



Construction of an Interactive Teaching Platform for Vocal Music Theory and Performance Practice Under Cloud Platform Technology

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Abstract. Based on cloud platform technology, combining streaming media technology and web application development, an interactive teaching platform for vocal music theory and performance practice is constructed, which effectively improves the current vocal music classroom teaching. Problems such as single teaching content, realize the network and information transformation of vocal music education teaching mode in colleges and universities. With the application advantages of cloud platform technology and streaming media technology, the system guides students to get out of the misunderstanding of focusing on practice and ignoring theory with functions such as online live broadcast, independent learning, extracurricular development, and personal presentation. The system establishes a student-centered educational concept, and strengthens teachers information interaction between students and between students, emphasis on teamwork, respect for practical innovation, fundamentally stimulate students' subjective initiative in learning. Under the blessing of high technology, college music education can radiate new vitality, thereby further contributing to the promotion of college education informatization reform.

Keywords: cloud platform technology · vocal music theory and performance practice · interactive teaching platform · streaming media technology

1 Introduction

With the continuous prosperity of my country's market economy and the continuous enhancement of comprehensive national strength, the overall development trend of society has shifted from a high-speed growth stage to a high-quality development stage. In the new era of development, education will also show a trend of "high-quality, modernized" development, and further clarify the direction and specific requirements of reform. As an important part of education, vocal music is also an art discipline. In the development of the times, it is urgent to keep pace with the times and to be in line with the world. It is necessary to actively adjust the talent training goals and teaching needs, and adjust the direction of vocal music development and talent training plans., The setting of courses

and the upgrading of teaching methods are linked to cultivate more compound vocal talents with one specialization and multiple abilities for the society and the country. [7] As far as the current vocal music education in colleges and universities is concerned, there are still some confusions in the curriculum setting of major subjects, talent training programs, and education and teaching practice, which are more directly reflected in teachers' emphasis on skills, less theory, and more emphasis on teaching curriculum. The problem of teaching and ignoring practice; talent training has no focus and levels are chaotic; only teaching materials are selected as a single resource channel; teaching methods are only classroom teaching; teachers lead students to passively accept learning methods, which limits students initiative to learn. In view of this, the current situation of vocal music education in colleges and universities is in urgent need of reform and transformation, and a new and modern education model is about to emerge.

The deficiencies of the traditional teaching model of music education in colleges and universities have become increasingly prominent, and this outdated teaching model has been unable to meet the higher pursuit of music learning by college students. Facing the various drawbacks brought about by the current traditional teaching mode of vocal music education in colleges and universities, teachers should continuously adjust the course structure and teaching content to adapt to the current teaching needs and improve the teaching work. As for the change of teaching mode, we should pay attention to the huge impact of current information technology on modern education, and make full use of the advantages of a series of high-tech science and technology in the current network information age, with diversified teaching tools and equipment, high-frequency dissemination of resource content, The convenient and comfortable interactive method builds the interactive teaching of vocal music in colleges and universities, promotes the communication between teachers and students, revitalizes the music classroom, and realizes the innovation and development of vocal music education with thinking, leadership and inquiry. [4] Therefore, this paper believes that based on cloud platform technology, the design and development of an interactive teaching platform for vocal music theory and performance practice are completed by combining streaming media technology with Web application development. Through the interactive teaching platform, the mutual learning and resource sharing between teachers and students and between classmates can be strengthened. At the same time, the innovative live teaching method stimulates students' interest in learning, and the online learning method also makes it more convenient to complete teachers' teaching tasks, play a role in assisting teaching, and improve teaching effects. Interactive teaching can create a democratic, relaxed and pleasant learning atmosphere, which is conducive to improving students' curiosity and enthusiasm for learning, cultivating students' abilities of unity, cooperation and creative thinking, and has a positive impact on the development of students in the future. effect. [10].

2 Related Technology Introduction

2.1 Web Technology

Web is a network information service system based on Internet technology for publishing, browsing and querying information. In the Internet environment, the Web is defined as two parts, namely the Web client and the Web server. The two parts use the Internet as the

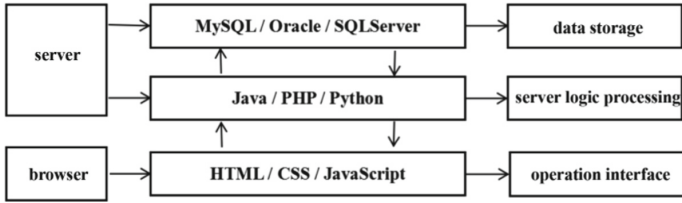


Fig. 1. Web Development Technology Architecture Diagram

communication medium to realize the transmission and application of data information. When a user visits a Web site through a browser, the connection between the two is established immediately. When the web client sends a message to the web server to request a specified content it expects according to the user's operation, the web server will return the corresponding information content or program running result to the web client for response. The relationship between the two is called the "Request/Response Model".

The continuous improvement of Web services is based on the continuous development of various Web technologies, and Web technologies have been updated and iterated for a long time, and corresponding technical systems have been formed according to various specifications, as shown in Fig. 1. Web technology can be divided into client-side technology and server-side technology according to functions and application levels, and can also be referred to as front-end and back-end technologies. The web front-end technology is mainly composed of the markup text language HTML, the style rendering method CSS and the script programming control language JavaScript, which is responsible for the structure of the web page, the appearance and visual performance of the web, and the interactive realization at the web level. The Web back-end technology mainly relies on a variety of object-oriented programming languages to complete the development of various server-side functions, such as Java, PHP, Python, C, C++ And multiple functional frameworks are used to complete the development of Web server, such as J2EE architecture, ThinkPHP architecture, Flask architecture. In addition, it also involves the use of various databases, such as Oracle, Sqlserver, Mysql, to improve the scalability of Web applications and optimize the server's ability to handle high concurrent transactions.

2.2 Cloud Platform Technology

Cloud computing platform, also known as cloud platform, refers to services based on hardware resources and software resources, providing computing, network and storage capabilities. Cloud computing platforms can be divided into three categories: storage cloud platforms that focus on data storage, computing cloud platforms that focus on data processing, and comprehensive cloud computing platforms that take into account both computing and data storage and processing. [8] Cloud platform technology is also a general term for a series of technologies, including a number of core technologies, such as cloud servers, cloud websites, and cloud databases. Among them, cloud servers can provide simple and efficient computing services with elastically scalable processing

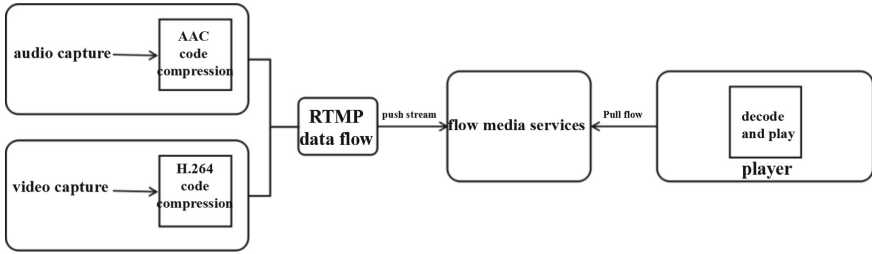


Fig. 2. Framework diagram of streaming media technology operation

capabilities, which facilitates the flexible deployment of various application systems, and improves system data security, data transmission efficiency, and system operation stability. Powerful features can virtualize high-performance servers into cloud servers, and complete database construction and Web server construction in a very short time. Cloud website technology can provide virtual running space for web applications, and adopts a load balancing architecture to ensure the availability and efficiency of web applications. At the same time, it supports ASP, ASP.NET, JAVA, PHP, Python and other Web development technologies. ApsaraDB for MySQL supports two relational databases, MySQL and SQL Server, and provides convenient database cluster services under various configuration types, supporting the use of various development application scenarios.

2.3 Streaming Technology

Streaming media technology is a multimedia network transmission technology that can realize real-time transmission of audio and video files. The core of its technology is to convert video, audio and other files into a continuous transmission medium - data stream, that is, to use a specific algorithm to compress multimedia files into multiple compressed data packets, and send these compressed data to the streaming media server. The packets are transmitted continuously and in real time through a specific network protocol. After the client receives these compressed data packets, it is decompressed and played by a specific decoding software. [5] In this paper, the online live broadcast function of the vocal interactive teaching platform mainly uses two technologies: video streaming and audio streaming. The transmission process is shown in Fig. 2. First, it starts from the collection of audio and video content. After encoding and compression, the streaming media files are uploaded to the streaming media server through the streaming media transmission protocol. This process is also called streaming. Then the client also obtains the resources of the streaming media server through the streaming media transmission protocol, and completes the decoding and playback. This process is called streaming.

2.3.1 Transfer Protocol

At present, the three main protocols commonly used in the field of streaming media technology are RTMP, HTTP-FLV and HLS. Among them, RTMP is the real-time message transmission protocol, which is the most widely used protocol for live broadcast.

Table 1. Comparison of mainstream streaming media servers

Flow media services	R & D institutions	Advantages and disadvantages
FMS	Adobe	Commercial, average performance, expensive license
Wowza	Wowza	Commercial, better performance than FMS
Helix	Real Networks	Commercial, multi-function support, general performance
BMS	Bravovcloud	Commercial, good performance, multiple operation support functions
Red5	OSCHINA	High performance and wide application
Crtmp	OSCHINA	High performance, less feature support

It has the advantages of good real-time performance, strong compatibility, good data confidentiality, and high stability, and is the best choice for online live broadcast in this system. The HTTP-FLV protocol can convert general media data into FLV format, and then transmit it to the client through the HTTP protocol. Although it has the characteristics of flexible scheduling and anti-shielding, this protocol only supports playback on mobile phones. The HLS protocol is developed by Apple, and is more suitable for Apple series products to run under the IOS system, with high performance, but the delay of data transmission is usually 10s-30s, which affects the viewing experience of system users.

2.3.2 Streaming Media Server

In Fig. 2, as the key to the operation of streaming media technology, the streaming media server is responsible for the coordination and control of streaming media data transmission. Its performance and operational support directly determine the robustness of a streaming media system. The essence of a streaming media server is a server program that can transmit real-time streaming protocols such as RTMP/RTSP. See Table 1 for common streaming media servers. Among them, in view of the application scenarios of this system and the volume of user data, the Red5 streaming media server will be used. Red5 is an open source streaming media server developed based on Java language. It supports RTMP transmission protocol, and supports users to record video on the client (Flash Player), and save the incoming audio and video from cameras, microphones, etc. to the server; it Support for shared objects and the ability to synchronize the state of all clients to support live stream publishing. [2]

2.4 Development Environment

According to the design requirements of the vocal music interactive teaching platform and the design and formulation of related transmission protocols, two parts need to be started from the overall development and design. The first part is the online live broadcast function, and the second part is the online learning and auxiliary teaching

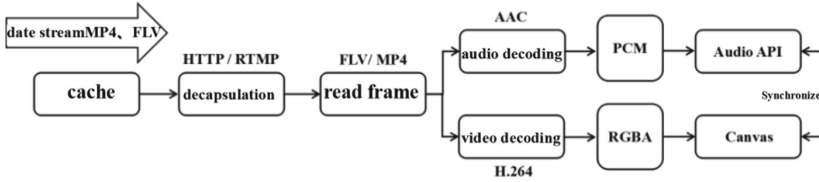


Fig. 3. The workflow of the player

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<!DOCTYPE web-app PUBLIC
"/Sun Microsystems, Inc./DTD Web Application 2.3/EN"
"http://java.sun.com/dtd/web-app_2_3.dtd" >
<web-app>
<display-name>Archetype Created Web Application</display-name>
<servlet>
<servlet-name>springmvc</servlet-name>
<servlet-class>org.springframework.web.servlet.DispatcherServlet</servlet-class>
<init-param>
<param-name>contextConfigLocation</param-name>
<param-value>classpath:springmvc.xml</param-value>
</init-param>
</servlet>
<servlet-mapping>
<servlet-name>springmvc</servlet-name>
<url-pattern></url-pattern>
</servlet-mapping>
</web-app>
    
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Fig. 4. SpringMVC framework configuration completes user request interception key code

function. Under the function of live teaching, the overall architecture is divided into three parts: encoder, streaming media server and client player. The encoding work uses Open Broadcaster Software, encodes audio and video according to H264 and AAC respectively, and completes the encapsulation in MP4 and FLV formats respectively. After that, the system will send the encapsulated audio and video files to the streaming media server according to the RTMP protocol to complete the streaming operation. [6] The streaming media server is built by Nginx and Red5, in which Nginx acts as a proxy server to distinguish and distribute user requests, so as to improve the overall concurrency of the system and control the balance of system load. Finally, the client-side player uses Flex technology to program the Flash Player and build the Flash interactive program. The workflow of the player is shown in Fig. 3. Flash Player performs a stream pull operation on the streaming media server, decapsulates the stream data, and then decodes the audio frames and video frames in MP4 and FLV formats and converts them into PCM audio streams. And the video stream in RGBA format completes playback.

In addition, when realizing the function of online learning and auxiliary teaching, the design idea of Java + Tomcat + MySQL + SpringMVC is used to complete. The basic operating system of the system is Linux, and the development environment of JavaWeb is Myeclipse 10.0. Spring MVC is a powerful and flexible web framework provided by Spring, which consists of DispatcherServlet, processor mapping, processor (controller), view resolver, and view. [3] As shown in Fig. 4, create a new Webapp project under Myeclipse, create a new Web-INF under the Webapp project, and create a new Web.xml below. By setting the relevant configuration of JspServlet under SpringMVC,

the interception of static resources such as Html has been realized. Precise control and capture of user needs by web servers. In addition, the online learning and auxiliary teaching of the system require a large number of digital resources for support. The system uses MySQL as some static files and requires corresponding storage media, and undertakes the overall operating capacity and expansion of the system. [9] Through the introduction of the above key technical theories, the overall environment for system development, the configuration of related software and tools are determined, and the technical feasibility of the overall project of the vocal music interactive teaching platform is also clarified.

3 Demand Analysis

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3.1 System Requirements Analysis

The system supports uploading, reviewing, and completing account registration for users with different roles. The uniqueness of an account is the key to identifying user roles and permissions. The functional requirements of the teacher side under the system are divided into two parts, one of which is the online live teaching function. Vocal music is taught through a personal computer or other mobile terminal. It breaks the restrictions on time, duration, space, etc. in the classroom teaching mode, strengthens the communication and exchange between teachers and students or between classmates in the classroom, and realizes interactive teaching. The second is the auxiliary teaching function. The system supports teachers to upload, organize and maintain various teaching content and resources related to vocal music courses. Teachers can participate in the design and production of teaching content and resources by themselves, and integrate a large number of excellent extracurricular teaching resources to achieve innovation in teaching content. Application and effective supplementation, promote the combination of vocal music theory teaching and performance practice, and achieve a balanced curriculum structure. In addition, the system also needs to support teachers to realize the functions of online auxiliary teaching such as answering students' special questions and commenting on students' works, so as to reduce the daily workload of teachers and improve the work efficiency of teachers.

On the student side, the functional requirements of students include participating in online live courses and relying on auxiliary teaching resources for independent learning. The extracurricular development function can provide students with a variety of team or group training content to improve students' mastery of vocal music theory knowledge and performance skills. In addition, the system also needs to provide corresponding storage space for students' personal display works to facilitate teachers' targeted guidance and comments.

3.2 Overall Design

The vocal music interactive teaching platform adopts the B/S architecture as a whole, the front end of the system is deployed under the Nginx server, and the back end server is accessed through port 8080. The back-end server is deployed in Tencent Cloud Server, the basic operating system is Linux Centos7.4, the overall operating environment is Java environment, JDK 1.8 is selected, Tomcat 8.0 is selected for the web server, Red5 is selected for the streaming media server, and MySQL is selected for the database. After completing the construction of the cloud platform server, package the JavaWeb program code in Myeclipse 10.0 into a WAR file format, and upload the WAR package to the Tencent Cloud server through the Xshell software to complete the cloud platform deployment of the entire system. [9] The overall architecture of the system is shown in Fig. 5, and the logical relationship and data information flow of each level are shown by arrows. The overall design and development idea of the system is completed according to the MVC model, which realizes the complete separation of the front-end and back-end of the system. The front-end relies on HTML + CSS + JavaScript to complete the design and presentation of user interaction pages, and the back-end SpringMVC framework simplifies development and configuration. run in a Tomcat container. The database uses

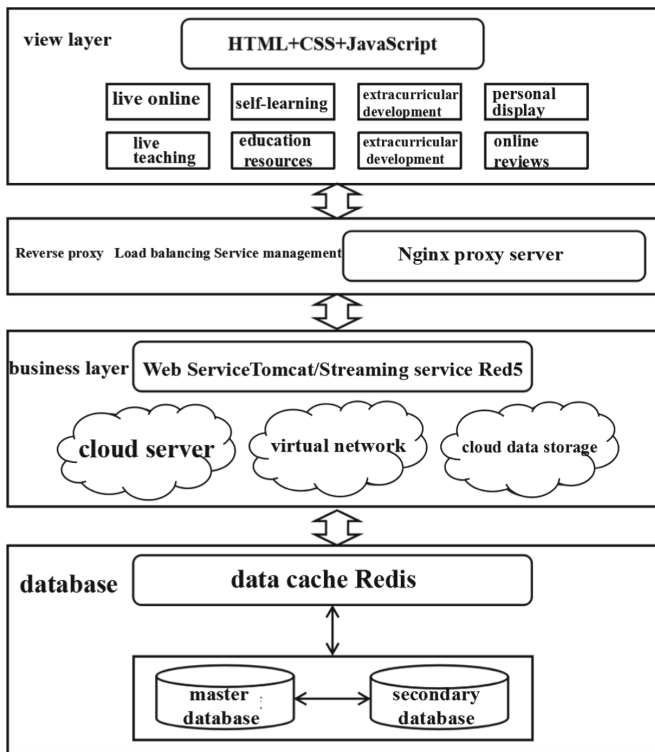


Fig. 5. Overall architecture diagram of the vocal music interactive teaching platform

Mysql to complete the master-slave database setting, and uses the Redis cache database to store frequently accessed data to reduce the pressure on the master database. [1].

4 Function Realization

4.1 Student Side

4.1.1 Live Online Learning

Under this function module, after logging in to the system, student users can see the live course notification issued by the teacher, including the specific time and course content arrangement, and students can choose to study according to their own time and study plan. The course content takes into account both the theory of vocal music and the practice of vocal music performance, such as basic music theory, solfeggio, vocal music, harmony, music form, song composition and so on. In the live course, students can get away from the textbook and learn according to the teacher's teaching content. At the same time, teachers can also show breath, intonation, articulation, rhythm, resonance, emotion and other list performance skills through actual singing, so that students can more intuitively feel the charm of vocal music, and quickly learn and master relevant knowledge, to improve their performance. In addition, students can interact with teachers in the form of a text barrage at any time during live courses. At the same time, online students can also actively participate in discussions, forming an interactive teaching atmosphere. On the one hand, it helps teachers to further improve the teaching content, teaching resources and teaching materials; on the other hand, students can re-examine the characteristics of the course and adjust the learning direction in time.

4.1.2 Self-learning

Under this function module, the system supports students to review the video of the live course, which is convenient for students to learn and review on their own after the live course ends. At the same time, the online learning line also supports viewing, forwarding and downloading of learning materials in classroom teaching, so that students can use the fragmented time for continuous learning and consolidation. In addition, the system will also provide more extracurricular knowledge content, such as the famous concert video "Chinese Classical Poetry and Calligraphy and Painting - Liao Changyong's Solo Concert of Chinese Art Songs", Chinese music education series documentary "Senior, Hello! "The Legacy of Voice: A Collection of Teaching Experiences of Masters in the History of Vocal Music in the World" by Lampierti, "The Art of Singing" by Zhao Meibo and other related vocal works.

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4.1.3 Extracurricular Development

Under the extracurricular expansion module, students can complete the task-based expansion activities released by teachers in groups or teams, and upload the final completion status. The forms of extracurricular expansion include offline discussions, chorus performances, singing and dancing performances, musical instrument ensembles,

etc., which greatly enrich the students' extracurricular life and improve their quality cultivation.

4.1.4 Personal Display

Under this function module, the system supports students to upload their personal singing, performance, arrangement, creation, etc., and can forward it to the teacher to obtain professional comments and targeted guidance from teachers to help students improve their vocal skills, so that students' skills and qualities can be developed more comprehensively.

4.2 Teacher Side

On the teacher's side, as the actual teacher of vocal music education, teachers should, according to the current development trend of vocal music education and advanced educational methods, combined with the interests and preferences of current students, complete the reorganization and adjustment of the content of the live broadcast course. Complete the teaching of vocal music live courses with the concept of paying equal attention to theoretical knowledge and performance practice. In addition, under the online assisted teaching function, teachers are also responsible for the sorting, production, uploading and maintenance of various teaching resources. At the same time, it can also view, comment and guide the works and practice videos and audio materials uploaded by students. Completing the education of students through the vocal music interactive teaching platform greatly changes the current teaching status, reduces the workload of teachers, and improves work efficiency.

5 Conclusions

The vocal music interactive teaching platform is based on cloud platform technology, combined with Web technology and RTMP streaming media technology, to realize the online learning function of vocal music education. The system can realize the reform of vocal music teaching mode in two ways: live teaching and online self-learning, emphasizing the information interaction and teamwork between teachers and students and between students, and giving full play to teachers' understanding of teaching content and course structure in the overall teaching process. Set the leading ability to solve the various drawbacks of the current vocal music classroom teaching, promote the common progress of teachers and students, effectively improve the quality of college vocal music education and teaching, and make college music education glow with new vitality under the blessing of high technology, and further promote colleges and universities. Contribution to education informatization reform.

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