Computer Life (CPL) ISSN: 1819-4818
DELIVERING QUALITY SCIENCE TO THE WORLD

Design and Implementation of Live Video System forReal-Time Classes Based on the Cloud Platform

Xiao Liang [1, a], Heyao Chen [2, b]

[1]Institute of Network Technology, Beijing University of Posts and Telecommunications, China

[2]School of Computer Science, Beijing University of Posts and Telecommunications, China

[a]m15801021028@163.com, [b]chyxyjh@163.com

Abstract: This paper introduces a live video broadcast system for real-time class by means of cloud computing. With the development of modern network technology, people pay attention to online education which has become a very popular industry. However the existing online educational platform mostly only provide prerecorded videos, namely distance education. In this paper, we realize a solution of the live video broadcasting system for real-time class by aids of the cloud platform, expecting to provide a new choice for the future educational mode.
Keywords: Online education, live video, real-time class, clouding computing.

---

1. INTRODUCTION

With the development of streaming media technology through the Internet, people have created a wealth of online video applications, and online educational platforms such as Large Open Online Courses (MOOC) have also emerged to catch up with the trend. However, most of the existing online educational platforms have only implemented the way of providing prerecorded video of lessons. This method faces the problem of slow updating speed, lack of interaction, and high operating costs [1]. Therefore, it is necessary to introduce real-time classes into the online education area.

In order to reduce the delay of videos and provide load balancing [2] between regions, educational platforms must possess strong infrastructures which brings about excessive upfront cost. The emergence of live video broadcasting on cloud provides a simple alternative, which helps enterprises to reduce the workload on development and maintenance. Cooperating with colleges to broadcast their daily professional lessons will make the quality of the courses guaranteed.

Aiming at the above difficulties, this paper realizes an online live video system to provide the real-time class, using the technology of cloud computing and streaming media. The main work of this paper is as following:

The existing live broadcast platform on cloud is investigated, and the recording client for the teacher is developed with the help of the Software Development Kit (SDK).

A real-time class website is developed for students, displaying the list of live videos and the course information intuitively. Live classes can be accessed by retrieving the keywords.

2. RELATED WORKS

The market of live broadcasting is in a high-speed growth period according to the report [3], and it will increase from 2 billion dollars in 2015 to 17 billion dollars in 2020 by the forecast. In the meanwhile, the online education industry has been popularized on a large scale. Large enterprises have launched self-developed education platforms one by one [4-6].

However, the current educational platform is still dominated by traditional way of recording, which has three shortcomings: i) slow updating speed, the prerecorded courses is short of timeliness, ii) lack of interaction and communication between students and teachers, and iii) high operating costs due to the cost of video storage and hiring part-time teachers.

Some researches aim to improve this situation. For example, the paper [7] added a special mechanism of providing customized questions for students to enhance interaction. But instead of making remedy, the most effective way is to transfer online education to live broadcasting. Considering the high requirement of infrastructure and performance for live broadcasting, small enterprises can construct their system with the help of the professional cloud platform.

The paper [8] studies the timing of video transcoding on cloud platforms, but it only concentrates on this single module. The paper [9] present an integrated solving scheme using live broadcasting cloud, but it is not implemented in reality.

Aiming at the problem that there is few available instances for online education using live broadcasting cloud, we implement a live video system for real-time class based on cloud platform.

3. SYSTEM ARCHITECTURE

This system aims to record the real-time teaching content through the streaming media technology. With the help of cloud video solution, the teaching process of teachers is presented on the web for live broadcasting in real-time.

The system can be divided into three parts: the back-end, the cloud and the front-end. The back-end is implemented as a recording client for the teachers. It manages the recording devices and caches video streams, and then pushes them up to the cloud. The live broadcasting cloud manipulates the video stream on demand, providing transcoding or load balancing services. The front-end is the web page to display the real-time classes. It also has to communicate with the cloud to retrieve necessary parameters. The overall architecture is drawn in the Figure 1.

3.1 The Recording Client

The recording client includes the following modules:

1) The main window module: the user interface of the client, controls the entire process.

2) The SDK interface encapsulation module: makes an encapsulation of the functions provided by cloud platform to simplify the calling method.

3) The configuration management module: manages and stores the configurations of the users.

4) The video rendering module: video rendering function is implemented here, so that users can get their real-time pictures captured by the devices.

5) The channel adding module: creates a new live video channel to distinguish from other courses.

Teachers interact with the system through the recording client to make a series of operations, such as recording and pushing video streams. After the client logs in to the corresponding account and liveroom, it calls the interfaces in the SDK to get the list of camera and microphone devices, and opens the selected devices for video capture. Then the client calls the side-pass pushing function to push the video streams to the live source station on the cloud, while the client renders the live picture to the screen in real time. Finally the liveroom address and quality parameters will be returned to the client.

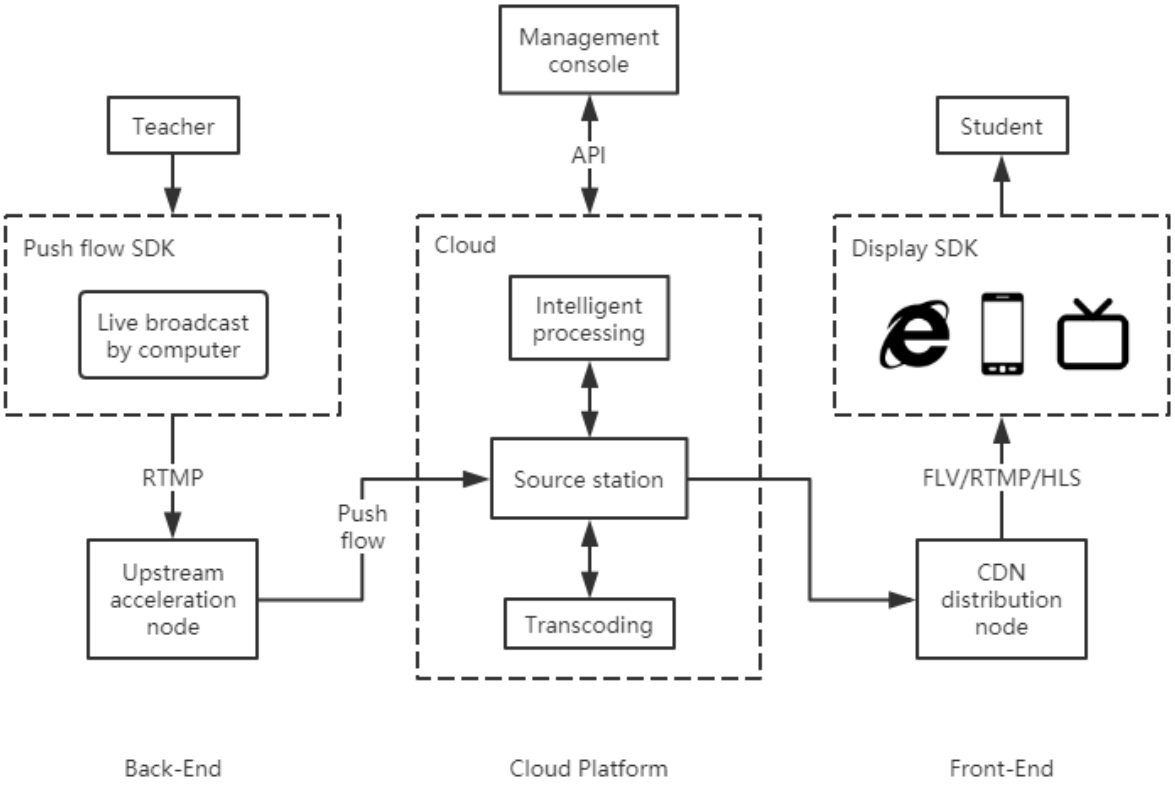

Fig 1 Architecture of the real-time class system

3.2 The Online Learning Website

The online learning website is divided into the following modules:

1) The home page module: the main interface for students to interact with the online learning website.

2) The data requesting module: requests for the neccessary parameters from the cloud, including the name of the liveroom, online population and information of the classes.

3) The signature generating module: joints the API request method, url address, sorted public and private parameters together according to the prescribed format, and generates the original signature.

4) The request sending module: uses cURL to send the request to the cloud server and receives the result.

Students interact with the system through the online learning website to get the list of channels and watch the corresponding live courses. Students can also enter keywords or addresses to access to the real-time classes. A series of parameters, such as the channel names and addreses, are obtained by calling the provided API of live broadcasting cloud.

4. RESULT ANALYSIS

In order to measure the performance of our system, we repeated the experiments 10 times and calculate the mean of the results. The Table 1 shows the latency comparison under different protocols.

Table 1 Latency comparison under different protocols

	Client	Website		
Protocol	RTMP	FLV	RTMP	HLS
Latency	0.5s	1.8s	2.1s	17.4s

The client only supports RTMP protocol for upstream and the latency is very low. On the webpage, the average latency when using RTMP and RTMP-FLV protocol is around 2 seconds, while that of using HLS protocol is 17.4 seconds. Therefore, RTMP protocol is recommended for the courses with stricter real-time requirements. But in fact, HLS protocol has higher performance and better support for CDN, so users can make the choice according to the actual situation.

The display page of the online learning website is shown in Figure 2. There is almost no distortion compared to the bit rate on the recording client.

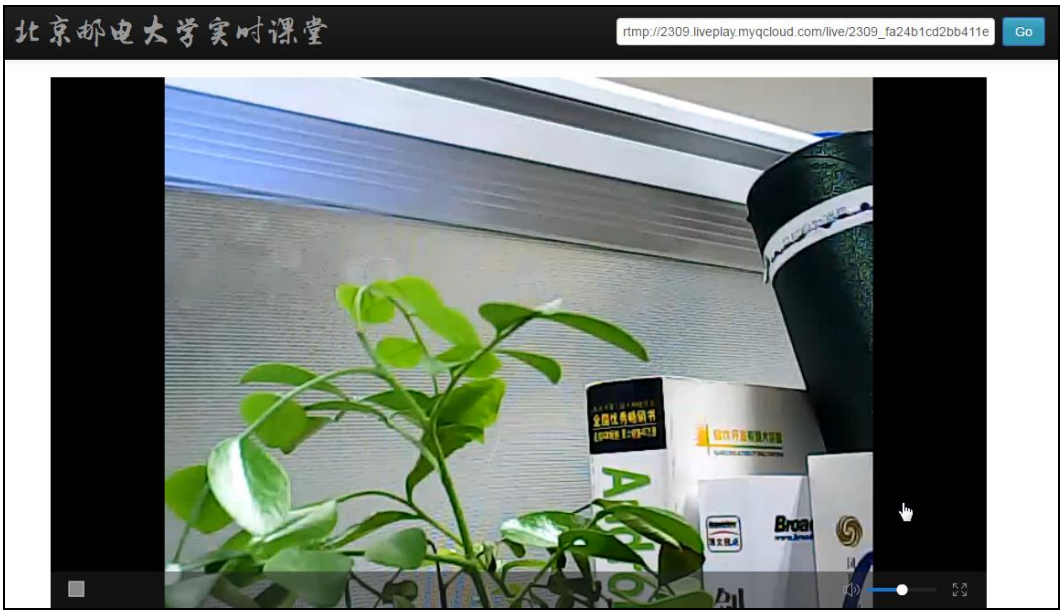

Fig 2 Test for the display of the live broadcasting on the web

5. SUMMARY

In this paper, we researched on the problem that prerecorded courses have many shortcomings, and the cost of self-developed live broadcasting system is high. Then we proposed a solution of a live video broadcasting system for real-time class by aids of the cloud platform. After a series of tests to the system, wo found that the latency can be reduced to about 2 seconds with no distortion.

REFERENCES

[1] Hamilton E C. Online Education and the Politics of Technology[M]. Technology and the Politics of University Reform. Palgrave Macmillan US, 2016.
[2] Membrey P, Hows D, Plugge E. Load Balancing Basics[M]. Practical Load Balancing. Apress, 2012.
[3] China Industry Research. China Cloud Video Industry Status Survey and Development Trend Forecast Report (2018 Edition) [EB/OL].

[4] Guo P J, Kim J, Rubin R. How video production affects student engagement:an empirical study of MOOC videos[A]. Acm Conference on Learning[C]. 2014:41-50.
[5] Heba B E A. Duolingo as a Bilingual Learning App: A Case Study[J]. Social Science Electronic Publishing, 2016.
[6] Severance C. Teaching the World: Daphne Koller and Coursera[J]. Computer, 2012, 45(8):8-9.
[7] Yu F. Scaffolding student-generated questions: Design and development of a customizable online learning system[J]. Computers in Human Behavior, 2009, 25(5):1129-1138.
[8] Li X, Salehi M, Bayoumi M. VLSC: Video Live Streaming Using Cloud Services[A]. International Conferences on Big Data and Cloud Computing, Social Computing and Networking, Sustainable Computing and Communications[C]. 2016.
[9] Zhao Q. Application study of online education platform based on cloud computing[A]. International Conference on Consumer Electronics[C]. 2012.