Research on Cloud Classroom Construction of Higher Vocational Colleges Based on Campus Micro-Cloud Platform

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Abstract. With the rapid development and popularization of the Internet, the Internet era has arrived, and the Internet has entered people's lives and has become an inseparable part. The system adopts RESTful architecture design and implements server-side interface to realize the unification of server interface; adopts JS (JavaScript) inter-modulation technology to realize it. The system adopts WeChat authorized login method to realize user login function. The system software is an online classroom software. Users need to be able to watch the course videos, so a player is required to play the course videos. After the experimental comparison and test, the improved server reduces the corresponding time and error rate of the system, and the instantaneous high concurrency performance of the network has been significantly improved, which can provide more stable technical support for the campus cloud classroom.

1. Introduction
Online education only exists on the computer side at the beginning. With the popularization of smart phones, online education on the mobile side has become increasingly needed. Many institutions and platforms have launched online education on the mobile side (NetEase Cloud Classroom and Mooke, etc.) [1]. This is also one of the reasons for the development of mobile phone software. In order to achieve the scalability and portability of the system, the system uses the Android control WebView to load the front-end page to display the system page, which provides convenience for the development of IOS client. In order to realize the information interaction between Android and web pages, the system adopts a third-party WeChat payment method; users need to obtain resources from the server from time to time (such as viewing user information) when using the system software. However, the MediaPlayer provided by the Android framework has too few functions and cannot meet the requirements of the system. The system adopts FFmpeg code transplantation and develops a simple player based on FFmpeg that is suitable for this system [2-4].

2. System design

2.1. Overall system design
The overall design of the system mainly analyzes and designs the system from a macro perspective, including hardware topology of cloud classroom system, system architecture of cloud classroom and functional structure of cloud classroom system.

The Android cloud classroom online teaching software developed in this topic is mainly implemented by Android’s WebView plus front-end web pages, that is, the pages displayed in the software are mainly from the front-end pages, and most of the requests in the pages are for new web pages or video data, and the web page data comes from the web and the video data comes from the video storage server. Of
course, the Android terminal also needs to interact with the Web page, and needs to play the video and provide some functions according to the obtained video data. In the video download page, the page is the layout of Android itself, and the data content displayed on the page is displayed through Listview, and the specific data content comes from the local database, which indicates that the system software will create a local database for storing cache task information [5-7]. The hardware topology diagram is shown in Figure 1.

![Cloud classroom system hardware topology diagram](image)

Figure 1  Cloud classroom system hardware topology diagram

(1) Cloud classroom system architecture diagram

The architecture of cloud classroom system is also layered. The system architecture is divided into three layers: interface layer, business logic layer and data storage layer. In this way, the logic of the system can be clearly divided. Each layer performs its own duties and performs its own corresponding work, while each layer is interconnected and makes corresponding events according to the dependency relationship [8-10]. The specific architecture diagram of the system is shown in Figure 2.

![Cloud classroom system architecture](image)

Figure 2  Cloud classroom system architecture diagram

As can be seen in Figure 2, at the interface layer, the Main Activity displays the web page interface to users through Web View; CY Downloading Activity displays the video download list to users through List View; and Media Play Activity displays the video playing interface through Player View [11].

At the business logic layer, CY Download Manager is responsible for the management of download tasks; View Controller is responsible for controlling the view of the interface during the playback process; and Media Controller is responsible for the playback control during the playback process.

At the data storage layer, a Web server is responsible for the request and response of user interface. A database is used to store data and to access the Web server. Video storage server is used to obtain video data content; Memory is used to store some user information such as WeChat authorization.
information and whether the user is a VIP, etc. The local database is used to store video download information to facilitate the display of data on the video download page.

(2) Functional structure of cloud classroom system

According to the demand analysis of the system, the cloud classroom system is mainly divided into three functional modules, which are the user center, video player and offline cache, as shown in Figure 3.

In the user center module, it mainly involves the user's WeChat login, the user's viewing of personal information, and the user's viewing of their learning records and consumption records. Among them, personal information is mainly WeChat personal information, and learning records are derived from the user's record of watching course videos, and consumption record is the consumption record of the user's purchase of VIP packages in the online mall.

2.2. Database design

The cloud classroom system uses the MySQL database. MySQL database design can save a lot of data content, and ensure the security of data in the background. The database has the following characteristics:

(1) It can fully show the system's demand for data, and the database can clearly know the relationship and connection between tables, and finally use it to serve the system.

(2) It can ensure the correctness and consistency of the data, and the database can ensure the robustness of the data through the primary and foreign keys, non null, restriction, unique index and so on.

(3) It can improve the query efficiency of data, and use better table structure and some convenient ways to improve the query efficiency of database.

(4) It has good expansibility, and can expand the data structure of database according to the requirements of the system, which is very helpful for the future development.

3. Experimental test analysis

3.1. Test environment

Some of the experimental server resources are virtualized by KVM to get a series of virtual machines, and then according to these virtual machines to complete the test of the relevant environment set up in this paper.

A total of 14 virtual machines are needed to build the cloud platform server based on micro-service architecture. Among them, three virtual units form a micro-service governance cluster; Three virtual machines are used to deploy the database cluster, including two MySQL databases and a Redis cache database. Three virtual units into a computing resource pool to provide application services; The two
virtual machines are used to deploy the business code of the existing cloud platform server; In addition, storage resources, communication services, and Git services each occupy a virtual machine implementation.

3.2. Analysis of test results
In the instantaneous high concurrency test, the ramp-up Period parameter of the JMeter thread group is set to 1s, that is, all threads are started within 1s, and then the number of threads is gradually increased to improve the amount of concurrency. The test results are shown in Table 1.

| JMeter configuration | Server before improvement | Improved server |
|----------------------|---------------------------|-----------------|
| Concurrency          | Average response time (ms) | Error rate (%)  | Average response time (ms) | Error rate (%)  |
| 3000                 | 9                         | 15              | 0                           | 14              | 0               |
| 4000                 | 9                         | 17              | 0                           | 16              | 0               |
| 5000                 | 9                         | 19              | 0                           | 17              | 0               |
| 6000                 | 9                         | 22              | 0.14                        | 19              | 0               |
| 7000                 | 9                         | 25              | 0.55                        | 21              | 0               |
| 8000                 | 9                         | 27              | 0.71                        | 23              | 0               |
| 9000                 | 9                         | 31              | 0.84                        | 25              | 0               |
| 10000                | 9                         | 33              | 0.97                        | 27              | 0               |

As can be seen from Table 1, under the instantaneous high concurrency test, when the concurrency number is less than 5000, the performance of the server before and after the improvement is close. After that, with the increase of concurrency, the average response time between them also increases. When the concurrency reaches 6000, the error rate of the server before improvement is 0.14%. When the number of concurrency reaches 10000, the average response time of the improved server exceeds 33ms and the error rate is 0.97%, while the improved server has no error and the average response time is relatively stable. Analysis of the test results show that the improved server can significantly reduce the average response time and error rate in the case of instantaneous high concurrency, thus improving the overall performance. In the case of instantaneous high concurrency, the comparison of the average response time and error rate of the server before and after the improvement is shown in Figure 4 and Figure 5 respectively.

![Figure 4](image-url)  
**Figure 4** Line chart of response time comparison under instantaneous high concurrency
4. Conclusion
In this paper, based on the micro-service architecture, the cloud platform server is redesigned and implemented, and the problem of video playback in cloud classroom under single architecture is solved. The improved server meets the requirements of the cloud platform, conducts functional tests on the system software, and verifies that the functions realized by the system can meet the functions of cloud classroom video teaching based on micro-cloud platform in higher vocational colleges.

References
[1] S. Calvo, A. Morales, J. Wade. The use of MOOCs in social enterprise education: an evaluation of a North-South collaborative Future Learn program[J]. Journal of Small Business &amp; Entrepreneurship, 2019, 31(3): 70-71
[2] L. Patrono, L. Podo, P. Rametta. An Innovative Face Emotion Recognition-based Platform by using a Mobile Device as a Virtual Tour[J]. Journal of Communications Software and Systems, 2019, 15(2): 150-158
[3] O. Y. Ye, M. T. Hu, A. Huet, et al. Profiling Wireless Resource Usage for Mobile Apps[M]. Springer International Publishing, 2018, 83-95
[4] Liu Tianbao. Design and implementation of an aerial surveillance information display and data evaluation system based on Android [D]. Beijing University of Posts and Telecommunications, 2019, 14-18
[5] Zhang Wen. Research on Security Protection Technology of Android Application Software [D]. Beijing University of Posts and Telecommunications, 2019, 20-22
[6] Liu Chunlan. "Internet + smart phone" mobile monitoring technology for telemedicine [D]. University of Science and Technology of China, 2018, 14-17
[7] Zhao Bin. Research and application of online course platform based on WeChat [D]. Beijing University of Posts and Telecommunications, 2019, 18-19
[8] Sheng Ruibin. Research and application of drainage mode based on WeChat maker platform [D]. Beijing University of Posts and Telecommunications, 2019, 25-26
[9] S. D. Khairunisa, G. Amirullah, M. Ninawati. Development of Learning Android Media-Based Mobile Learning Applications in Courses Basic Concepts of Natural Sciences[J]. Jurnal Inovasi Pendidikan Dasar, 2019, 4(2): 49-56
[10] Xiao Kaile. Design and implementation of news client based on Android system [D]. Beijing University of Posts and Telecommunications, 2017, 30-31
[11] H. Altuwajri, S. Ghouzali. Android data storage security: A review[J]. Journal of King Saud University-Computer and Information Sciences, 2018, 7(1):13-18

Figure 5 Line chart comparing the error rate of instantaneous high concurrent requests