Hindawi
Mathematical Problems in Engineering
Volume 2023, Article ID 9876215, 1 page
https://doi.org/10.1155/2023/9876215

Retraction

Retracted: Optimization of Music Teaching Management System for College Students Based on Similarity Distribution Method

Mathematical Problems in Engineering

Received 13 September 2023; Accepted 13 September 2023; Published 14 September 2023

This article has been retracted by Hindawi following an investigation undertaken by the publisher [1].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

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

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

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

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

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

References

[1] J. Lian, "Optimization of Music Teaching Management System for College Students Based on Similarity Distribution Method," *Mathematical Problems in Engineering*, vol. 2022, Article ID 6444554, 11 pages, 2022.

Hindawi
Mathematical Problems in Engineering
Volume 2022, Article ID 6444554, 11 pages
https://doi.org/10.1155/2022/6444554

Research Article

Optimization of Music Teaching Management System for College Students Based on Similarity Distribution Method

Jue Lian

Music Department, Faculty of Creative Arts, University of Malaya, Kuala Lumpur 50603, W.Persekutuan, Malaysia

Correspondence should be addressed to Jue Lian; rva180019@siswa.um.edu.my

Received 27 January 2022; Revised 25 February 2022; Accepted 28 February 2022; Published 22 March 2022

Academic Editor: Wen-Tsao Pan

This paper puts forward a method of similarity distribution and applies it to music teaching management system. We use Java language, using JavaME development platform to complete the basic information management, music homework management, music practice management, online classroom management, information notification management, and other modules of the technical implementation. The system uses mobile learning system to provide a convenient learning platform for learners. However, student users can only view the course information in the system. To allow students to know the course change information more quickly when teachers update course information, the system implements the course information update reminder function. Compared with the existing music teaching system, the music teaching system based on Android adopts wireless Internet technology, which is more suitable for the daily habits of today's college students and makes full use of the fragmentary time, which is conducive to improving their learning efficiency and stimulating students' interest in learning.

1. Introduction

With the continuous development of mobile communication technology, it has obtained better research and development results in the field of mobile communication research, making mobile communication technology widely used in society, and people can carry out various kinds of work through mobile communication technology [1]. In recent years, wireless network technology has also developed faster and faster, and various mobile smart devices have emerged, including smartphones, iPad, and other mobile terminals [2]. Through the study of the current stage of education development, it is known that many colleges and universities have introduced microlearning platforms as an aid to traditional teaching and learning for students. Education sector has carried out educational reforms in response to the current educational situation, strongly advocating the widespread use of information technology, optimizing educational equipment in schools, and providing a better educational environment for students [3]. However, there are certain problems with the current reform, and it is completely impossible to carry out a thorough reform in a short time because of the wide and deep influence of traditional teaching [4]. This kind of teaching mode will not make students feel very oppressed or difficult to digest but will allow students to easily learn knowledge and improve the quality of professional teaching. In such a development, there are still major problems regarding the reform of information-based education in the subjects of art. In the traditional teaching of art subjects, information-based means are almost rarely used for the education and teaching of students, and most of them are in the form of on-site practical teaching, which allows students to master relevant knowledge and information in the classroom. However, such a form restricts students' review after class, and when students review after class, many problems will occur, thus affecting students' learning efficiency, which is also a major drawback of traditional teaching [5]. With the continuous development of information networks, the subjects of art have reformed traditional education and teaching, gradually integrating information technology into the actual teaching process, improving the efficiency of teachers in the actual teaching, and bringing a more innovative teaching model for students [6].

With time, online education has been widely noticed and used, promoting the continuous development of online education technology and, to a certain extent, solving the time and space limitations of classroom learning for a long time. At the same time, online education needs to be built on an online education platform that provides students with teaching documents, materials, videos, etc., and students can also upload relevant educational learning resources for the convenience of other students [7]. In the process of learning, students can specify their needs and search and browse to find the resources they need, and since then, online education, also known as education networking, has begun. Because, in the beginning, online education platforms are not meticulous division and classification of some resources, making a large amount of teaching knowledge and resources in a confused and disorganized state, although there are also some relatively good search algorithms, in the face of an excessive amount of information and educational resources, it is difficult to search effectively, and the indexed information also has redundant miscellaneous items, in addition to the poor experience of students in the learning process, not only choosing. Since the microlecture platform is a platform that carries small resources, the length of the video uploaded on this function must not exceed 20 minutes. Students not only have to select and ignore some miscellaneous information in the learning process, but also spend a lot of time to choose the right and desired knowledge resources. Therefore, the problem of information overload is also more serious in online education platforms. At present, many online education platforms are using better information retrieval algorithms. When students search for relevant resources, they enter relevant resource keywords, and the search algorithm searches for teaching resources in the library by keywords, which also slows down the impact of information overload to a certain extent, and students can search for suitable resources to meet part of their teaching resource needs. The keyword search method has developed a lot in resource search and is constantly improving, but inevitably, some problems are overlooked, such as students' screening and sorting of search resources in the search process, which takes a lot of time and seriously affects students' learning efficiency. At the same time, because most online education platforms do not pay attention to individual characteristics, the resources searched are also uniform [8]. To enable students to use their time effectively, learn and expert knowledge efficiently, and improve their experience, online education platforms necessarily need personalized recommendation algorithms to provide personalized recommendation services.

Recommendation algorithms are mainly used to generate recommendations for students by discovering the implicit relationships between students and resources through explicit relationships between students and resources. In this function, students can view a lot of knowledge information about music teaching, which is convenient for students to learn independently. For example, if two or more students are like each other, the learning information of the students can be tracked, and the students with similar learning information can be found through the learning information. It is possible to recommend the resources that similar students have browsed to the students themselves. It is also possible to find similar educational resources and recommend them to students based on the appropriate resources that they have studied and browsed. Compared with the search mechanism, the personalized recommendation algorithm focuses more on individual differences and does not simply use keywords as matching items, which is a more advanced resource matching and resource integration mechanism, and the key is to solve the information overload problem.

2. Status of Research

Gimeno et al. first proposed recommendation systems, and since then, they have developed extensively and gradually become a very important academic research area and have been applied in various aspects, mainly for recommending products at the beginning, and along with the development of e-commerce, they are widely used in e-commerce, and with this comes the increase in the variety and quantity of products, which makes the users need to browse a large number of pages and spend a lot of time while buying products [9]. At the same time, users need to browse many pages, which takes a lot of time, and part of the information browsed is not very relevant to the goods they buy, and then the problem of information overload is manifested, and the user experience is not good, facing this problem, personalized recommendation algorithm comes into view, and personalized recommendation algorithm is added to the e-commerce system [10]. Personalized service is particularly important. The personalized education platform itself is a many-to-many diversified service, which focuses on the relationship between the characteristics and attributes of student users and resources, and the purpose is to construct the interactive mapping relationship between the characteristics and attributes of student users and resources. The construction of the user interest model plays an important role in the recommendation algorithm. Rahmanifard and Plaksina proposed an item-based collaborative filtering algorithm that considers the decay of user interest over time, and the main idea is to add a time decay function to the user's predicted rating formula for an item and to calculate the product of the similarity of the nearest neighboring items and the time decay function as a weighted sum of the weights [11]. Zhi et al. added more time effects to the MF model and pointed out through experimental validation that the weighting method of time decay would lead to the loss of old important data, so the experimental results were not optimal [12].

The core idea of collaborative filtering recommendation algorithm is to calculate the similarity between users or items through a large amount of historical data between users and items and find out the set of users with higher similarity to the target user and then provide the recommendation list for the target user through the historical rating information of these users. Therefore, collaborative filtering recommendation algorithms can be divided into user-based collaborative filtering, item-based collaborative filtering, and model-based collaborative filtering [13]. User-based algorithms calculate the similarity between users and provide a list of recommended items based on the historical rating data of other users who are similar to the target user; item-based collaborative filtering algorithms calculate the similarity between items and recommend items for the target user that are similar to their historical preferences based on their historical rating data; and model-based methods are based on such as linear regression, plain Bayesian machine learning methods, build offline models, and then predict the ratings of the target user based on the rating matrix [14].

This part mainly completes the outline design and the detailed design of the system. In the outline design part, the system architecture design and the functional module structure design are mainly completed, and the framework structure and the functional modules of the system are completed in general. The search range of the turning point interval in dynamic programming is narrowed, thereby improving the running efficiency of the algorithm. In this part, the system database design is completed with table structure and conceptual model. This part is the technical implementation part of the system. Since there are many functions in the system, some typical functions are selected in this part, and their technical implementation is described through function description, code program, and running interface. Based on the implementation, the system functionality and performance tests are completed by designing test cases.

3. Analysis of Dynamic Segmentation and Weighted Integrated Matching Retrieval Algorithm in Music Teaching System for University Students

3.1. Design of Retrieval Algorithm with Dynamic Segmentation and Weighted Integrated Matching. The source of online reviews is the spontaneous comments from consumers after their experiences, which are the feedback of real experience information. Due to the characteristics of online reviews such as free expression form and no syntactic structure, the user preferences expressed by this review information are uncertain. Therefore, based on uncertainty theory, this chapter uses uncertain variables and uncertain sets for sentiment analysis modelling, based on which a new method for computing similar user preferences is proposed, and recommendations are generated. Sentiment analysis modelling based on domain sentiment lexicon focuses on two aspects: sentiment propensity analysis and sentiment intensity analysis [15]. To effectively analyze the sentiment tendency and sentiment intensity of users in comments, it is necessary to calculate the sentiment tendency value and the sentiment intensity value of words in each comment. In this paper, we apply uncertain variables and uncertain sets to build the sentiment tendency and sentiment intensity analysis model of users based on the domain sentiment dictionary.

The automated description of musical content is based on computable time-frequency domain signal feature extraction and will describe the concept and extraction process of individual features. The average response time is 0.358 seconds. When 200 concurrent users have access, the expected design goal can be met within 10 seconds. Considering some client hardware configurations, the performance requirements of actual operation can be met within 1 second. Frequency is simply a sine curve, defined as the number of cycles per second, or Hertz (Hz). For example, the frequency of a sine wave is $f = 440\,\text{Hz}$, which means that it contains 440 cycles per second. The reciprocal of frequency is the period, which physically means the number of seconds, of a sine signal in an oscillation cycle.

In the time domain, the analogy signal $x(t)$ is sampled once every Ts seconds to obtain a data signal representation. The spectrogram of the time domain signal is the expression of the audio signal in the frequency domain, and the spectrogram of the signal can be obtained after the Fourier transform (FT), and the resultant value of the Fourier transform is usually expressed in terms of amplitude and phase, as shown in Figure 1.

The figure shows the corresponding frequency domain characteristics when the same note C4 is played using different instruments, where the top is the flute signal, the middle is the oboe playing, and the bottom is the horn playing. As can be seen from the figure, all the sound frequency positions are the same. However, the spectral shapes of the sounds of different instruments are different [16]. The flute has a softer tone, so the waveform will have less energy than the fundamental frequency. The oboe and horn sounds have more energy in the high-frequency components.

The spectrum is an important factor in determining the quality or timbre of a sound, and complex sounds contain correlated amplitude signals at different frequencies. For a sampled signal $x[n]$, the discrete Fourier transform (DFT) is calculated. Spectral analysis of audio signals is usually performed on a short segment, called a "frame," and the short-time Fourier transform (STFT) can capture the change in frequency content over time, including smart phones, iPad, and other mobile terminal devices. Through the research on the current situation of education development, it is known that many colleges and universities have introduced microlecture platforms as an auxiliary tool for traditional teaching to educate and teach students. The mathematical expression of this transform is to add a window function $w[n]$ to the discrete signal $x[n]$, which generally uses a bell shape and is smooth in a short time.

Short-time correlation analysis of the signal defines the autocorrelation function of a frame signal as $R_n(k)$.

$$R_n(k) = \lim_{N \longrightarrow \infty} \sum_{m=0}^{N-k-1} S_n(m+k) S_n(m) S_n(m-k), \tag{1}$$

where $S_n(m)$ refers to a music signal; $S_n(m)$ is a segment of windowed split-frame signal; N is the window length; k is a lag, $k = (\text{aN} + 1) \sim (N - 1)$. The autocorrelation function will peak at integer times of the fundamental period, so the fundamental period value can be extracted by detecting the location of the peak. To ensure the correct extraction of the fundamental, the window is set to be longer than two fundamental periods when the system is framed, and the

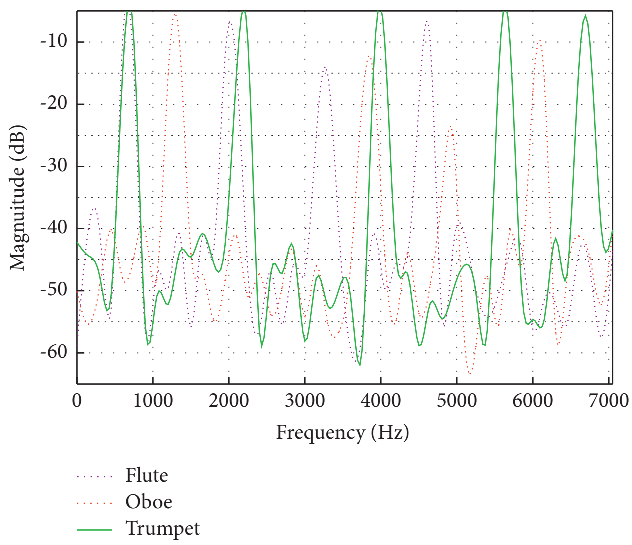


Figure 1: Frequency domain representation of the note C4 played by different instruments.

median smoothing method is used to remove the "wild spots" caused by the fundamental extraction process.

$$y(n) = \lim_{L\longrightarrow\infty} \sum_{m=-L}^{L} x(n+m)w(m)x(n-m), \tag{2}$$

where $x(n+m)$ is the input signal; $y(n)$ is the output of the median filter; $w(m)$ is the smoothing window at the point $2L+1$, satisfying $\sum_{m=-L}^{L} x(n+m)w(m)$, ; m is a point in the smoothing window, $m = \{aL, -L+1, -1, 0, 1, \ldots L\}$; and L is the smoothing window length. Here, for each frame of the music signal, its fundamental note is extracted to form a fundamental frequency string, which can be easily retrieved according to the pitch change because the change of the fundamental string value can correspond to the pitch change [17]. In the traditional amplitude difference note, the segmentation algorithm can affect the average value of fundamental frequency due to inaccurate calculation of note occupancy frames or affect the number of notes due to wrong division and affect the matching accuracy. Therefore, a dynamic threshold segmentation algorithm based on the amplitude difference function is proposed. The algorithm uses the amplitude difference function to dynamically set the threshold value to find the segmentation line position and set the constraints to finally determine the segmentation line. In the traditional teaching of art subjects, information technology is rarely used to educate students, and most of them are in the form of on-site practical teaching, so that students can master relevant knowledge and information in the classroom. The adaptability and accuracy of the algorithm are improved.

The amplitude of the music signal will change dramatically with time, especially the amplitude at the note division has a significant drop, and the amplitude function in the traditional division algorithm is defined as

$$A(x) = \lim_{N\longrightarrow\infty} \sum_{w=0}^{N} a(w), \tag{3}$$

where $A(x)$ denotes the waveform amplitude function; $a(w)$ is the amplitude of the w-th sample point; N is the window length; x is a frame of the input signal $E(0, M)$; M is the number of frames of the input signal. Then, $A(x)$ amplitude difference function is

$$D_A(x) = A(x-1) + A(x). \tag{4}$$

All these features are necessary for a general learning support service system, but in this learning mode, students lack certain incentives and often suffer from learning fatigue, which, coupled with the absence of relevant supervision and oversight when learning online, makes them less motivated and less effective [18]. Therefore, the music teaching system studied in the thesis introduces features such as online learning and music-specific learning, which allows learners to realize a comprehensive music learning platform through classroom learning, homework practice, and information notification, which puts learning in the music learning environment and changes the previous mode of learning without practice on the Internet, enhancing the learning effect. The system can be applied to other professional learning systems, and the functional and dynamic models of the teaching and learning system studied in the thesis can be applied and promoted, and its students' learning mode and practice mode can be adopted in similar online learning systems, which stimulates learners' interest in learning and improves learning efficiency.

From the perspective of the characteristics of music teaching, traditional music teaching is carried out by music professional teachers teaching individuals or groups, a teacher can only teach a few students, and the teaching interval is long, the learning progress of students is also low, also, the teaching of musical instruments involves the synchronization of students' left and right hands and other defects, and the guidance of students' interests is not enough, this music teaching mode, and the teacher and students lack sufficient communication. Under this mode of music teaching, there is a lack of sufficient communication between teachers and students, and teachers cannot grasp and understand students' understanding and proficiency of classroom knowledge in a timely and effective manner, and teaching efficiency and quality cannot be guaranteed [19, 20]. Convenience for other students: in the process of learning, students can clarify their own needs and find the resources they need by searching and browsing. Since then, online education has begun, also known as education network. Therefore, the Android-based music teaching system is developed to meet the traditional teaching needs while improving the above-mentioned traditional shortcomings. The system changed the original offline teaching work to online through the modules of basic information management, student music homework management, music practice management, online classroom management, information notification management, etc., which successfully improved the working efficiency, as shown in Figure 2.

The core idea of INCF is to obtain the items preferred by the target user based on their historical rating data, compute a recommendation list of other items with high similarity to

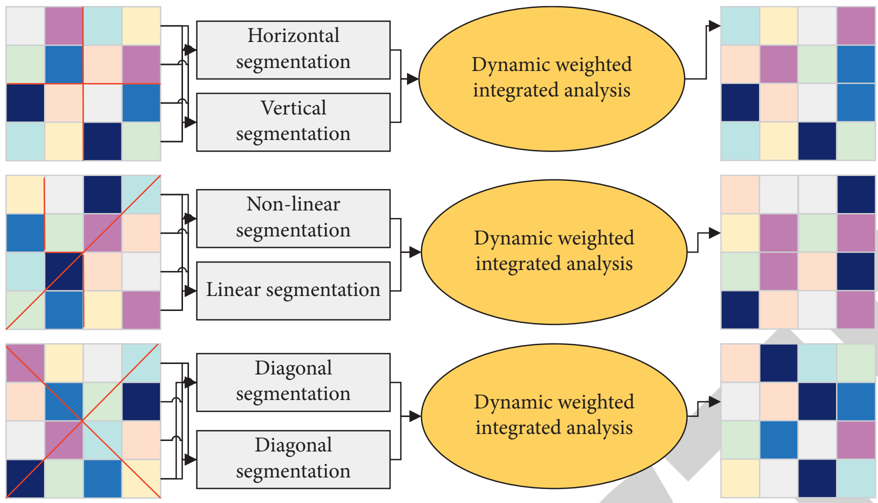


Figure 2: Framework of retrieval algorithm with dynamic segmentation and weighted integrated matching.

the item, and select the k items with the highest recommendation score for a recommendation based on the k-nearest neighbor principle. The similarity calculation is still involved here, and we still use the method of assigned similarity, but it is different from the user-based method.

In the user-based case, the graph structure is a directed unweighted graph, considering the relevance structure between users, because the attention behavior is unidirectional. The assigned similarity between any two items is calculated.

$$s_{\alpha\beta}^{w} = \begin{cases} w \otimes \dfrac{a_\alpha + \beta}{\mathrm{tag}_\alpha} \otimes s_{\alpha\beta}, & a_{\alpha\beta} = 0 \\ \dfrac{1 + w^2}{1 - w} \otimes s_{\alpha\beta}, & a_{\alpha\beta} \neq 0 \end{cases}. \tag{5}$$

Common metrics used to evaluate recommendation systems are Precision, Recall, $F1$, and Coverage, which evaluate the performance of recommendation systems from different aspects.

$$\begin{aligned} \text{Precision} &= \frac{\text{TÈR}}{\text{R}}, \\ \text{Recall} &= \frac{\text{TÈR}}{\text{T}}, \\ F1 &= \frac{\text{Precision} \times \text{Recall}}{\text{Precision} - \text{Recall}}, \end{aligned} \tag{6}$$

where T denotes the set of items reviewed by users in the test set and R the list of recommended items. Therefore, in the online education platform, the problem of information overload is also more serious. At present, many online education platforms use relatively excellent information retrieval algorithms. When students search for relevant resources, they enter relevant resource keywords, and the search algorithm searches the teaching resources in the library through the keywords. In general, Precision and Recall are two contradictory evaluation metrics, when Precision is high, Recall will be low. Therefore, Precision and $F1$ are used in this chapter as the evaluation indexes of the recommendation algorithm, and the coverage index is further considered.

$$\text{Coverage} = \frac{U_{u\hat{I}U} R(u)}{I^2}, \tag{7}$$

where U and I denote the set of users and the set of items, respectively, and $R(u)$ denotes the list of recommended items for user u output by the system. The coverage ratio is used to measure the ability of the recommendation system to recommend items, that is, the ratio of the number of items that can be recommended out to the total number of items. Therefore, a good recommendation system needs not only high accuracy, but also high coverage.

3.2. Application Design of Music Teaching System for College Students. Through system analysis and system outline design, we have a detailed understanding of the functions realized by system. A system is supported by a database, so a complete design of the system database is needed in this part by the system database conceptual model and physical structure design to describe the design of the system database. The database table design is a part of database physical design in this part to the database table design, through the description of the data table structure, to achieve the database physical design. In this part, some tables are selected, and their physical structure is described.

The functional design of the recommendation system is mainly divided into two modules, namely, offline recommendation service and online real-time recommendation service [21–24]. The main difference is that the offline recommendation mainly integrates all the historical data information of users and uses the already set offline statistical calculation method and offline recommendation algorithm to calculate some indicators that can be statistically and computationally calculated in advance to provide the corresponding data support for the real-time recommendation service and front-end and periodically updates the data to relieve the pressure of real-time calculation on the server and reduce the actual response time of users. The data information is not updated in real-time, and the update frequency depends on the algorithm scheduling frequency of the scheduling system [25–27]. In the course list management function, to let students know the changes of their weekly and monthly course information faster, the teacher user needs to update the course information in the system periodically to ensure that students can follow the normal schedule of the course under the teacher's arrangement. In this function, the teacher user can upload the course information, and after the upload is completed, the student user can immediately receive the latest information of the course schedule, so that the students can follow the latest course schedule to study the course. According to the system requirement analysis, the system architecture is divided into three parts, namely, the system data layer, business logic layer, and user interaction layer. The system software architecture is shown in Figure 3.

Data storage is the basic function of the system data; in this layer, it mainly realizes the operation of data storage, data query, data maintenance, etc. The system database specifically includes a music assignment database, student information database, and learning database. This layer provides basic data support and a query interface for system business. Data storage mainly realizes basic data preservation, and this layer provides data storage, but more importantly, it provides data query and statistical interface; all the relevant database operations in the system are realized in this layer [28, 29]. There is similarity between two or more students, and the students' learning information can be tracked, and students with similar learning information can be found through the learning information. The business logic layer includes business rules definition, business processing settings, and user role rules. Among them, business rules definition is used for the system to handle the functional rules of music teaching; user role rules are used for the defined students and teacher's system role assignment, role authorization, etc. From the main framework, the functional operation interface includes basic information management, student music assignment management, music practice management, online classroom management, and information notification management functions.

The physical structure design is described below. In the physical structure diagram of the system in Figure 4, the music teaching platform server is the central server of the system, which provides application services for students' cell phone terminals and teachers and system administrators, and students' cell phone terminals realize data communication with the server through a mobile communication network (GSM, CDMA, etc. of mobile, Unicom or telecom), and teachers and system administrators realize data background maintenance operation. The teachers and system administrators can realize data background maintenance operation through the Internet.

In the management of course information, teachers can add, change, and delete course information on the system according to their actual needs, but students can only view the course information on the system. To let students know the information of course changes faster when teachers update the course information, the system implements the function of course information update reminder, and if the course information in the system has changed, the system will remind users, so that student users can receive the news of course schedule changes faster.

To improve the mode of music teaching in vocational schools, the system visualizes the music teaching process in the form of microlessons on music skills, professional knowledge, basic vocalization, and other lessons. The microlesson teaching mode is characterized using fragmentation and fragmentation of professional knowledge and finally placed in the system in the form of videos for students to view. Such a teaching mode does not make students feel very overwhelmed or difficult to digest but rather enables them to learn knowledge easily and improve the quality of professional teaching. Since the microlearning platform is a platform for small resources, the length of the videos uploaded on this function should not exceed 20 min, and the size of the data should not exceed 200 M, so that the users can view the videos without boredom when the students view them.

The learning of the platform includes not only the learning of microlesson videos, but also the learning of many knowledge aspects. Sentiment analysis modelling based on domain sentiment dictionary is mainly from two aspects: sentiment tendency analysis and sentiment intensity analysis. To let students have access to more forms of learning modes on the platform, the system implements the microlesson design management function, in which students can view numerous knowledge information about music teaching, which is convenient for students to conduct independent learning. The microlesson design management function includes three subfunctions: microlesson information design management, microlesson information viewing, and microlesson information data management. Teachers need to design the content of microlessons in the microlesson information design subfunction and then store and publish it to the system after the design is completed, so that students can view it on the system.

4. Results and Discussion

4.1. Performance Results of the Retrieval Algorithm with Dynamic Segmentation and Weighted Integrated Matching. The DINA modelling was used to derive a vector of student knowledge, and to filter the test questions to be recommended to students based on the variability of their knowledge and weaknesses. Based on students' response information and similarity information among test questions, the test questions to be recommended are filtered and recommended to students. Also, Jaccard was used to calculate the similarity between students based on their responses, and the most similar students were recommended based on their answers. A comparison of the experimental results is shown in Figure 5.

The above algorithms were experimented using test sets of different sizes, and as shown in Figure 5, with the increasing size of the test set, the personalized test recommendation algorithm based on cognitive diagnosis and

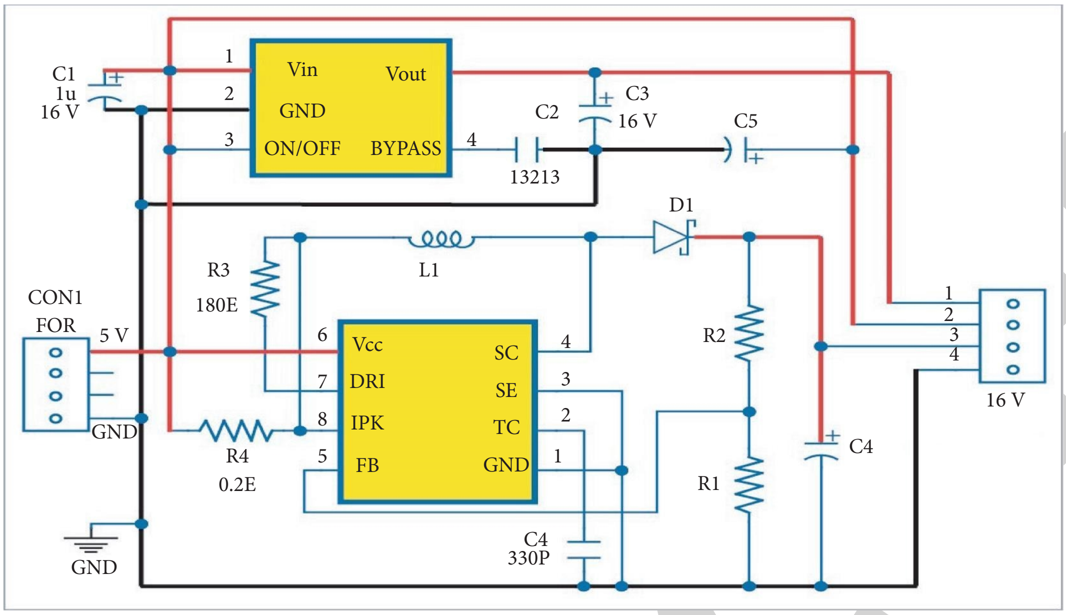
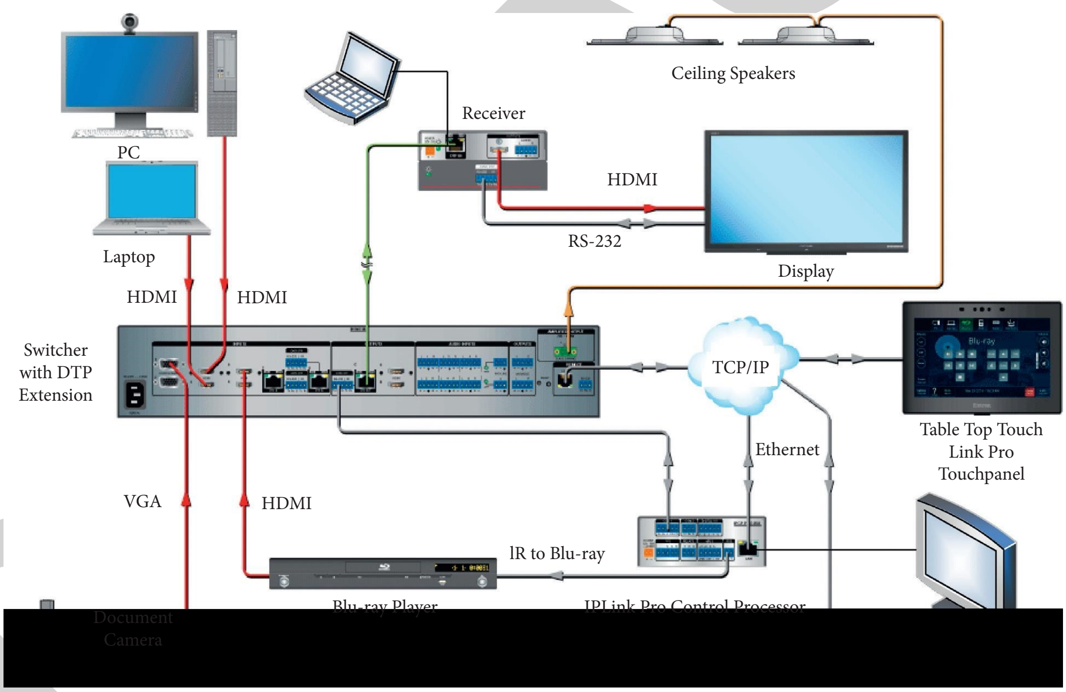


Figure 3: System software architecture.



[redacted]

Figure 4: System physical structure diagram.

attention mechanism has higher recommendation accuracy than the other three algorithms, and the F1 values also have different increases compared to each other. To effectively analyze the user's sentiment tendency and sentiment strength in the comments, it is necessary to calculate the sentiment tendency value and sentiment strength value of the words in each comment. The algorithm uses the cognitive diagnosis method in educational psychology to assess the students' knowledge proficiency level through the cognitive diagnosis model and then rates the test resources through the attention mechanism and neural network method to generate recommendations. With the development of network technology, the rise of online education means that education and teaching are more extensive and comprehensive and can give full play to the sharing of knowledge and resources, overcoming the previous temporal and spatial limitations in education. Online education teaching systems and platforms have sprung up, and the growth of teaching resources is particularly evident with the growing pool of resources and experts. It will be very difficult to manage the growing resource base effectively, and users have their characteristics and individual differences.

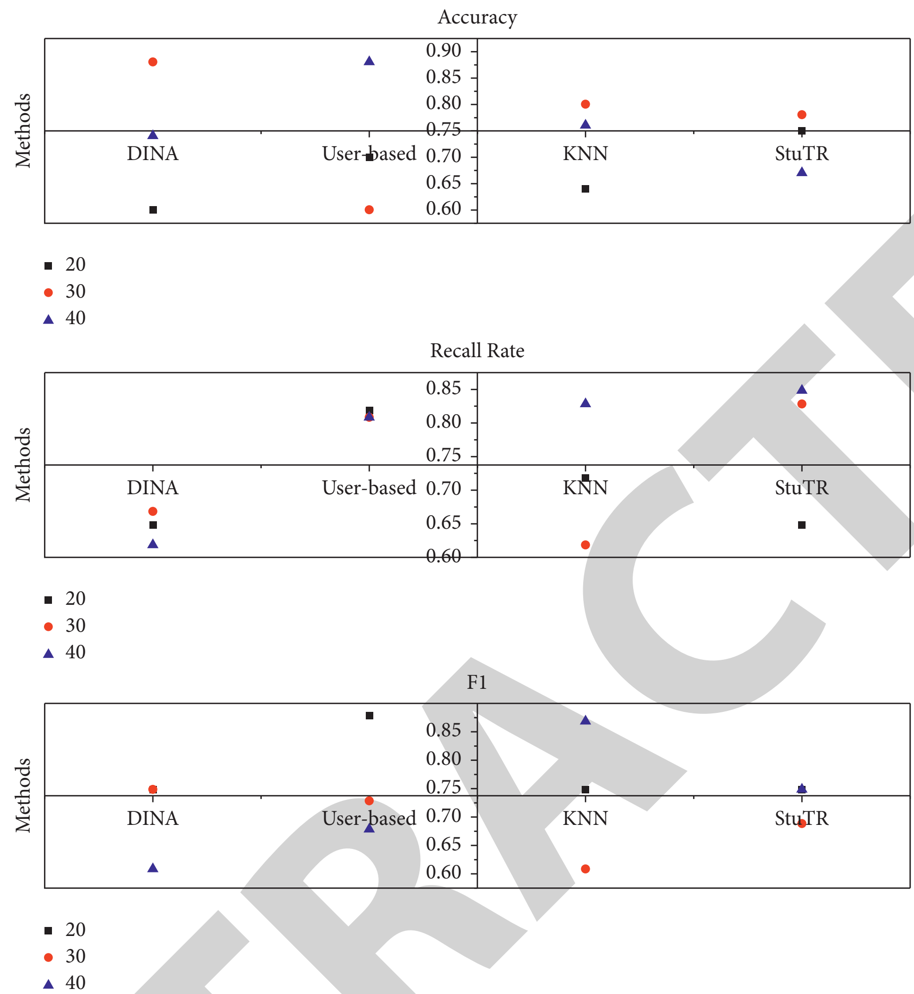


Figure 5: Comparison of experimental results.

The current many online education platforms, mostly for mass education, are unified content; without personalized characteristics analysis of student users, it is difficult to consider the differences between different individual student users and personalized needs. This is difficult for students to find the right focus and spend more time, but do not get better learning results, so the online education platform and personalized services are particularly important. The personalized education platform itself is a many-to-many diversified service, focusing on the relationship between the characteristics and attributes of student users and resources, to build an interactive mapping relationship between the characteristics and attributes of student users and resources. The purpose is to build an interactive mapping relationship between student user and resource characteristics and attributes and to associate many resources in the resource library to form a linked resource relationship network, to achieve the maximum resource utilization rate while ensuring student user experience and driving student user traffic on the website.

We have pointed out that, for multiscale turning point estimation, the regression effect is more satisfactory when the number of turning points is small relative to the amount of data. Figure 6 shows the experimental regression effect, and we can see that the SMUCE regression estimate in step and the regression estimate obtained by our fast DP algorithm both achieve good regression effect, and the number of turning points and the value of each segment parameter function are the same. The mathematical expression of this transformation is to add a window function w[n] to the discrete signal x[n]. The window function generally uses a bell shape and is stationary in a short time. To avoid the experimental effect, Figure 6 is just a chance phenomenon; furthermore, we use the mean square error (MSE) test to compare the accuracy of the SMUCE, fast DP algorithm solution. We still take the Gaussian mean regression model as an example, and the simulated generated data are standard normally distributed independent random variables with data size (100,200,500,1000,200,5000,10000,20000,30000). In the first set of experiments, we control that the number of turning points is fixed, that is, $K = 5$. Figure 6 shows the mean square error of the regression estimates of SMUCE and fast DP for a fixed number of turning points, and we can see that the MSEs of fast DP and SMUCE are equal, because the number of turning points is fixed, as the number of observed data

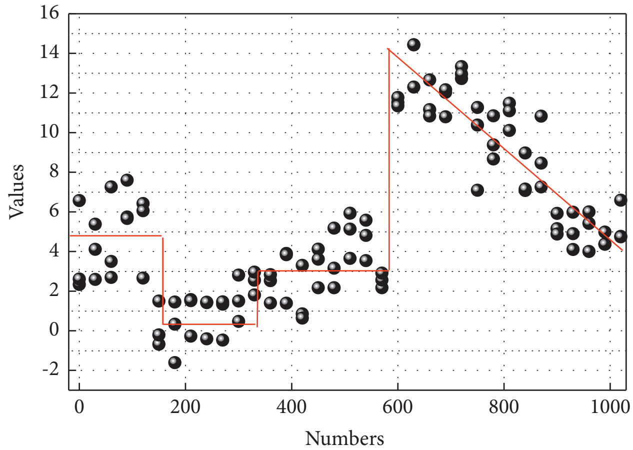


Figure 6: Regression estimates of SMUCE, fast DP for the example data.

increases. The mean square error of both SMUCE and fast DP decreases, showing convergence to the true value.

The traditional dynamic programming algorithm for solving the turning point problem is first introduced, and then a new pruning method is proposed on this basis, which reduces the search range of the turning point interval in dynamic programming by establishing new local dynamic multiscale statistics constraints to determine the left and right boundaries of each segment, thus improving the operational efficiency of the algorithm. Based on this, we propose a new fast dynamic programming solution algorithm that improves the problem of conservative turn point estimation under the traditional global error control and the high computational consumption of the traditional dynamic programming algorithm. Through numerical experiments, we verify that the estimation of this algorithm is equivalent to the SMUCE estimation in step when the number of turning points is not large, and the computational speed is much faster than SMUCE and even close to the PELT algorithm. Also, by comparing fast DP with SMUCE and FDRSeg through the simulation of dental signals, we find that fast DP fits better than SMUCE without more missed turning points, but there is still a gap compared with FDRSeg, which is our next expectation for improvement.

4.2. System Application Results. In addition to functional testing, we also need to perform nonfunctional testing of the system, including system stress testing and cluster performance testing. For the concurrent stress test here, we used LoadRunner for concurrent performance testing in distributed mode, and secondly, we deployed and ran the system server under Linux OS and conducted performance testing on the cluster through Spark. We used LoadRunner to write test scripts to simulate five kinds of accesses, namely, 10, 20, 50, 100, and 200, and to calculate the response of the whole system to test the performance of the system. We specify that 5 people log into the system every 10 seconds, each user visits once in a cycle, and 5 people log out every 10 seconds; the test results are shown in Figure 7.

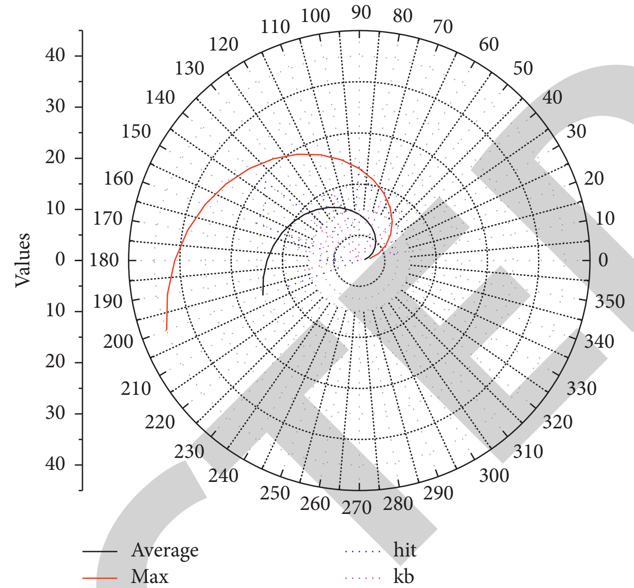


Figure 7: The results of login concurrency test.

Mainly through the system design, recommendation service function design, system implementation, and testing four aspects, a detailed introduction to the development process of the movie recommendation system includes the overall system architecture, data architecture analysis, and design, and the design and implementation of different recommendation service functions combined with the improvement of algorithms in the previous chapters, and the results of each functional module. Functional testing is to test the implemented functions separately through test cases, by clicking on the function menu, entering relevant data and conditions, and the data maintenance function by entering data and testing whether it can be saved normally. The data query and statistical functions are done by selecting the set conditions to complete the statistics and testing whether the statistical results meet the preset conditions. Functional testing is mainly done through test cases to describe whether the test functions work normally, test to find out the situation that cannot be handled in the system functions, and find out the system errors, and test cases are done by testing the design function situation, including function points, test results, and conclusions.

When the system data addition function is operated, there is a corresponding integrity check operation in the client; without going through the server, this check is done in the client, and the corresponding data type check is given eliminating unnecessary invalid data and dirty data entry, ensuring the data quality, and after entering complete data, it can be saved to the database. In this part, the system database design is described by the system database conceptual model and physical structure design. The database table design is a part of the database physical design. In this part, the database table design is used to realize the database physical design through the description of the data table structure. Select some tables in this section to describe their physical structure. When the system deletes the operation, the system has the corresponding confirmation operation, which

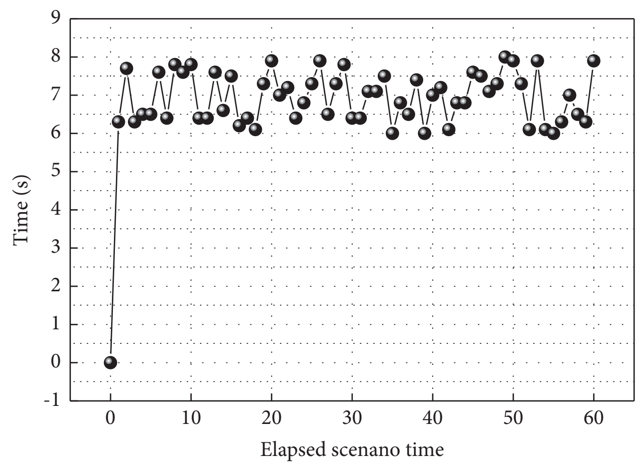


Figure 8: System throughput test results.

reduces the user's accidental deletion operation. The tested data query operation can be fuzzy matched according to the keywords entered by the user and displayed in the form of a list, and the test results meet the expected query objectives. After the system function test, it is known that the system function has concise and safe features in user operation.

The system performance test was implemented by LoadRunner 9.5. The system response time and system throughput were tested by executing query operations at 200 concurrent Visors at the same time, and Figure 8 shows the response time test results. The minimum response time is 0.214 seconds.

From the system response time test results, the system executes query transactions, and the average response time is 0.358 seconds in the state of 200 concurrent users. The expected design target can be met within 10 seconds when 200 concurrent users' access, and considering some client hardware configurations, the performance requirements of actual operation can be met within 1 second. In summary, the system functionality and performance tests were completed according to the corresponding test strategy. The test results show that the system implementation meets the system requirements. This section is the system implementation and testing section, according to the outline design and detailed design of the music teaching system, the implementation of each functional module of the system is completed, and the system testing is completed based on the implementation, and the testing phase includes functional testing and performance testing. The testing shows that the system meets the requirements of functionality and performance.

5. Conclusion

The study of online learners' learning needs for music majors, the analysis of data query and back-end data maintenance needs on the Android side, the proposed functional model to realize student music homework management, music practice management, online classroom management, and information notification management completed the analysis of nonfunctional requirements of the system. The online classroom management provides a planned teaching model for teachers, a step-by-step music learning process for students, and a progression model for mastering music knowledge. In addition to the normal completion of learning, the system achieves communication between teachers and students through information notifications, through which teachers can timely release teaching news, and students can timely obtain various notifications. For the conceptual model and core table structure of the system, which consists of four modules, students' music homework management, music practice management, online classroom management, and information notification management, detailed functions are designed for each of the four modules. The system adopts the Android system and JavaME framework for the mobile side, which realizes the back-end Web side to publish relevant data and maintenance and provides the possibility for students to complete relevant music learning on the mobile side. A combination of structured data and unstructured data is used to complete the database design of the music teaching system and to realize the management of music learning materials and the improvement of music teaching effects.

Data Availability

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

Conflicts of Interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

References

[1] L. Zhou, "Product advertising recommendation in e-commerce based on deep learning and distributed expression," *Electronic Commerce Research*, vol. 20, no. 2, pp. 321–342, 2020.

[2] J. Lin, Y. Li, and J. Lian, "A novel recommendation system via L0-regularized convex optimization," *Neural Computing & Applications*, vol. 32, no. 6, pp. 1649–1663, 2020.

[3] X. Wang, Y. Han, V. C. M. Leung, D. Niyato, X. Yan, and X. Chen, "Convergence of edge computing and deep learning: a comprehensive survey," *IEEE Communications Surveys & Tutorials*, vol. 22, no. 2, pp. 869–904, 2020.

[4] F. Moradi, H. Mohammadi, M. Rezaei et al., "A novel method for sleep-stage classification based on sonification of sleep electroencephalogram signals using wavelet transform and recurrent neural network," *European Neurology*, vol. 83, no. 5, pp. 468–486, 2020.

[5] L. Vrysis, N. Tsipas, I. Thoidis, and C. Dimoulas, "1D/2D deep CNNs vås. Temporal feature integration for general audio classification," *Journal of the Audio Engineering Society*, vol. 68, no. 1/2, pp. 66–77, 2020.

[6] M. Chen, Y. Cao, R. Wang, Y. Li, D. Wu, and Z. Liu, "DeepFocus: deep encoding brainwaves and emotions with multi-scenario behavior analytics for human attention enhancement," *IEEE Network*, vol. 33, no. 6, pp. 70–77, 2019.

[7] G. Ioannakis, A. Koutsoudis, I. Pratikakis, and C. Chamzas, "RETRIEVAL—an online performance evaluation tool for

information retrieval methods," *IEEE Transactions on Multimedia*, vol. 20, no. 1, pp. 119–127, 2017.

[8] T. S. Walia, G. S. Josan, A. Singh, and A. Singh, "An efficient automated answer scoring system for Punjabi language," *Egyptian Informatics Journal*, vol. 20, no. 2, pp. 89–96, 2019.

[9] P. Gimeno, I. Viñals, A. Ortega, A. Miguel, and E. Lleida, "Multiclass audio segmentation based on recurrent neural networks for broadcast domain data," *EURASIP Journal on Audio Speech and Music Processing*, vol. 2020, no. 1, pp. 1–19, 2020.

[10] M. Hartmann, O. Lartillot, and P. Toiviainen, "Interaction features for prediction of perceptual segmentation: effects of musicianship and experimental task," *Journal of New Music Research*, vol. 46, no. 2, pp. 156–174, 2017.

[11] H. Rahmanifard and T. Plaksina, "Application of artificial intelligence techniques in the petroleum industry: a review," *Artificial Intelligence Review*, vol. 52, no. 4, pp. 2295–2318, 2019.

[12] R. Zhi, M. Liu, and D. Zhang, "A comprehensive survey on automatic facial action unit analysis," *The Visual Computer*, vol. 36, no. 5, pp. 1067–1093, 2020.

[13] N. Vryzas, L. Vrysis, M. Matsiola, R. Kotsakis, C. Dimoulas, and G. Kalliris, "Continuous speech emotion recognition with convolutional neural networks," *Journal of the Audio Engineering Society*, vol. 68, no. 1/2, pp. 14–24, 2020.

[14] W. S. Lasecki, C. D. Miller, I. Naim et al., "Scribe," *Communications of the ACM*, vol. 60, no. 9, pp. 93–100, 2017.

[15] J. Le Kernec, F. Fioranelli, C. Ding et al., "Radar Signal Processing for Sensing in Assisted Living: the challenges associated with real-time implementation of emerging algorithms," *IEEE Signal Processing Magazine*, vol. 36, no. 4, pp. 29–41, 2019.

[16] H. Weber, M. Schwenzer, and S. Hillmert, "Homophily in the formation and development of learning networks among university students," *Network Science*, vol. 8, no. 4, pp. 469–491, 2020.

[17] D. D. Ruikar, R. S. Hegadi, and K. C. Santosh, "A systematic review on orthopedic simulators for psycho-motor skill and surgical procedure training," *Journal of Medical Systems*, vol. 42, no. 9, pp. 168–221, 2018.

[18] K. K. Ganguli and P. Rao, "On the perception of Raga motifs by trained musicians," *Journal of the Acoustical Society of America*, vol. 145, no. 4, pp. 2418–2434, 2019.

[19] S. Deldari, D. V. Smith, A. Sadri, and F. Salim, "ESPRESSO: entropy and shape aware time-series segmentation for processing heterogeneous sensor data," *Proceedings of the ACM on Interactive, Mobile, Wearable and Ubiquitous Technologies*, vol. 4, no. 3, pp. 1–24, 2020.

[20] M. R. Jabbarpour, H. Zarrabi, R. H. Khokhar, S. Shamshirband, and R. C. Kim-Kwang, "Applications of computational intelligence in vehicle traffic congestion problem: a survey," *Soft Computing*, vol. 22, no. 7, pp. 2299–2320, 2018.

[21] M. Bajor, T. Haque, G. Han, C. Zhang, J. Wright, and P. R. Kinget, "A flexible phased-array architecture for reception and rapid direction-of-arrival finding utilizing pseudo-random antenna weight modulation and compressive sampling," *IEEE Journal of Solid-State Circuits*, vol. 54, no. 5, pp. 1315–1328, 2019.

[22] T. E. Simos and C. Tsitouras, "Evolutionary Derivation of Runge–Kutta pairs for addressing inhomogeneous linear problems[J]," *Numerical Algorithms*, vol. 87, pp. 1–15, 2020.

[23] J. Yang, C. Wang, H. Wang, and Q. Li, "A RGB-D based real-time multiple object detection and ranging system for autonomous driving[J]," *IEEE Sensors Journal*, vol. 20, no. 20, pp. 11959–11966, 2020.

[24] S. Yang, B. Deng, J. Wang, Huiyan Li, Meili Lu, and Yanqiu Che, "Scalable digital neuromorphic architecture for large-scale biophysically meaningful neural network with multi-compartment neurons[J]," *IEEE Transactions on Neural Networks and Learning Systems*, vol. 31, no. 1, pp. 148–162, 2019.

[25] M. C. Chen, S. Q. Lu, and Q. L. Liu, "Uniqueness of weak solutions to a Keller-Segel-Navier-Stokes system[J]," *Applied Mathematics Letters*, vol. 121, Article ID 107417, 2021.

[26] M. Chen, S. Lu, and Q. Liu, "Uniqueness of weak solutions to a Keller-Segel-Navier-Stokes model with a logistic source[J]," *Applications of Mathematics*, vol. 67, no. 1, pp. 93–101, 2021.

[27] J. Li, G. Deng, W. Wei, H. Wang, and Z. Ming, "Design of a real-time ECG filter for portable mobile medical systems[J]," *IEEE Access*, vol. 5, pp. 696–704, 2016.

[28] Q. Ke, S. Zeng-guo, Y. Liu, Wei Wei, Marcin Woźniak, and Rafał Scherer, "High-resolution SAR image despeckling based on nonlocal means filter and modified AA model[J]," *Security and Communication Networks*, vol. 2020, 2020.

[29] W. Wang, N. Kumar, J. Chen et al., "Realizing the potential of Internet of things for smart tourism with 5G and AI[J]." *IEEE Network*, vol. 34, no. 6, pp. 295–301, 2020.