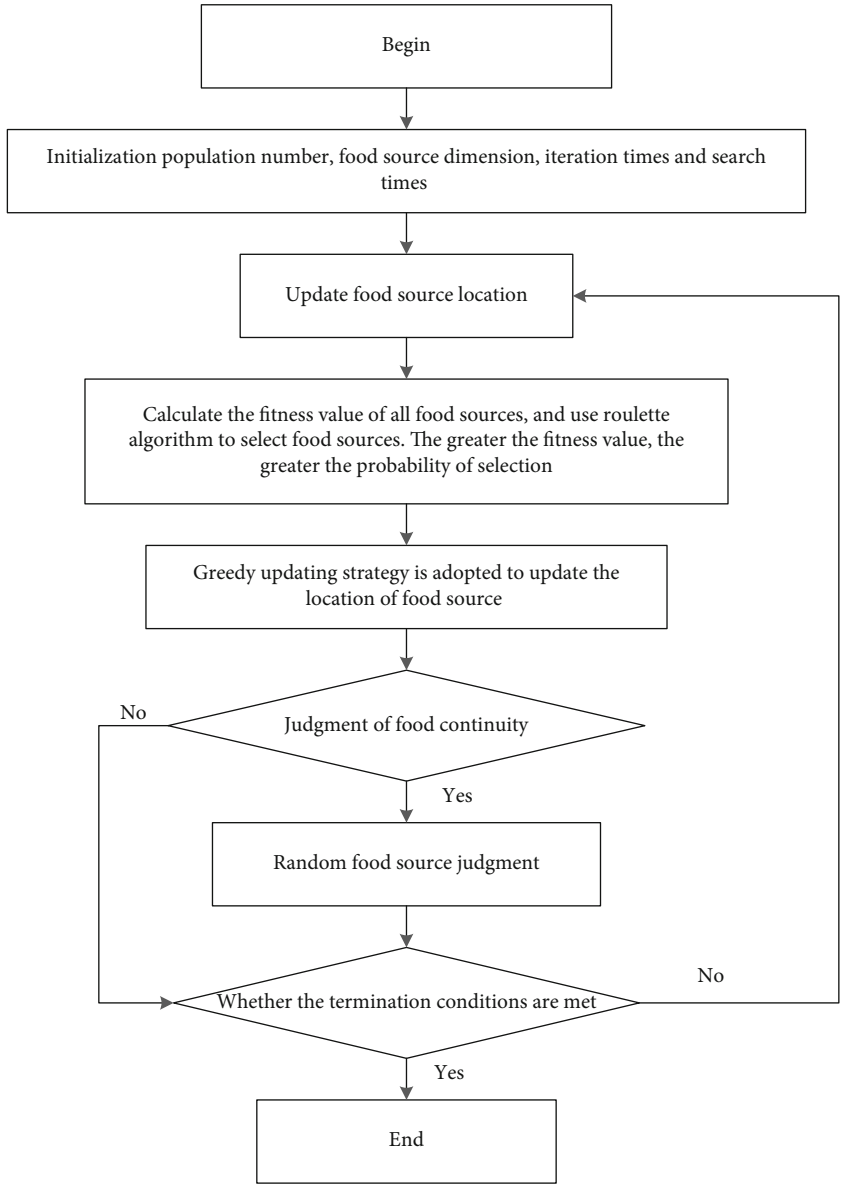

Figure 2: Flow chart of artificial bee colony algorithm.

There are also

$$s_j^{(k)} = \sum_{i=1}^{n} a_i^{(k)} w_{ij} - \theta_j, \tag{14}$$

$$b_j^{(k)} = f\left(s_j^{(k)}\right), \tag{15}$$

$$l_i^{(k)} = \sum_{j=1}^{p} b_j^{(k)} v_{jt} - \gamma_t, \tag{16}$$

$$c_i^{(k)} = f\left(l_t^{(k)}\right). \tag{17}$$

The interval value of the actual output $c_i^{(k)}$ of the network is (0, 1), and the interval value of the output y_t is $[m, m]$.

Ideal output [23] is

$$\tilde{y}_t^{(k)} = (B - A)\frac{y_t^{(k)} - m_t}{M_t - m_t} + A. \tag{18}$$

The actual output corresponds to the actual value:

$$\tilde{c}_t^{(k)} = m_t + \frac{\left(c_t^{(k)} - A\right)(M_t - m_t)}{B - A}. \tag{19}$$

Calculate the sum of squares of errors of k learning models.

$$E_k = \frac{1}{2}\sum_{i=1}^{q}\left(1 - \frac{m_t + \left(\left(c_t{}^{(k)} - A\right)(M_t - m_t)/(B - A)\right)}{y_t{}^{(k)}}\right)^2. \tag{20}$$

In the network, there will be obvious deviation in the output value interval in the actual situation, so the ideal output is standardized and the standard interval is set as $[B, A]$. At the same time, the number of nodes in the hidden layer needs to be output to all levels of the output layer to ensure that the number of nodes in each interval is equal.

2.3.1. Mathematical Derivation of BP Network. In order to reduce the positive gradient of the sum of squares of relative errors, it is necessary to calculate the partial derivative of the actual output.

Partial derivative [24] is as follows:

$$\frac{\partial E^k}{\partial c_t{}^{(k)}} = \left(1 - \frac{m_t + \left(\left(c_t{}^{(k)} - A\right)(M_t - m_t)/(B - A)\right)}{y_t{}^{(k)}}\right) \cdot \left(-\frac{M_t - m_t}{(B - A)y_t{}^{(k)}}\right). \tag{21}$$

The mean square error influence degree under k learning models can be obtained, namely,

$$\frac{\partial E^k}{\partial v_{jt}} = \frac{\partial E^k}{\partial c_t{}^{(k)}}\frac{\partial c_t{}^{(k)}}{\partial v_{jt}}. \tag{22}$$

Connect weights in a positive gradient [25], that is,

$$\frac{\partial E^k}{\partial v_{jt}} = -d_t{}^{(k)} b_j{}^{(k)}. \tag{23}$$

According to the principle of gradient descent, the negative ratio of the adjustment amount can be calculated, and the adjustment amount is

$$\Delta v_{jt} = -\alpha\frac{\partial E^k}{\partial v_{jt}} = \alpha d_t{}^{(k)} b_j{}^{(k)}, \tag{24}$$

where a is the learning rate, $a\,E\,(0, 1)$.

The adjustment amount pushed to the threshold is

$$\Delta\gamma_t = -\alpha\frac{\partial E^k}{\partial \gamma_t} = -\alpha d_t{}^{(k)}, \tag{25}$$

$$\Delta\theta_j = -\beta e_j{}^{(k)}, \tag{26}$$

where β is the learning rate, $\beta\,(0, 1)$.

3. Establishment of Neural Network Model of Gymnastics Sports Characteristics

3.1. Model Structure of BP Neural Network. The antierror algorithm based on one-way propagation of multilayer network is the most mature network optimization algorithm. In many fields, it has the conduction function that is difficult to analyze and realizes the fast output algorithm that reduces the difficulty layer by layer, weakens the definition in the sense of fixed parameters, and greatly simplifies the modeling process. Its basic structure includes the input layer, hidden layer, the output layer of the nodes connected with each other, and the same level of conduction mode of nonconnection, in order to build a network model. Its structure diagram is shown in Figure 3.

In order to study and analyze the characteristics of gymnastics, the input layer can be expressed as the gymnastics movements of athletes or related enthusiasts. The hidden layer can be expressed as the arrangement of some difficult actions. The output layer is the perfect performance of gymnastics. Through such a process, the BP neural network model of gymnastics characteristics can be established.

3.2. Training Process of Network Construction. After determining the structure of the network model, it is necessary to carry out training analysis on the network sample data (analysis of athletes' physical characteristics and action completion degree). The specific training process is as follows:

(1) The incentive function is constructed by the connection weights and thresholds between hierarchies

(2) Randomly select the action training set of remote mobilization and reprint it to the network

(3) Split and output the detailed actions of hidden layer in the form of network calculation

(4) The response of network output layer is analyzed

(5) Neuron error is analyzed under given conditions

(6) Calculate the neuron general error of hidden layer

(7) The correction of connection weight and threshold is adopted to reduce the experimental error

(8) Carry out the second optimization and improvement to get the calculation threshold

(9) Randomly select another athlete's characteristic analysis, and repeat the above before doing it, so as to make full use of the training set

(10) Carry out all the above operations, so that every athlete can go to the analysis coach to carry out education and guidance through the analysis results

Through the above-mentioned testing process, the correct concept of training and guidance is objectively considered, so that the sports improvement can effectively adapt to the arrival of special circumstances. Using the BP neural network algorithm to stimulate the action of the data set of learning more quality fitting effect greatly enriched the gymnastics in the health activities of the degree of interest.

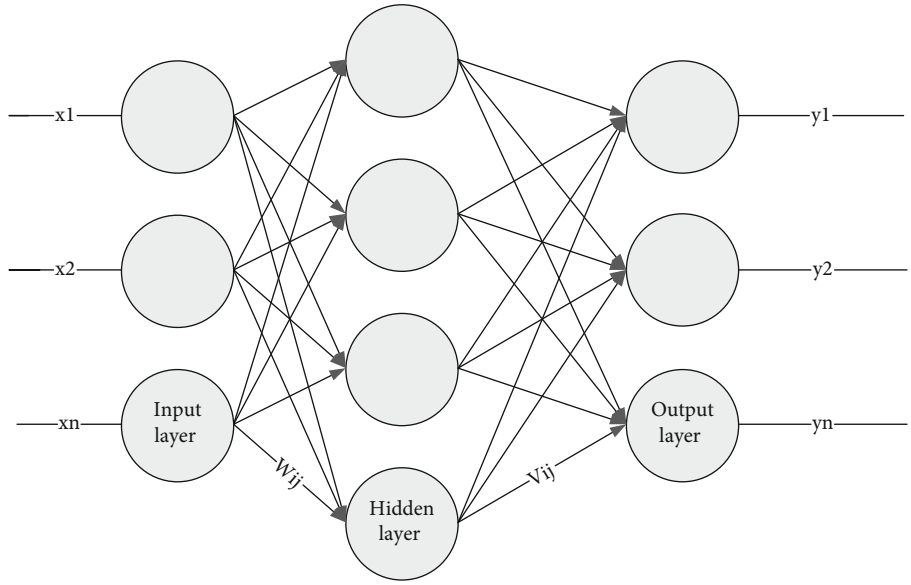

Figure 3: Structure diagram of BP neural network.

3.3. Application of Artificial Neural Network Model in Gymnastics. Gymnastics requires extremely high physical quality of the human body, which cannot be easily realized by ordinary people. It needs to be practiced day after day, also the basic mastery and proficiency of movements. However, it is easy to get hurt in the learning process, and it is common to be unfamiliar with equipment, which leads to injuries. In the process of assessment, we mainly collect and describe the related activities of injury risk. After getting a certain amount of index analysis, we can carry out the pretreatment stage, which is also the most important step to prevent the preparation before injury. Through the early warm-up preparation work will greatly reduce the possibility of injury in the artificial neural model in the factor analysis of the output results effectively further improved. The expected error parameters of the transfer function between network levels are solved. When the error value is greater than the expected value, the training can be stopped for rest to relieve fatigue and reduce the risk rate.

Of course, in individual and double training, the injury rate will obviously increase, and double cooperation will greatly increase the possibility of injury because the degree of tacit cooperation is not enough and the mistakes in operation are all risk factors. In this case, it is necessary to investigate according to the trust of both parties, and it is necessary to carry out risk assessment activities of both parties, so as to make the scientific prediction results more accurate and ensure the common security of both parties.

3.4. Analysis of Gymnastics Characteristics Based on Intelligent Optimization. The above-mentioned firefly intelligent optimization algorithm is used to analyze the sports effect of competitive gymnastics, and the detailed decomposition of actions is obtained after the perfect segmentation. However, compared with the traditional firefly algorithm, it has some local shortcomings, such as slow response speed and difficulty to solve complex problems. In addition, in order to further improve individual quality and obviously improve their own ability, it needs to be explored in a reasonable dimension. Therefore, the finite dimension update method is used to reduce the search speed and improve the search accuracy, which more balances the search speed and accuracy of the algorithm. The improvement of the algorithm is as follows:

(1) The local shortage method is driven by the optimal individual, and the coverage process is realized from the optimal point outward, without letting go of any dead angle. Relatively speaking, a team must have excellent talents to drive people with poor strength to move forward together and make a choice between one-dimensional and all-dimensional

(2) Fireflies are subject to the most individual-led updating strategy, and the dimensions will be randomly selected between one-dimensional and weighted dimensions. By constantly updating the last individual, the honey collection quality of the population can be improved

3.4.1. Leading and Renewal Strategy of Elite Group. Simply put, a team cannot overcome the unity of the team, that is, the introduction of elite groups to enhance the overall strength. The objective function is constructed, and the value of the objective function is determined by comparing and analyzing any individual of the elite group. The experimental results show that the brightness of the optimal individual will be obviously better than that of the basic individual, so elite individuals can lead the monomer to collect honey. The specific formula is as follows:

$$X_b^{\lim} = X_{22b}^{\lim} + \text{rand}\,(-1, 1) \times \left(X_{22b}^{\lim} - X_b^{\lim}\right). \quad (27)$$

(1) It means that the optimal individual is randomly selected from 22 arbitrary individuals to lead the learning training, while lim means updating in limited dimensions.

(2) Retrieve high-quality information for standby, and meet the standard high-quality conditions

(3) The roulette algorithm can be used to collect stage information

(4) When the experimental samples are sufficient, the high-quality search in the area can be performed

3.4.2. Finite Dimensional Renewal Strategy. In order to increase the learning interest of high-quality individuals and avoid interference from other groups, a finite-dimensional updating strategy is adopted to realize the local optimal algorithm. The optimal individual strategy is

$$X^{\lim} = X_b^{\lim} + \text{rand}\,(-1, 1) \times \left(X_b^{\lim} - X^{\lim}\right), \quad (28)$$

where $X^{\lim}$ represents the current update individual, then X_b is the optimal individual, and lim represents the finite-dimensional update mode.

Calculate the current number of iterations as

$$\text{rand}\,(0, 1) < 1 - \left(\frac{0.5 * k}{\text{maxgen}}\right). \quad (29)$$

max is the maximum number of iterations and is also the updated strategy. After the update, an ordinary individual can be randomly selected to follow. The researchers simulated the mathematical method of intelligent optimization mainly through the behavior characteristics of fireflies and artificial bees and further obtained scientific research results. After each task of the group gives instructions, the intelligent optimization algorithm is obtained by iterative process optimization. So far, it can enhance the seeking ability, avoid falling into local defects, and achieve overall equilibrium. In the initial iteration, the right side of the unequal sign is close to 1, which makes the greater the probability, the greater the probability of randomly selecting the best. After entering the final iteration, the right side of the iteration is close to 1/2, and the selection probability becomes 50%, which is beneficial to improve the precision of searching elements in the final iteration.

4. Research on Aesthetic Characteristics and Application of Gymnastics

4.1. An Analysis of the Essence of the Beauty of Sports Gymnastics. Taking the beauty of competitive gymnastics as the research point, we can show the rich and colorful forms of beauty and achieve evaluation through people's perceptual cognition. In gymnastics performance with the rhythm of music, through the beauty of body, difficulty and music beauty of gymnastics form. When stretching the body movements, it is necessary to optimize and improve the movements to perform perfectly. The display of beauty through body movements, rhythmic jumping, and rotation are extremely elegant postures. The combination and induction of the systematic structural elements of competitive gymnastics are to give full play to the unique characteristics of sports events. The summary diagram is shown in Figure 4.

The aesthetic process of competitive gymnastics is the expression result presented by a jury and audience with the perceptual system of feeling, perception, and hearing. The random number distribution of artificial bee colony is shown in Figure 5.

By comparing the left and right segmentation images, we can know that the gradual recursive trend of the left gradient is uneven in the gradient results of random numbers. Among the random numbers with a total number of 5000, (0-0.1) has the largest proportion and then shows a decreasing distribution trend step by step. The right random numbers show the trend of stable arrangement, and this algorithm makes up for the locality and balances the overall search results.

4.2. Algorithm Test and Comparison in Experimental Dimension. In order to verify the performance of the algorithm, 10 dimension values under the standard test are selected for test comparison and judgment. In order to avoid randomness, the population number is fixed to 40, and the iteration times are set to 10, and the convergence curves under dimensions are obtained, respectively. The result of the operation is shown in Figure 6.

Through the calculation results of dimension value, we know that the dimension value of BP neural network is the highest, which is the performance of relativity and stability, but there are still some cases of non-convergence. Compared with the bee colony algorithm, the convergence is not enough, showing two-level differentiation results, which is not enough to calculate high-precision performance. Through the convergence results of different dimensions, it is recognized that updating the calculation strategy will help balance the global and local search capabilities.

4.3. The Expression Form of Gymnastics Beauty. Score the whole process through the form of human expression and posture, and score the specific form of its display according to each part. Each stage and performance skills have their own uniqueness, and each athlete also has his own style, but he needs to report the performance according to the competition rules. The scores of the judges are shown in Figure 7.

In the process of competition, the judges mainly take the posture beauty displayed by the body as the main scoring method, followed by the stretching beauty of the movement as the secondary evaluation method, and the rest of the beauty shows a certain score ratio. There is no relatively big difference in the scoring of each judge, and the highest

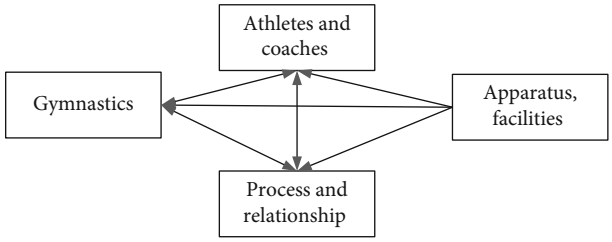

Figure 4: Competitive gymnastics sports system.

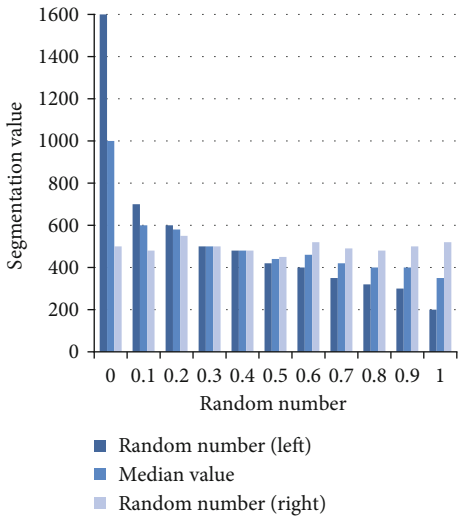

Figure 5: Comparison chart of random number division.

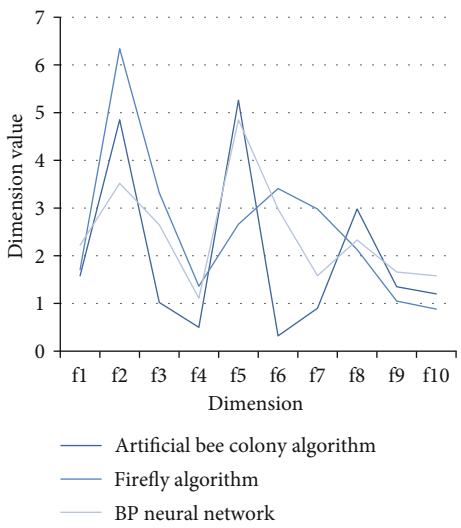

Figure 6: Dimension value calculation result of F1-F10.

score is 95 points, which shows that it needs to be improved in the usual training process.

It needs to be selected according to the difficulty, because the scores of high scores and low scores are obviously different, and the completion of players will be quite different. Therefore, according to the action, the final selection is shown in Figure 8.

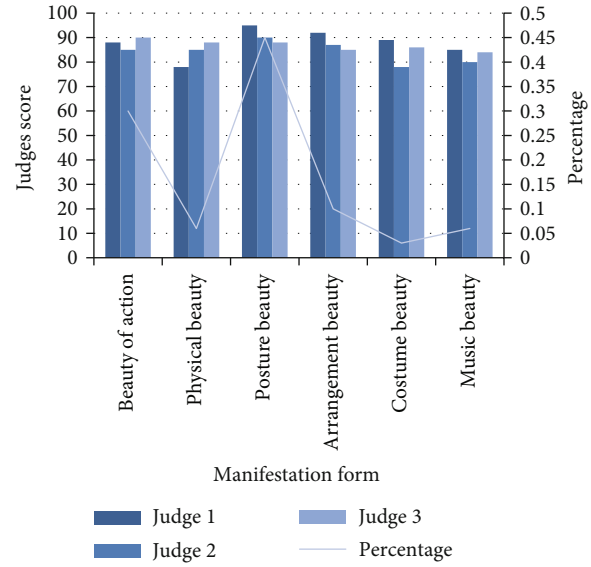

Figure 7: Statistical chart of judges' scoring on the expression form of gymnastics beauty.

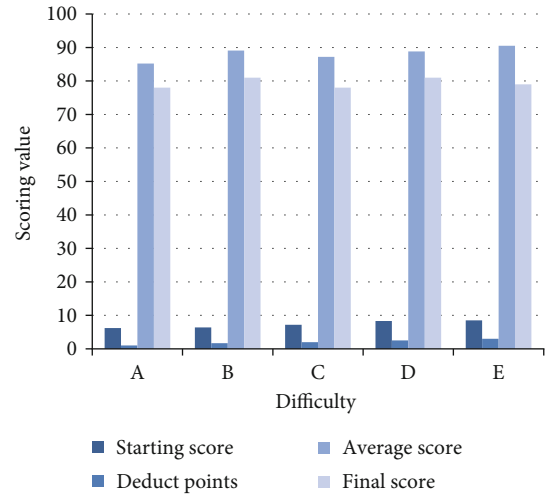

Figure 8: Difficulty score.

Under different difficulty levels, the scoring situation is relatively different. In the face of difficult movements, the judge's score will be relatively high, but the deduction will be relatively serious. In this way, we can complete the corresponding actions according to our own strength and achieve our ideal results. It is also a good thing for some players to break through themselves, which may surpass their usual performance and deserve encouragement.

4.4. Iterative Analysis of Gymnastics MSE under Artificial Network. Collect the frequency of movement error in the process of sports competition to do further action improvement analysis, and get the analysis result of iteration times of network structure. It is also a decision-making means to prepare for the next competition for the experimental analysis of each competition, which greatly improves the performance. The error graph is shown in Figure 9.

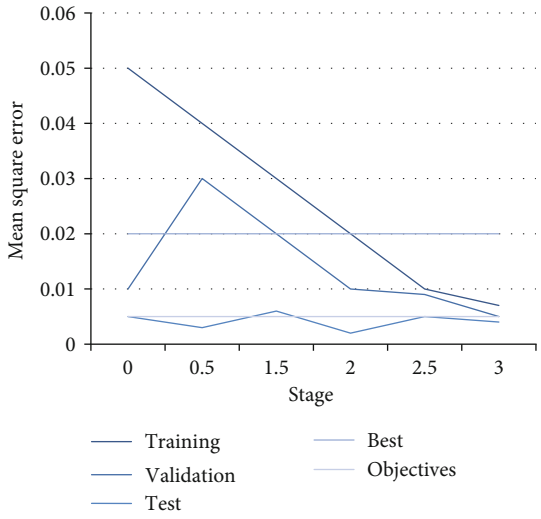

Figure 9: MSE iterative curve of artificial neural network.

From the network model in the training process of iteration times significantly reduced, it shows that in the case of reduced mean square error, good convergence is needed to achieve error accuracy. In order to achieve the ideal target error, it is necessary to carry out the premise work of verification and training and achieve the training purpose of each step.

4.5. Comparative Analysis of Convergence of Gymnastics in Various Algorithms. This paper is exploring the most perfect display form of gymnastics characteristics, focusing on the classical algorithm to optimize algorithm practice, so that gymnastics more perfectly displayed in the eyes of the world. The necessary analysis of the convergence speed of each algorithm causes the perfect posture to show a more balanced temperament. The convergence curve is shown in Figure 10.

It can be clearly seen from the figure that the convergence effect of artificial peak method is the best, and the algorithm has the global search ability. The biological method that individuals depend on populations will give full play to the effective performance of individual capabilities. The three algorithms will effectively improve the effect of scientific training and make a good contribution to gymnastics.

4.6. Correlation Analysis of Spatial Characteristics of Gymnastics Events. Athletes may complete some difficult spatial movement tracks such as rotation, translation, and jumping of the body mechanically when completing the complete set of gymnastics movements. Spatial movement within a certain period of time creates a beautiful artistic shape which is the perfect display of gymnastics art by the athlete or highly skilled person. The performance space of gymnastics is based on body movements, assisted by equipment, and then evaluated according to the types of movements, the distance of space movement, and the flexibility of the body.

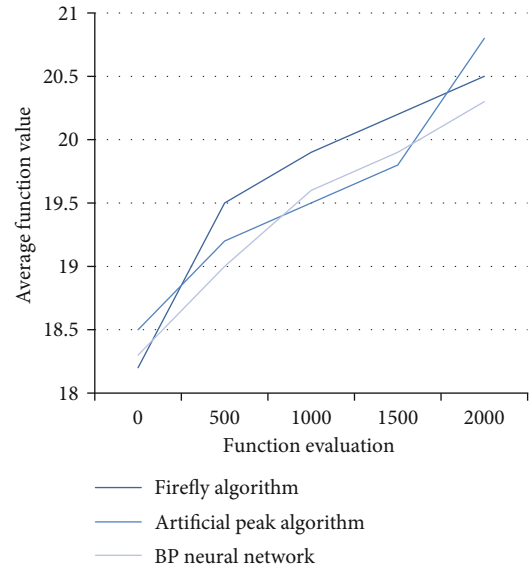

Figure 10: Comparison of convergence curves of three algorithms.

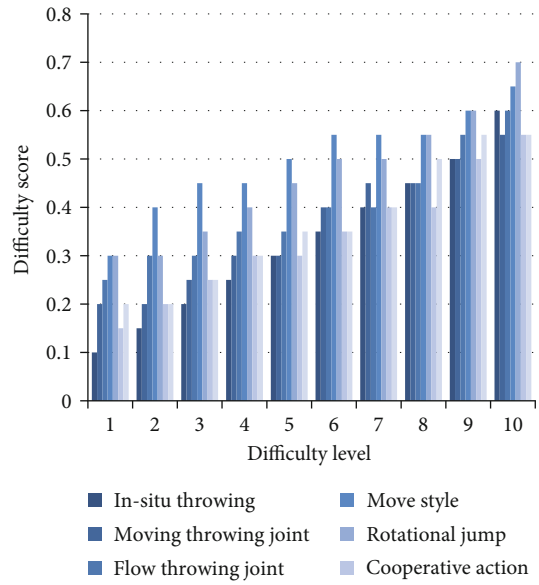

Figure 11: Difficulty and score of action.

The space gymnastics operation performance with team cooperation can show the difficult performance form more comprehensively. Through the form of difficult movement space of the team, this paper explores the form of grasping the body space when the complete set of movements is completed. It studies the spatial characteristics according to the grade coefficient, and the results are shown in Figure 11.

Through the score in the difficulty level, we can judge which spatial performance features are difficult. It belongs to rotary jumping when it is difficult, because sometimes it is necessary to complete difficult movements completely by personal physical quality without the help of equipment. Swelling, twisting, swinging, and landing perfectly in the air to keep balance, which is why there is a high difficulty score of 0.7 on the score level.

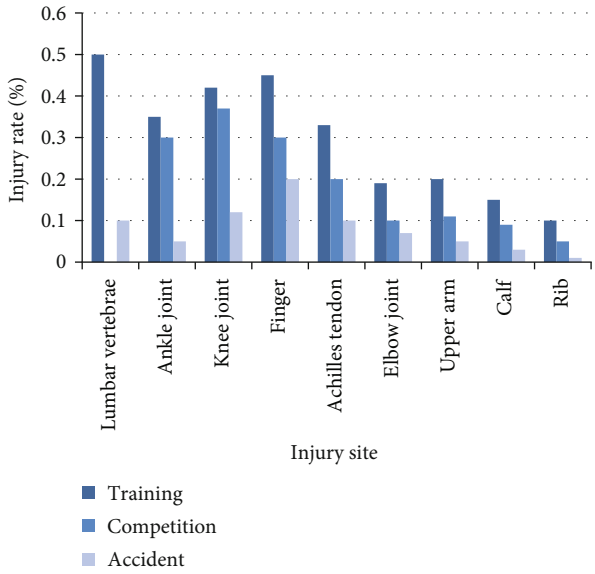

Figure 12: Distribution of main sports injury parts in competitive gymnastics.

4.6.1. Distribution Characteristics of Injury Parts in Gymnastics. After the above-mentioned experimental analysis of gymnastics difficulty, it was considered that in the process of training and performance, it is inevitable that there will be injuries in different positions. Some athletes may train for a specific part to improve their ability to resist injuries. However, the injury between boys and girls can also appear in different parts, and the distribution map of the parts is shown in Figure 12.

Through the histogram, we can know that the possibility of injury during training is greater, which may be caused by long-term fatigue and improper training. However, the main injured parts are generally distributed on joints and important torso, such as waist, ankle joint, and knee joint, so these parts are important protective parts. No matter in training, competition, and peacetime, the injury rates of lumbar spine are 50%, 45%, and 10%, respectively, which is a high-risk injury of sports injury, so protective measures should be strengthened.

5. Conclusion

Gymnastics, with its own unique charm, is displayed in front of people, and is also concerned by everyone in sports. After the advent of the scientific era, the performance form has been greatly changed. From simple movements to difficult realization, it is the improvement of physical quality, but it is also the technical display of scientific analysis. From objective evaluation to today's standardization, it is the experimental result on the road of human exploration, which makes the beauty of human posture fully displayed. This paper subjectively analyzes the detailed description of gymnastic movement characteristics with the mathematical calculation method under the structure of artificial bee colony, firefly, and neural network and explains the skills and methods in the competition process. The experimental contents are summarized as follows: (1) The traditional firefly algorithm has the defect of poor convergence. Based on the investigation of experimental problems, a globally optimized finite-dimensional algorithm is obtained, which greatly improves the search speed and update strategy. (2) The artificial bee colony relies on individual excellent bees to lead the common bee colony to collect honey, which balances the local defects of the whole and greatly improves the quality of collecting honey. (3) Under the neural network, the regular learning mode of greatly simplifying the process and improving the concentration cannot only improve the learning efficiency, but also reduce unnecessary injuries. (4) The diversification of gymnastics brings people rich and colorful feelings, so paying attention to it will also be a way for people to keep fit.

The following are the conclusion and prospect: (1) In the hierarchical structure of neural network, the theoretical knowledge research is not mature enough, and the system needs to be more perfect to embody the experimental results effectively. (2) The influence degree of parameters on the firefly algorithm is regionalized, so it is necessary to find excellent parameters to define the optimization algorithm and modify it. (3) In the elite colony, there will also be some colonies mixed with them, so it is necessary to test and discriminate to determine the excellence of the colony. (4) The constant change of movements is through people making difficult movements according to their physical conditions, so the complex ideas of human nerves can be explained by not only experimental data.

Data Availability

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

Conflicts of Interest

The authors declared that they have no conflicts of interest regarding this work.

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