Construction of Art Network Training Platform Based on Streaming Media Technology

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Abstract: With the development of Internet communication technology, multimedia transmission technology is becoming more and more mature, and streaming media technology is emerging. This paper makes use of the characteristics of high flexibility and real-time of streaming media, and develops an art network training platform based on streaming media technology. The streaming media function of the platform is developed by ffmpeg software, which realizes the process of encoding, decapsulating, pushing flow, decoding and pulling flow in the process of live broadcast. The architecture of Nginx+RTMP+Module is selected for the construction of streaming media server, and Flash is used for the player. The platform is developed in JAVA language, and SSH is used as the functional development framework. The key point of this system is that students can study and practice interaction with teachers, with emphasis on practical operation. Streaming media network training can avoid the limitation of time and space in theoretical courses after class or offline studio exercises, and can also adapt to the education and teaching in the current epidemic environment.

1 INTRODUCTION

With the rapid development of network technology, educational methods are changing with each passing day. With the improvement of people's material living standard, the promotion of art cultivation has become a new pursuit of more and more people. Art teaching also began to gradually increase the use of network information technology for optimization and reform. Students have a terminal for receiving online information, and online art teaching has the conditions to integrate into daily life and study. All kinds of information of art resources are widely spread on the Internet, but at the same time, there are problems of clutter and fragmentation. Students' access to art resources is prone to confusion, which makes it difficult for students to form systematic and structured cognition in art learning, and it is not helpful to solve the problems encountered in art learning. Moreover, the network resources are intermingled and complicated, which makes students easily fall into bad aesthetic information. It can be seen that the knowledge absorption efficiency of online art resources learning without professional guidance is not high. (Wan, 2019)

In order to solve the above problems, the author of this paper believes that an art network training platform based on streaming media technology should be developed. By using streaming media, students' learning state can be improved, and with real-time professional guidance, the most direct answers can be given to the problems that are difficult to solve. The system has an art resource database and is carefully selected by professional teachers, which avoids the uneven level of students' selection of art resources and effectively improves students' artistic aesthetic quality. After testing, compared with the traditional streaming media system, this system has the advantages of wide application scenarios, low power consumption, reliable transmission, etc. This system is effectively applied in the art training industry, which can improve the learning efficiency of students in learning art knowledge and improve the teaching quality of teachers.

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2 TECHNICAL SUMMARY

2.1 Web

Web technology is the technology that enables Internet users to browse web content in browser window, and adopts the architecture of B/S browser/server. Its realization is that the user sends the operation instruction request to the server through the browser on the computer system, then the server responds to the customer's request, and finally returns the request result to the web page browsed by the user. Web architecture consists of three parts, and the composition diagram is shown in Figure 1. Web server refers to the storage point that provides users with the resources needed to access Web pages and provides related functions, which is also called a website. The construction of a server usually consists of front-end and back-end. The front-end is usually built by VUE or this react software, and the front-end development language is a combination of HTML+CSS+JS. Back-end development is Apache+tomcat to form a connector and container. The connector and the client are connected by HTTP protocol, and sometimes the container needs the help of remote software to provide related functions. Secondly, it needs a database server to store the required data. The second part refers to the client. Users need to access web pages through the client. Currently, the most commonly used clients on the market include browsers, mobile apps and applets. The third part refers to the communication protocol. The client and the server need to communicate by the communication protocol, such as HTTP Hypertext Transfer Protocol, and HTTP is the cornerstone of the communication between the browser and the web server in the client. In addition to the three parts, it is necessary to introduce a new concept, that is, URL Uniform Resource Locator. URL is used to represent server information, and the client can connect to the corresponding server terminal through URL. (Wang, 2019)
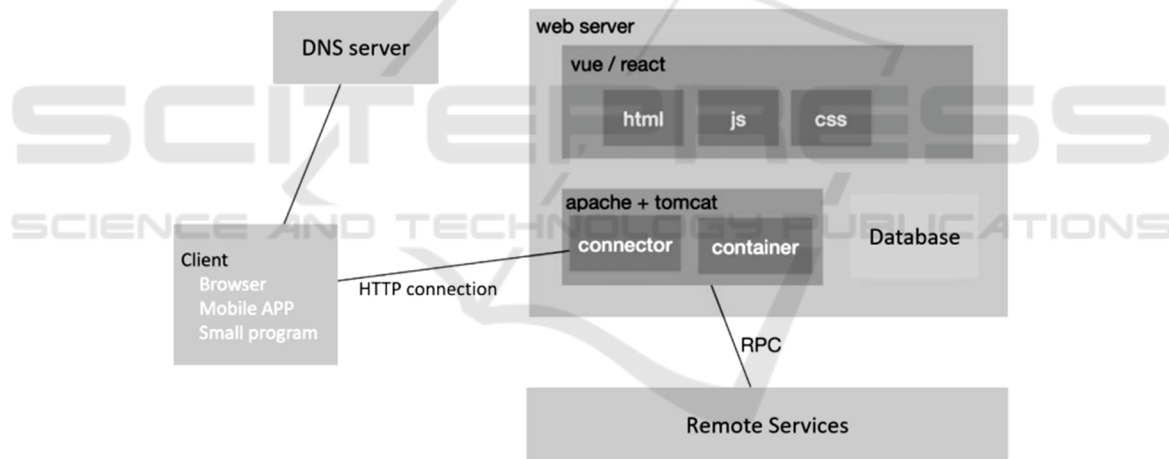

Figure 1: Web composition

2.2 FFmpeg

FFmpeg is an open-source application that is specially designed to convert digital multimedia audio and video files into data streams recognizable by the server. It can not only encode and decode audio and video files, but also be a suite for developing audio and video decoding. Ffmpeg provides a large number of audio and video calling interfaces for streaming media developers. The main workflow of Ffmpeg can be roughly divided into four steps. The first step is to read the information of the input source and parse the audio and video encapsulation formats by calling libavformat interface. The second step is to decode each frame of audio and video files, which is provided by libavcodec. The third step is to convert the parameter coding of audio and video data of each frame. The fourth step is to repackage the audio and video data files and then output them to the target. The main functional components used in this process are shown in Table 1. (Zhao, 2021)

Table 1: Main functional components of FFMPEG

Name	Function
libavformat	It can generate and parse the packaging formats of various multimedia files, mainly composed of demuxers video parser and muxer video generator.
libavcondec	It encodes and decodes various audio and video multimedia files.
libavutil	It is a full-featured public tool library, such as the codec of base64, the encryption and decryption device of DES.
libswscale	Video format conversion, such as scene scale adjustment and color mapping adjustment, can also convert RGB to YUV format.

2.3 MySQL Database

MySQL is a database management system launched by Apache Foundation, which has the characteristics of small size, open source data, relational and so on. It is these characteristics that make mysql widely used in the development of various small and medium-sized web by developers. Besides, it has the characteristics of fast running, small size and low cost, which are loved by developers. And the community version of mysql can also be compatible with other server software, so as to jointly form an expandable development environment, which is more conducive to the development and maintenance of programs. The operating languages of MySQL are C language and C++ language, and different compilers can be used to test the system. This function can greatly enhance the portability of source code, so MySQL has the feasibility of running under various operating systems, and also provides an API for various software system development languages. These programming languages include Python, PHP, perl, Ruby, Java and so on. MySQL can make full use of all kinds of CPU resources and realize multi-thread operation. Moreover, the SQL statements used in MySQL have the functions of adding, deleting, modifying and querying, and the algorithm is simple and easy to use, which can greatly improve the efficiency of the system query engine. The ways and means of connecting MySQL with other system development software also have diversified characteristics. JDBC is the most commonly used interface, besides ODBC and TCP/IP. MySQL supports diversified storage engine modes. Even in the case of large databases, MySQL can still successfully complete tasks such as data optimization, inspection and management, and has strong data processing capability. (Jiang, 2020)

2.4 Development Environment

The development environment of online art training platform is divided into two aspects: streaming media environment and web programming environment. This system uses streaming media technology to realize the live video function in the training platform. The operating system of this system is Linux cent os7 version. The streaming media server is developed with the framework of Nginx+RTMP+Module, and the development software is FFmpeg. The version of Nginx is 1.7.3. The audio and video sources are acquired by ffmpeg and pushed to the server. RTMP module is deployed on Nginx to realize the forwarding of streaming media data. Then it is configured by the RTMP server. The functions of the client use JWplayer and build Flash player to complete streaming, decapsulating video, decoding and completing audio-video synchronization, so as to realize real-time playback. The main steps to build the Nginx+RTMP server are to download and install the Nginx compressed package and the RTMP compressed package first, then configure the installation options of Nginx and compile Nginx. On the basis of the default configuration of Nginx, add the RTMP third-party module with the add-module command and finally use it. /Nginx command to start nginx. The code implementation is shown in Figure 2. (Xiao, 2020)

```
[root@localhost nginx]# cd /usr/local/nginx/conf
[root@localhost conf]# vim nginx.conf
rtmp  {
    server  {
        listen 1915;
        timeout 20s;
        application live  {
            live on;
            record off;
        }
        application anyrtc  {
            live on;
            hls  on;
            hls_path temp/zyh;
            hls_playlist_length 5s;
            hls_fragment 1s;
        }
        application vod  {
            play /var/flvs;
        }
        application vod_http  {
            play http://IP/vod;
        }
        application hls  {
            live on;
            hls on;
            record off;
            hls_path /tmp/hls;
            hls_playlist_length 5s;
            hls_fragment 1s;
        }
```

Figure 2: NGINX+RTMP server deployment code

The web application building environment of this system is divided into front-end and back-end. The front-end VUE.js tool is used for development, and the front-end development language is a combination of HTML+CSS+JS. Back-end development is to use Apache tomcat to build a server, the development tool is struct2+spring+hibernate, and the development language is Java. The database server chooses the relational database MySQL to complete the construction of dynamic web pages. Through the introduction of the above key technical theories, the overall environment of the system development, the configuration of related software and tools are determined, and the technical feasibility of the overall project of the art network training platform based on streaming media technology is also clarified.

3 REQUIREMENT ANALYSIS

3.1 Function Requirement

According to the research on the target groups of art teaching, this paper sets up two user ports: teacher's client and student's client, according to the different needs of different groups. The main functional modules of the system include four key modules: online live teaching, extracurricular supplement, homework and teacher-student communication. In this system, students can learn the prescribed tasks in class, complete the homework reserved by teachers, and submit the homework by uploading scanned pictures. Teachers need to record the live course content through the system combined with external microphones, cameras and other hardware, select appropriate multi-category art teaching video courses such as Chinese painting, sketch and oil painting and upload them to the extracurricular supplementary modules of the system to help students improve their art literacy and aesthetics. Combined with the students' homework completion, after-class Q&A and live classroom barrage, teachers can judge students' learning efficiency and situation, further adjust and optimize teaching methods. (Lu, 2018)

3.2 Overall Design

The design of art network training platform based on streaming media technology adopts B/S architecture and Java network programming technology to realize the control function of the system. The main function of this system is the live teaching function, which is designed in three aspects: coding end, streaming media server end and player end. The coding end mainly realizes the collection of audio and video resources, encodes, compresses and encapsulates the resources, and finally pushes the packaged packets to the server to realize the coding degree and the data interaction of the streaming media server. At the coding end, the data is sent out by using the related methods of FFMpeg encapsulation, and the data packets are transmitted in the form of RTP real-time data stream. The main function of streaming media is to receive data packets and distribute them to other clients, and to complete the real-time transcoding in this process. The player finishes streaming, decapsulating video, decoding and completing audio-video synchronization, so as to realize real-time playback, which is displayed on the user's webpage. The playback method uses the data stream playback method in SDL library. The real-time transmission and reception of streaming media data between teachers and students is mainly realized by RTP protocol and FFmpeg technology. The operation instruction transmission between clients is realized by the related methods of socket class. (Dai, 2018)

4 FUNCTION REALIZATION

The main functional modules of the art network training platform system based on streaming media technology include four key modules: online live teaching, extracurricular supplement, after-class homework and teacher-student communication. The core function of the system is the live course module. After students log in to the system through their account numbers and passwords, they can see the art teaching courses displayed by teachers in real time when they enter the live class of the system within the specified time. During the teaching demonstration of teachers' art skills, students can send barrage to express their views and questions in real time, and teachers can directly answer questions in live class. The workflow of the live broadcast module of the system is shown in Figure 3. The RTP protocol dialogue is established in the audio playing interface and the video playing interface respectively, and RTP is used to monitor the audio and video data streams so as to receive them in time. After receiving the audio and video data stream, the player can obtain RTP audio and RTP video. The client player needs to integrate audio and video into audio and video data source, then clone this data
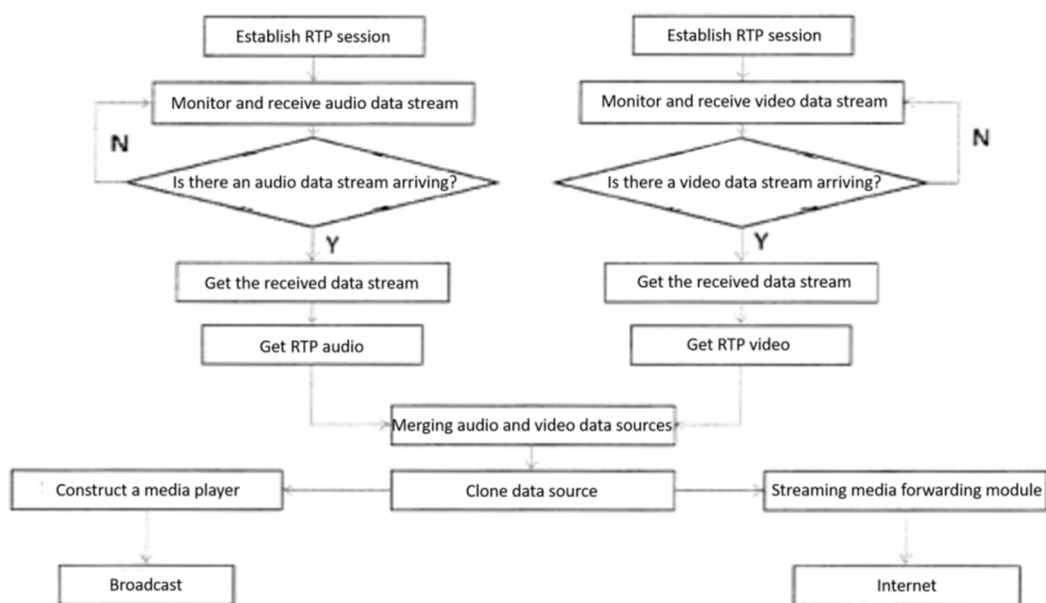
Figure 3: Workflow of streaming media live broadcast module

source, and play it through the streaming media forwarding module to the Internet network. (Tao, 2021)

Teacher end can choose two ways to upload some resources for extracurricular learning. One is to upload the downloaded files to the system. The other is to upload the link address of an external website, but students will automatically jump to the page where the link is located to watch it when playing the video. The video upload function uses the avformat open_ input function, which can provide the path of file upload and determine the file format, and then select the appropriate demuxer package format. While the function for playing the external chain video uses the avformat find_ stream_ info function. This function can fill in the metadata information of all stream data and automatically find the corresponding decoder. The read_packet () function is used for decoding. To improve the efficiency of accessing external network resources, three variables of this function can control the length of decoded data to improve the efficiency, namely probe_size, max_ analyze_duration and fps. _probe_size. (Tao, 2021)

5 CONCLUSIONS

This paper analyzes the web technology, ffmpeg technology and database technology needed for the design of the art online training platform based on

streaming media technology, and makes a detailed and systematic introduction to the workflow of ffmpeg in live streaming media system, and elaborates the streaming media function of server and client and the design and implementation of web presentation respectively. Due to my lack of ability and limited time and space, the system is still lacking in function. It is hoped that related workers will improve it and further promote the reform process of the art online education industry.

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