Design of Online Vocal Teaching Auxiliary System in Colleges and Universities Under the Background of Big Data

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Abstract. In today's society, the Internet has penetrated into all aspects of daily life, and has become an indispensable part of people's life. In the teaching of vocal music, teachers and students constantly put forward problems that need to be solved in teaching. For example, due to the lack of teaching time, teachers do not have enough classroom time to teach comprehensive vocal music skills for students. The homework assigned by teachers needs to be checked and scored uniformly. The workload is heavy, and there is no communication channel between teachers and students except classroom time. In this paper, the application of software engineering, computer network, web site architecture and other aspects of knowledge, the requirements of the system are analyzed, and on this basis, the overall architecture of the system and its internal modules are designed in detail. In the process of implementation, with the help of ThinkPHP, the mature software framework, on the basis of which, the data persistence layer and presentation layer of the system are realized, and the business logic layer of the system is set up between the two layers to realize the hierarchy and module structure of the system design. After the implementation of the system, we also use the system testing method to test the system in an all-round way to ensure the correct use of the system.

Keywords: Vocal music teaching · Auxiliary system · MVC website architecture

1 Introduction

Information management system based on the Internet has always been an important part of the Internet, shouldering the responsibility of solving various practical problems. After long-term development, the industry has accumulated a lot of successful experience in building information management system. In the face of practical problems in the actual work and life, we can appropriately learn from the industry's previous successful experience to solve [1].

Music (especially vocal music) teaching and learning because of its own particularity determines that a large number of live demonstration teaching methods must be used between teachers and students to teach singing skills and practice skills guidance. However, in the actual teaching process, according to the schedule of the course, there

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is often not enough time for teachers and students to have face-to-face interaction after the necessary theoretical study.

For a long time, in vocal music teaching practice, this problem is solved by the way of transmitting and watching videos between teachers and students: teachers record the singing skills they need to teach students into videos, and then distribute them to students. Students who need to learn singing skills by downloading and watching videos. In the process of practice, if students have any questions or difficulties that are difficult to solve, they can record their own practice videos and send them to relevant teachers for guidance (see Fig. 1).

Fig. 1. Online music system

2 Overall Design

Before the overall design, it is necessary to clarify some basic design principles to be followed in this stage. In general, the overall design should make the designed system simple, flexible, stable and reliable, and easy to maintain [2]. Specifically, the following design principles will be followed to achieve this purpose:

At present, the common design methods are top-down method and bottom-up method. The latter is a more traditional method, which is suitable for building new systems with existing underlying designs. This method can quickly complete the construction of the system by combining the underlying modules when the underlying design is determined. At present, this method is not suitable for use, because this research project is to gradually design and implement a new system from scratch, and there is no ready-made underlying design for use. The top-down design method is more in line with the actual situation of the project. Because the core idea of the top-down method is to gradually divide complex and macro problems into simple and micro problems. After several steps of abstract processing, the problems can be described qualitatively and quantitatively, thus making the problems controllable. In addition, the top-down design method

can gradually refine the design of the system in the process of design, or find the deficiencies in the previous design and make up for them, so as to make the design of the system more unified and coordinated.

The entity connection of teaching video management module is shown in Fig. 2.

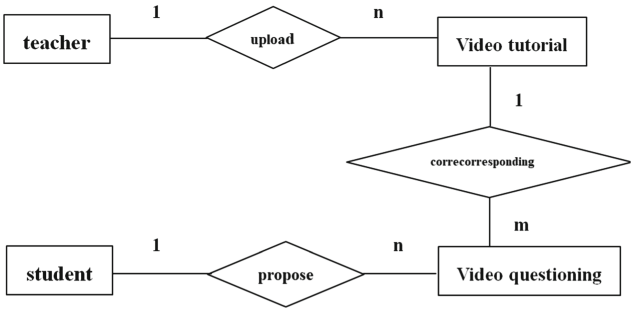

Fig. 2. ER diagram of teaching video

Group fitness F:

$$F = \frac{\sum_{i=1}^{n} f_i}{N} \tag{1}$$

Where: n is the number of individuals in the group, and N is the total number of elements in the training set that should be matched by all individuals in the group.

Coverage rate P:

$$P = \frac{\sum_{i=1}^{m} f_i}{N} \tag{2}$$

Where: n, N have the same meaning as formula (1), m < n, that is, the fitness of the subgroup composed of the first m individuals of the group.

3 Detailed Design and Implementation of the System

3.1 Design and Implementation of Data Persistence Layer

In the system, under ideal circumstances, each part of the system performs its own duties and has a clear division of labor. However, many times, data and system logic are closely coupled [3]. This will leave hidden trouble for the future maintenance of the system, because in each module of the system, data access operation will be carried out. If each module of the system does its own work and there is no unified data access scheduling center, it is easy to fill each module of the logic layer with similar data access representation. If the data changes in the future, there will be more than one place to be modified, which will easily cause omission or inconsistency after modification.

In order to solve this problem, it is necessary to add a data persistence layer in the system. The main task of the data persistence layer is to unify the data access operations to this layer. The modules outside the data persistence layer no longer implement their own data access operations. They only call the data access interface provided by the data persistence layer for data operations when necessary. On the one hand, it ensures the consistency of data access, on the other hand, it also brings convenience to the future system maintenance.

3.2 Design and Implementation of Logic Layer

The main task of the public module is to manage the registration, login, password modification and other functions in the system. Teachers and students are the main users of the module. The login implementation process: the login user needs to fill in the login information in the login page and submit the information to the background login processing page. After receiving the information submitted by the user, the login processing page encrypts the password submitted by the user with the same rules as the registration process, and queries the user's information in the system database together with the submitted user name. If the corresponding information does not exist, an error message will be returned. Otherwise, the system login page will set the session for the user on the server side.

3.3 Design and Implementation of Presentation Layer

The presentation layer is located on the outermost layer (the top layer) of the system and is closest to the user. As an interface for interaction between users and systems, presentation layer is often used to display data or receive data input from users.

The presentation layer has two important aspects to consider: interface style and data display. These are two different fields. The interface style needs the participation of special art staff and web front-end engineers to determine the best layout and presentation style of the user interface, while the background programmer is generally responsible for accessing the background data to the user interface. This leads to a problem: background programmers usually don't know the technology of the front end of the page, so when embedding background data on the page, the layout or style of the page may change inadvertently.

The communication mechanism between logic layer and presentation layer is realized by filling template parameters in logic layer. The template parameters and their types that need to be filled in when the template is used to display data will be described in the template instructions. The logic layer only needs to fill in the specified data according to the requirements, and does not need to care about the expansion of data in the template. Generally, there are two ways to fill template parameters: using the variables in the language to fill in the parameters, or returning the files in JSON or XML format by the logic layer, and then filling the template parameters by JavaScript operation data on the client side.

3.4 Summary of this Chapter

This chapter mainly carries on the detailed design of each level of the system. In this stage, the internal representation of each layer and the communication between layers are designed in detail, and the internal structure of each layer in the division of the overall design stage is refined. The logical rationality and necessity of the hierarchy and its internal module division are preliminarily verified, so that the outline of the system is more and more clearly visible [4]. On this basis, this chapter also briefly introduces the specific implementation of each layer of the system, and introduces the technical selection and technical difficulties in the system implementation one by one. So far, the preliminary implementation of the system has been completed, and it can be put into use after testing. The simulation of teaching effect is shown in Fig. 3.

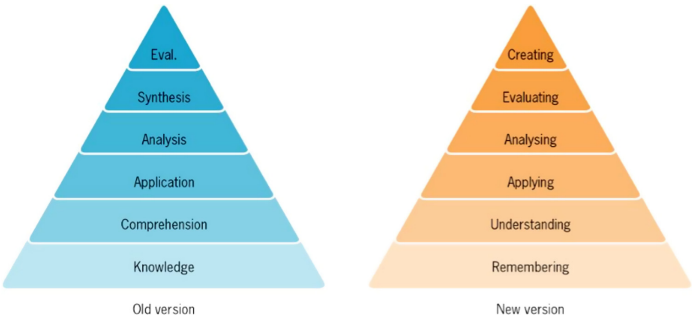

Fig. 3. Teaching effect simulation

4 Overall Design of System Technical Framework

Framework is an application skeleton that can be customized by developers according to their needs, which makes the whole or part of the system reusable [5]. It is represented as a group of abstract components and the method of interaction between component instances. In the application system, the biggest advantage of applying mature framework is reuse, which can reduce the burden of developers to establish solutions to complex problems [6]. With the increasing social needs and the rapid development of software technology, today's software system is very complex, especially the design of server-side application software, which will involve a lot of knowledge, content and problems. Using mature and robust framework in the development of complex application system can greatly simplify the development difficulty and workload, and make system designers concentrate on the business logic design of the system. An application system based on framework usually includes one or more frameworks, component classes related to the framework and function extensions related to the application system [7].

4.1 Web Design Technology

XHTML (the Extensible HyperText Markup Language) is a basic web page design language. XHTML is not only the successor of HTML language, but also a markup

language based on XML. The syntax requirements of HTML are relatively loose. For web designers, it can be operated more freely and conveniently. However, for machines, the looser the syntax is, the more difficult it is to process, and the worse its compatibility with various browsers is. XHTML standardizes and rewrites HTML language through XML syntax, which is more strict. Therefore, XHTML is essentially a transitional technology, which combines the powerful functions of some XML and inherits the simple features of most HTML, showing good usability and compatibility [8].

Xhtmil language combined with CSS (cascading style sheets) can better reflect its advantages. The combination of the two can separate the style and content of the web page, combine the web page code organically, and even mix all kinds of XML in a single file, such as SVG, MathML and so on [9].

4.2 CSS Technology

CSS is an abbreviation for cascading style sheet, which is translated into cascading style form and cascading style sheet. CSS is a kind of markup language which is designed to control and enhance the design style of web pages, and it is a markup language to separate the style information from the content of web pages. By using CSS technology, the browser can describe HTML elements in the form of preset expression. CSS can be regarded as the rule of describing HTML elements by browser. CSS is the best performance design language based on text display. It can control many attributes that can not be controlled by HTML technology [10]. For example, it can control the location layout of Web objects to pixel level accurately, support almost all font style, have the ability to edit the image and model styles of web pages and can conduct preliminary interactive design. CSS language can be regarded as a breakthrough in web design. Through CSS technology, designers can control the style and layout of multiple pages at the same time. Website developers can define the unique style for each HTML element and apply it to any number of pages [11]. If you need to update the page globally, simply change the cascading style sheet, all elements in the website will be updated automatically. With the help of the powerful function of CSS, web designers can not only release the design inspiration fully, and beautify the web page as much as possible. CSS can simplify and optimize the code according to the understanding ability and programming style of different designers, so as to reduce the design difficulty and improve the work efficiency. In the development of Web site, CSS technology can also cooperate with struts tags to realize the design of web pages. The performance layer of the Java intelligent assistant teaching system designed in this paper is based on Struts2 framework. Struts2 provides a very rich tag to help the design of the performance layer. Many pages in this system use tags provided by Struts2. When calling struts tags, it is important to note that when defining a presentation style in the tag body, you cannot use the style keyword, but instead use cssstype keyword [12].

5 Design and Implementation of the Main Function of the System

5.1 Design and Implementation of Media Learning Environment

Media learning environment consists of three important functional modules: basic learning materials module, training and testing module and in-depth learning module. Among

them, the basic learning materials module is a visual and interactive narrative e-book based on the syllabus and teachers' courseware, referring to the classic java books and network materials, and then designed through a variety of RA methods. The visual narrative e-book in the media learning module is completely realized by the background, and does not provide editing function. The training and testing module provides links to other functions of the system, which can be edited by teachers or administrators. The in-depth learning module provides links to network resources, which can be added by teachers or students according to their needs [13].

5.2 Design and Implementation of Test Exercise Environment

There are two modules involved in the system: the teacher oriented test resource management module and the student oriented test exercise module. The test resource management module is located in the website background management center, which is mainly responsible for providing teachers with visual test entry, classification, editing and other functions; the test exercise module is located in the java learning system, which is mainly composed of test exercise and homework system.. According to the actual needs of Java teaching, the question bank designed in this paper supports three types of test questions, which are judgment questions, multiple-choice questions and other objective questions with standard answers, subjective questions and programming exercises. The system can automatically mark the objective questions with standard answers and the programming exercises with test cases; for the subjective questions, due to the lack of marking standards, the system can not mark the subjective questions, so it can only hand over the answers submitted by the students to the teachers, and then the teachers can complete the review and feedback [14].

5.3 Question Resource Management

System for teachers and system administrators to provide two main ways of test management: manual editing and formatting test file entry. Teachers can edit the test questions manually according to their needs. The main operation functions are search, add, modify and delete. But the amount of test questions in the question bank is very large, especially for the objective questions [15]. Manual editing will add a huge workload and teaching burden to teachers, so the system provides the format file entry function for teachers and system administrators. Teachers and system administrators can upload specific format of Excel test questions and test paper files to batch add test questions and test papers, which can not only greatly reduce the burden of teachers, but also export the test questions in the Java question bank currently used by the school to excel file, and then import them into the Java Teaching system, that is, realize the data migration of the question bank through Excel.

5.4 Design and Implementation of Programming Training Environment

The background implementation of programming training environment is mainly composed of four parts: Java source program compilation error detection, logic error detection, foreground editing environment and class structure analysis. Compiler error detection is to dynamically compile java source program to detect whether there are syntax

errors in the code submitted by students. Logical error detection means that when the source code submitted by students passes the compilation error detection, the system preset test cases are used to check whether the running results of Java code are correct in all aspects. In order to facilitate students to write code in the browser, the system not only provides a design friendly java source program editing interface, but also highlights Java keywords, and outputs members in the Java source program in the form of a list.

Generally, the compilation of Java source program is implemented by using javac command after the code is written, whether it is directly calling the command line or using the configured ide. However, the situation of programming training environment in this paper is special. It needs to compile java source code online (browser side) and get the results, which requires the system to have the ability to compile, load and run java source code on the server side. There are many ways to compile, load and run java source programs by calling Java API, the most common of which are: (1) to compile java source code by calling native javac commands. (2) The application program receives the data, generates java files and saves them to the hard disk, and then calls API to perform compilation operation. (3) Call Java API to compile and execute string data, and complete Java dynamic compilation, loading and execution in memory.

6 Research on the Key Technology of the System

6.1 The Necessity of RIA in Java Teaching Assistant System

RIA is the abbreviation of rich Internet application, which can be translated as rich Internet program. It has rich user experience, high interactivity and page design ability. The traditional web model is based on HTML page design, the page design is simple and needs frequent refresh, lack of browser side intelligent mechanism, almost unable to complete complex user interaction. With the development of the times, people's requirements for the complexity of network applications are increasing. The traditional web model has been difficult to meet the needs of users. The emergence of RIA solves this problem well. RIA absorbs the advantages of desktop applications, such as fast response and strong interactivity, and can provide a richer, more interactive and responsive user experience. RIA architecture can be understood as a CS application running on B/S structure. It not only has the advantages of strong interaction, fast response, rich pages and so on, but also has Internet, which is very convenient for users. The Java teaching assistant system designed in this paper has very high requirements for user experience, especially the design of media learning environment. Media learning environment not only provides users with visual and interactive narrative learning resources, but also embeds code running process demonstration and a small amount of programming training functions. These functions need strong page display ability, rapid response ability and complex interaction ability to achieve good, and the traditional web architecture is powerless for such a high user experience requirements, so RIA is the cornerstone of Java intelligent teaching assistant system design, which is necessary for the development and design of the system.

6.2 Overview of Ajax Technology

The full name of ax is asynchronous JavaScript and XML (asynchronous JavaScript and XML), which is a web development technology to create interactive web applications. Ajax technology is one of the most important technologies in Web2.0. It is a framework of U I function and concept driven by request and response server call model based on XML. AAX application is essentially a kind of RIA. Compared with other RIA technology frameworks, AJAX has obvious advantages: the application based on Ajax does not need to download any plug-ins from the browser, and has excellent compatibility, and can run well on almost any browser.

7 Conclusion

According to the characteristics of vocal music teaching field, this system studies and discusses how to use modern information technology to help teachers and students in art colleges to carry out vocal music education better and more efficiently. At the same time, it also reflects the humanization of students' education, so as to promote the development of modern technology combined with traditional education. This system is committed to the use of modern software engineering methods to build and develop a practical online vocal music teaching interactive platform, and in the development process, comprehensive use of various methods in software engineering as a guide, for vocal music education provides more possibilities, but also for students learning vocal music to bring more efficient learning methods.

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