Research Article

Design of Vocal Music Teaching System Platform for Music Majors Based on Artificial Intelligence

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The cyberspace consisting of information technology, artificial intelligence (AI), communication systems, computer systems, automatic control systems, digital devices, and the applications, services, and data they carry is advancing in an unprecedented way. It is no longer a dream to assist the development of pedagogical expert systems to solve the current problems of insufficient teachers and single teaching tools in music pedagogy reform and to realize the sharing of teaching resources. Artificial intelligence system under music education and education not only breaks the traditional music education model but also promotes the development of music education. This paper introduces the principle of artificial intelligence and analyzes the problems faced by university music education, and the implementation method of vocal education system based on artificial intelligence for music majors is also specifically studied in this paper. This mainly involves the design of the system architecture, such as the system architecture, which is designed to meet the requirements of the whole system. A survey of 100 students found that 82% of students preferred computer-based education to traditional music education. An artificial intelligence-based vocal teaching system for music majors is a system with good applications, where teachers keep track of students’ learning through reasoning and analysis, enabling students to learn on their own. Learning music requires constant practice, expanding horizons, and accepting new ways of teaching, and the combination of music and the Internet is the latest option to use resources wisely, optimize them, and provide comprehensive resources. Although a variety of music education aids have emerged, few are actually suitable for music classroom education, so it is important to study and implement AI-based speech education systems for music majors.

1. Introduction

The Internet can be combined with any industry and belongs to all areas of education, which also generates new forms of education [1]. Based on the interpenetration of computer science, psychology, philosophy, linguistics, and other disciplines, artificial intelligence is a marginal discipline that has developed [2]. The development of musical art is also accompanied by a breakthrough in material civilization [3]. Artificial intelligence will bring new changes to the teaching methods and theories of music education [4]. The use of artificial intelligence in music education and education has not only begun to change the way education is taught but has also improved the quality of music education and teachers’ teaching [5]. This reduces the difficulty of teaching, increases students’ interest in music, and is more conducive to the development of students’ musical aesthetic skills [6].

Artificial intelligence theory investigates ways to use artificial intelligence to simulate, extend, and expand intelligence, which is mainly the work of scientific and engineering researchers [7]. It allows for the sharing of educational online course resources and the practice of online learning models such as large online open courses [8]. It also accelerates the reform of the higher education system by establishing new systems such as online learning credit recognition and credit transfer [9]. As the forefront of our vocal talents and vocal education in colleges and universities, we must ensure the sustainable development of vocal education in colleges and universities with a new concept [10]. It is mainly reflected in teaching and learning, which can provide learners with learning contents, learning process, and
learning methods [11]. These different learning models not only satisfy general classroom learning but also make learning more effective by allowing learners to complete exercises or test runs through the platform [12].

Artificial intelligence-based music professional voice teaching system makes music education less monotonous for students who are just starting out and allows students to have fun and a sense of accomplishment while learning music through an immersive teaching mode [13]. During the music initiation stage, more children can enter the concentration state faster [14]. Online teaching and learning platforms based on AI platforms embody the advantage of being able to complete learning tasks through cell phones anytime and anywhere by maximizing the convenience and speed of the current mobile Internet [15]. It is also portable and can fully use the learners’ scattered time to complete the exercises and ensure the learning effect. Therefore, based on the concept of artificial intelligence education, artificial intelligence is comprehensively applied to the education of college vocal courses so that vocal education can meet the special vocal learning needs of college students and meet the needs of modern people.

The innovations of this paper are as follows.

(1) This system uses a rule-based expert system, which can analyze all students of a certain group specified by the teacher, such as several classes and a college, so that this system can better serve for teaching. In particular, it lays a good foundation for the construction of digital resources for university music curriculum and teaching and thus opens up new space for the development of disciplinary tools of the National Digital Learning Engineering Technology Research Center.

(2) Through the assisted teaching system, students can give feedback to teachers on the difficult questions they encounter in the learning process and submit course assignments, and teachers can reply to the questions through the background to help students solve their confusion in the learning process.

(3) To clarify the nature of educational objectives and specific teaching goals in basic music education and to provide a scientific and effective basis for teaching design. Moreover, through distance and amateur learning methods, it can also provide more resources and ways to teach music in school teacher education bases and education masters.

The research framework of this paper consists of five major parts, which are arranged as follows.

The first part of this paper introduces the background and significance of the study and then introduces the main work of this paper. The second part imports the work related to the vocal teaching system for music majors, AI. The third part makes a sorting out of the main building steps of the expert system and the overall design method of the music teaching system, so that the readers of this thesis can have a more comprehensive understanding of the design method of the AI-based music teaching system. The fourth part is the core of the thesis, which completes the description of the teaching system and the system validation analysis from two aspects: the music teaching system under AI and the system validation. The last part of the thesis is the summary of the whole work.

2. Related Work

2.1. Research on Vocal Music Teaching System for Music Majors. The application of artificial intelligence system has been greatly improved in modern times, and the application scope has been gradually expanded to various professional fields. The AI-based music education system makes full use of the existing network technology, combines the characteristics of music profession, and integrates AI's integrated platform of basic information management, student music assignment management, music practice management, online classroom management, information management, and notification management into a comprehensive education platform. The digital sound processing of music and the development of software programs have made great progress, and the combination of artificial intelligence and music education has produced many studies.

Ma proposed the concept of e-learning support system, which has been used until now. Under the influence of this idea, foreign educational institutions and software manufacturers have developed many similar e-learning service systems. The basic design mode is the same as it is to transfer knowledge to learners through video and audio by making maximum use of computer multimedia technology [16]. Chen and Wen put forward three centers representing "progressive education" in the traditional education center of Herbart: teacher center, classroom center, systematic book knowledge center, children center, activity center, and personal direct sales center. To some extent, it improves people's understanding of doctrines [17]. Levchenko and Sadykova used the method of comparative analysis to compare the traditional paper pen test and computerized online evaluation and analyze their respective effects [18]. The results show that the traditional teaching methods are relatively backward. If computer technology can be used to better promote Cai, it will further promote education and teaching. Li analyzed the current situation of traditional education, compared the importance and research benefits of Internet education and traditional education, and put forward some opinions on future education [19]. Zhang et al. have strengthened the scientificity of teaching theory by systematically connecting teaching theory with psychology [20].

Therefore, in the context of artificial intelligence, vocal music teaching for music majors can better bring positive practical value to music education in the Internet era and bring new changes to teaching and teaching methods.

2.2. AI-Related Research. The combination of artificial intelligence and music has existed for a long time since the 1974 American International Conference on computer music. At that time, the application method was to apply intelligent technology to keyboard instruments, so that the instruments
had a variety of instrument timbres, which was conducive to music performance. Many universities and research institutions are carrying out artificial intelligence research and education and have produced many research results, such as expert system, pattern recognition, Chinese understanding, theorem proving, aided design, aided education, intelligent control, intelligent management, robotics, and office automation.

Liu and Yang’s “Emotional Adaptation Model of Knowledge Expression” initiated a new method of “information modeling.” The candidate model is provided by the computer, and emotion selection and human-computer cooperation are carried out on the computer. Establishing a satisfactory information model can effectively learn in complex situations [21]. Cao et al.’s “Analysis of the Development of Internet+Education Model” discussed the “internet plus,” described the “Internet+Education” model, and proposed that the “Internet+Education” model should evolve into the “Internet Education” model [22]. Levcenko’s “High-dimensional Geometry and Neural Network” has created a new method of designing and describing artificial neural network by using geometry [23]. Jia and Zhang pointed out that the education industry is facing the challenge of the “internet plus” era and the responsibility system of building education informatization, and “big database” should be established in colleges and universities for team analysis [24]. Lv and Shen have created an information science methodology and information conversion mechanism, extracting knowledge from information and generating intelligence from knowledge [25].

To some extent, the learning mode based on artificial intelligence has become a useful supplement to campus education, allowing more learners who have no chance to study in school to obtain professional knowledge and receive professional training. Therefore, artificial intelligence plays a special and important role in music teaching and has attracted more and more attention from music educators, music majors, and amateur music lovers.

3. Design Method of Music Teaching System Based on AI

3.1. Main Construction Steps of Expert System. Expert systems are one of the most active areas of applied research in artificial intelligence [26]. Increasingly widely used expert systems achieve maximum integration and sharing of educational resources, improving connectivity and communication between schools, teachers, and students [27]. With the help of multimedia and with the development of affective robotics and deep learning, learning and practice are much more efficient and will form a good training cycle, as shown in Figure 1.

Firstly, after detailed investigation and analysis of user needs, designers, domain experts, and knowledge engineers have formulated a comprehensive design specification and design objectives for the application problems to be solved, including the type and scope of the problem itself. The role of music has been completely replaced by the Internet, forming a new teaching model based on the management constraints of music personalized service, which generally has a five-tier network model. The first level is the information factors related to the case. The second layer is the membership function, and the formula is as follows:

\[ u_{ij}(x_i) = \exp \left( \frac{(x_i - c_{ij})^2}{\sigma_j^2} \right). \]  

The network system enables students to better understand music knowledge and the functions of music elements and experience music while learning. The system database adopts SQL Server database, and the database access interface is defined in the system data layer, including database instance object, authorized database role, and user password. System JDBC interface is used to realize database operations, including database query, data saving, and data changing. The third layer describes the number of fuzzy rules. The mathematical calculation of the output of the j rule, such as formula:

\[ \Phi_j = \exp \left[ -\sum_{i=1}^{r} \frac{(x_{ij} - c_{ij})^2}{\sigma_j^2} \right] = \exp \left[ -\frac{||X - C_j||^2}{\sigma_j^2} \right]. \]  

Secondly, under the current technical conditions, consult a large number of data at home and abroad to collect, summarize, and sort out domain knowledge, select appropriate methods for knowledge acquisition, such as manual knowledge acquisition, semiautomatic knowledge acquisition and fully automatic knowledge acquisition, and then conceptualization. The fourth layer is the normalization layer. The nodes of this layer should be consistent with the fuzzy rule nodes. The output of the j node \( N_j \) is as follows:

\[ \psi_j = \frac{\Phi_j}{\sum_{k=1}^{N} \Phi_k}, \quad j = 1, 2, \ldots, u. \]  

Nowadays, music teaching classrooms use multimedia equipment, musical teaching has changed from imagination to visual presentation, and the use of multimedia makes the music teaching more visual and diverse [28]. The fifth layer is the output layer, which outputs the evaluation of each skill of music performance, and its output, as formula:

\[ y(x) = \frac{\sum_{i=1}^{n} \left[ a_{ij0} + a_{ij1}x_1 + \cdots + a_{ijn}x_n \right] \exp \left( -\frac{||x - c_i||^2}{\sigma_i^2} \right)}{\sum_{i=1}^{n} \exp \left( -\frac{||x - c_i||^2}{\sigma_i^2} \right)}. \]  

\( w_k \) is the connection formula representing the k rule, that is, the sum of the weight products of the output variables, as shown in the formula:

\[ y(x) = \sum_{k=1}^{n} w_k \psi_k. \]  

It is used to define the business logic of the system. There are two storage methods for the definition of general
business logic. One is stored in XML file format, such as the system configuration file web of server application server xml. The other is XML file format and how database table records are stored. The main contents are knowledge points, parent knowledge points, knowledge point content introduction, audio files, score files, knowledge point chapters, difficulty levels, and other information, and the edited knowledge points are added to the content and input information in the preset format [29].

Finally, after the previous work is done, this stage is to transform the formal knowledge into a computer program. In music classes, it is difficult for teachers to find audio material, to change patterns and tones, and to get suitable accompaniment. Internet addition not only provides technical support for music education but also centralizes classroom resources for teachers. It can accept input from operating users and submit the input or selected work items from the client side to the server side, while displaying the processing results on the server side, including operation result tips and data query results. The system automatically retrieves all knowledge point belief contents from the background database and presents them through DataGridView control. For the knowledge point information that needs to be deleted, users can select the information of the column with the mouse and click to delete the knowledge.

3.2. Overall Design of Music Teaching System. The system adopts B/S (browser/server) three-tier architecture. B/S structure, namely, browser/server structure, is improved and developed with the development of technology in the late 1990s [30]. Traditional education has no education platform. No matter whether music education is integrated with the Internet or not, the topic is to start with the educational content and build a high-quality music sharing platform on the Internet as a means of music education. This type of driver is similar to a bridge driver. It needs to load some binary code into each client and then convert the JDBC call of the loaded client API to Oracle, Sybase, Informix, DB2, or other DBMS transport. Therefore, two point sets are given:

\[ A = \{(A_1, w(A_1)), (A_2, w(A_2)), \ldots, (A_m, w(A_m))\}, \]
\[ B = \{(B_1, w(B_1)), (B_2, w(B_2)), \ldots, (B_m, w(B_m))\}, \]  

where \( w(A_i), w(B_i) \) = weight.

The whole system includes four types of user area experts, music teachers, students, and system administrators. The AI-based music teaching system breaks the disconnect between school music education and social music education, and it crosses the boundary between school education and social education. The overall structure of the system is shown in Figure 2.

First, the system administrator is the person designated by the system owner to perform the daily maintenance of the system. The maintenance is completed through JavaBeans. In JavaBeans, functions are used to read and set business logic. In JavaBeans, server-side configuration file reading and database interface call can be completed, which can be represented by the above functions. This layer can provide business processing results and call the access interface of the data layer. By inheriting the UserControl class, developers can develop various controls according to their own needs, which can be compiled into DLL files for other WPF programs. However, in practice, it is often assumed that the content has little to do with the media output speed, because it only controls the output speed of various media rather than changes the output content to achieve synchronization, so we can get:

\[ V = \begin{bmatrix} v_1 \\ v_2 \end{bmatrix} = \begin{bmatrix} v_1(F, M) \\ v_2(F, M) \end{bmatrix}. \]  

Second, domain experts are experienced music teachers

![Interactive learning loop diagram.](Figure 1)
with many years of teaching experience who are able to analyze in depth the knowledge, extent, and certainty associated with music test questions. Focusing on student characteristics, appropriate media and combinations are selected to facilitate learning and create external conditions for the most effective delivery of the intended learning. A standardized form of mutual information, symmetrical uncertainty (SU), was therefore used as a measure of correlation between features and categories, with SU calculated as follows:

$$SU(x, y) = \frac{2I(X, Y)}{H(X) + H(Y)}.$$  

The domain expert authority is realized at the client through HTML5, JavaScript, and other technologies, realizing the data interaction between the client and the server and adopting JSON data format. When the trigger interface event or the value of the data object changes, the routing event is triggered, and the program can capture the routing event and make corresponding changes to the interface or data. The user information management of music teaching system includes user information maintenance, user information query, and user information statistics. The basic information management is shown in Figure 3.

Teachers refer to ordinary music teachers. Each music teacher assigns a class and students. The main authority is to organize the examination, upload the examination results, and analyze the knowledge points of the designated student group. When the system changes the business logic due to business requirements, there is no need to change and adjust the front-end page, just expand and change it in the business layer to replace the java bean. In this way, a set of intermediate (or previous) goals can be identified backward from the results of specific learning, and predictive learning can be carried out according to the completion of these intermediate learning goals. Take a sample $R$ randomly from the training sample set each time, then find $k$ nearest neighbor samples of $R$ from the sample set similar to $R$, and then update the weight of each feature, as shown in the following formula:

$$W(A) = W(A) - \sum_{j=1}^{k} \text{diff}(A, R, H_j),$$

$\text{diff}(A, R, H_j)$—difference between $R_1$ and $R_2$ in characteristic $A$.

Finally, students are regular students who can log in to the system using the username and password provided by the system administrator. Students can log in to the system after registering with their student numbers, and after logging in, they can view course-related information, view and view actual questions in detail, view test questions and teachers’ answers, take online exams and view statistical results, and complete assignments. The operator sends a statistical operation message to the “user object,” and the “user object” receives the statistical operation passed to it, receives the parameters, identifies the current operation as a statistical user, and then calls the “statistical user object” to analyze and obtain statistical conditions.

4. Teaching and System Verification Analysis

4.1. Analysis of Music Teaching System under AI. The core algorithm model of interactive educational music
intelligence system adopts AI algorithm-RBF algorithm. In other words, during the design process, the system should be decomposed into relatively independent subfunctions to prevent changes in one subfunction from affecting other subfunctions, making the system design tasks clearer and easier to upgrade and maintain. Since these classes boil down to adding, deleting, and checking data tables, they are assembled according to business functions by calling the data application layer. The edited training and experimental courseware can be distributed directly to the streaming server, and through fast data transfer with the streaming server, real live online functionality can be achieved in the web-based training. Music learning is becoming more and more common, and various music APPs are emerging. The most common one is to simulate a musical instrument on the screen and touch it to make a sound. The touch principle is to use multilevel sample motion path extraction and editing algorithm to edit the encoded path; we specify the travel path and remove the average error, low-pass filtering, or low-precision approximation of the encoded trajectory curve to extract a smooth path curve; the results are shown in Figure 4.

Firstly, a set of weight coefficients and thresholds obtained in the form of internal coding after learning are transformed by the subject and rule table mainly provided by domain experts, and the knowledge of network structure and weight configuration is stored in the knowledge base. These knowledge are obtained through the neural network learning module belonging to the meta knowledge acquired by the system, which provides information for reasoning and judgment. The three-layer feedforward neural network can realize any approximate continuous function, on the premise that the hidden layer nodes can be set freely according to the needs. We compare and analyze the performance of vocal music teaching system and the use of computer memory and check the problems of central processing unit (CPU) sharing and memory sharing, respectively. Figures 4 and 5 compare the CPU and memory usage of the system before and after loading.

The platform design incorporates the concept of algorithms to achieve the functionality of the platform interface (as the Figure 6), and the algorithms are fully visible when writing the code, effectively adapting to the interactive learning model. In this architecture, part of the transaction logic is implemented through the browser on the client side, while the transaction logic is implemented on the server side. Servers can include web services, ftp services, database services, etc. Finally, a three-tier architecture has emerged to reduce the storage and workload of the computer. The main function of the platform database is the music learning question database, and the lesson question database contains performance questions, piano sheet music questions, judgment questions, and general music knowledge questions. Table 1 is the list of database information.

Secondly, we classify our music knowledge into 20 knowledge points according to the knowledge provided by domain experts, and music experts add questions to these 20 knowledge points as test questions in the sample data-base, and the choice of questions should be representative. When the library and network are well trained and when students want to test themselves, they will also take test questions for self-testing. The information in the system is similar to some educational notices and usually consists of two parts: main information and relevant additional information. Tasks such as online search and backend maintenance of relevant additional information and data include information messages and notification lookups. The attachment information table is used to store notification information and related document attachment information. The attachment information in the system is stored in file format, and the title, category, and address of the file are stored in the attachment information table. Information such as fields, types, and physical storage names in this table is shown in Table 2.
The number of samples required for network training depends on the complexity of the input-output nonlinear mapping relationship. The more complex the mapping relationship is, the greater the noise in the sample. The larger the number of samples required to ensure a certain mapping accuracy, the larger the scale of the network.

Finally, when dealing with a series of large-scale data, the first $m$ data of music data are taken as initial training, and then, the RBF model for students to learn music knowledge is constructed, which is continuously evaluated through the designed software platform until the perfect model is finally constructed. Music domain experts input samples, knowledge engineers initialize the network, and the system trains the neural network according to the samples, constantly modifies the network weights and thresholds, and finally obtains the network structure parameters for students to make self-diagnosis.

4.2. System Verification Analysis. “Internet plus music education” calls for schools to change their educational concepts. With the help of cloud technology, education can become transparent, specific, data driven, and intelligent.
In this mode, communication and learning become a new direction of education. Cloud technology can speed up the accurate calculation of all teaching resources that rely on data analysis problems. The education area of the whole system connects the teacher host and student extension through LAN, which can achieve better interaction. Due to the diversification and development of teaching conditions, teaching achievements, and teaching methods, as well as the nonlinear relationship between them, there are many kinds of music pedagogy.

First, it uses a distributed network topology that supports different identities and permissions for different user levels, such as teachers, students, and administrators. At the same time, they have slightly different services that are closely related to the music intelligence system. Generally speaking, whether a diagnosis is accurate and consistent with the real world is inseparable from the quantity and quality of the selected objects, and the more music data and the higher the quality, the more accurate the diagnosis of the neural network will be. Currently, artificial intelligence devices can more easily help music learners, whether it is a smart electronic instrument or an intelligent educational system, where music learners practice and play to achieve better results. A survey of 100 registered students found that 82% preferred computer-based education to traditional music education.

![Figure 6: Comparison of memory utilization.](image)

**Table 1: List of database information.**

<table>
<thead>
<tr>
<th>Field name</th>
<th>Content explanation</th>
<th>Data type</th>
<th>Category restriction</th>
<th>Remarks</th>
</tr>
</thead>
<tbody>
<tr>
<td>Test_Type_ID</td>
<td>Type number</td>
<td>Number (5)</td>
<td>Not null</td>
<td>Interactive type</td>
</tr>
<tr>
<td>Grammar_ID</td>
<td>Exercise number</td>
<td>Number (3)</td>
<td>Not null</td>
<td>Principal linkage</td>
</tr>
<tr>
<td>Test_Text</td>
<td>Knowledge point text</td>
<td>Varchar3 (3000)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Book_No</td>
<td>Music score source</td>
<td>Number (15)</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Table 2: Annex information table.**

<table>
<thead>
<tr>
<th>Field name</th>
<th>Type size</th>
<th>Field remarks</th>
<th>Physical name</th>
</tr>
</thead>
<tbody>
<tr>
<td>Document title</td>
<td>Character</td>
<td>Cannot be empty</td>
<td>WJBT</td>
</tr>
<tr>
<td>Document address</td>
<td>Character</td>
<td>Cannot be empty</td>
<td>WJDZ</td>
</tr>
<tr>
<td>Upload time</td>
<td>Date and time type</td>
<td>Cannot be empty</td>
<td>SCSJ</td>
</tr>
<tr>
<td>Number of visitors</td>
<td>Character</td>
<td>Cannot be empty</td>
<td>ZLRS</td>
</tr>
</tbody>
</table>

Secondly, by applying intelligent methods such as teaching methods and learning ability evaluation to teaching management, we can effectively integrate and manage various roles and obtain necessary services from the intelligent system. These basic information become the basis of the system, and the detailed information of users can be viewed at any time in the whole system. If it needs to be changed, perform the operation through modification. The user information should...
be deleted when the user logs off. In the practice stage, the system lists the practice steps from simple to complex, which is convenient for teaching. Different exercises are accompanied by different speeds. At the same time, the whole process is monitored, and finally, the system vulnerabilities are found. Figure 8 accurately describes the average response time of the music education information system when accessed by various users.

Finally, the operating environment of the intelligent system is a combination of hardware and software. In the server environment, a database server is deployed, and the system is set up with 4G memory, 500G solid state drive, dual CPU Xeon processor system, and gigabit. There are also educational systems that design course progressions through a level model, where each level is set with knowledge and music, such as ONE Smart Piano Education, where students pass the level and integrate the content. As the number of students increases, the scenarios change, giving students a refreshing feeling.

5. Conclusions

The Internet and music education are responding to the needs of the times, and the country is actively advocating the construction of "Internet+Education," and schools all over the world are actively investing in the construction of Internet campuses and gathering excellent teaching resources from all
over the world. As an essential and important art form in human life, music has had a profound impact in enriching the human spiritual world. The main goal of music education is to let students feel the infectious power of vocal music based on improving their professional skills and passing on their aesthetic and artistic orientation. Intelligent devices are also widely used in the education and training industry, and music education is no exception, with a variety of intelligent electronic instruments and intelligent educational systems coming into being. The development trend and trend of modern higher education is influenced by the current convenient communication tools (QQ, WeChat, FMS, etc.), and the trend of online distance education has emerged, mostly based on the existing one-to-many model. The trend and development of modern higher education are influenced by the current convenient communication tools (QQ, WeChat, FMS, etc.), and the trend of online distance education is mostly based on the existing one-to-many model. The music teaching system in the context of artificial intelligence in this paper actively promotes the integration with AI cutting-edge technologies, while restructuring the processes that emphasize the frontier and practicality of professional music practice skills in order to improve the practical skills of music professionals and contribute to the needs of social development. Therefore, AI-based vocal music education for music majors can better realize the effect of interactive music intelligence system, allowing students to immerse themselves in interactive music intelligence system and enhance software design.

Data Availability

The data used to support the findings of this study are included within the article.

Conflicts of Interest

No competing interests exist concerning this study.

References


