



# Design of English Listening Simulation Teaching System Based on Cloud Computing

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**Abstract.** In the design of traditional analog teaching system, the design is usually based on the Moodle framework, which requires a lot of calculations, which makes the host computer occupancy rate of the teaching system higher. Therefore, this research designed a new English listening simulation teaching system based on cloud computing. In the hardware, the PC host is removed and the RS484 converter is added to perform serial port control conversion. In the software program, first use the cloud computing service framework to construct the system framework, and draw up the connection process of the system server. Set up ordinary nodes and super nodes with different functions on the system nodes, and then establish the user's collaborative filtering operation and the collaborative filtering operation of the teaching item, and thus complete the design of the teaching system. In order to verify the effectiveness of the above-mentioned teaching system, a simulation test experiment is designed. The English listening course resources of a school are imported into the system, and the performance of the teaching system is tested. The test results show that the host occupancy rate of the teaching system is low, which meets the original intention of the design.

**Keywords:** Teaching system · Moodle framework · System design · Cloud computing

## 1 Introduction

The development and application of Internet are changing the way people work, live, learn and interact with each other. In the field of education, the application of the Internet has greatly expanded the spatial and temporal boundaries of education, changed the relationship between “teaching” and “learning” in English teaching, and also greatly improved people's interest, efficiency and initiative in learning [1, 2]. Based on this, relevant scholars use information technology to design a variety of information teaching systems, such as Moodle, big data, ZigBee and other technologies into the education system, and the combination of Grewptool and information technology, the integration of teaching resources and courses, so as to build a teaching system [3–5]. However, the computing process of the current teaching system is all realized in the host server. When

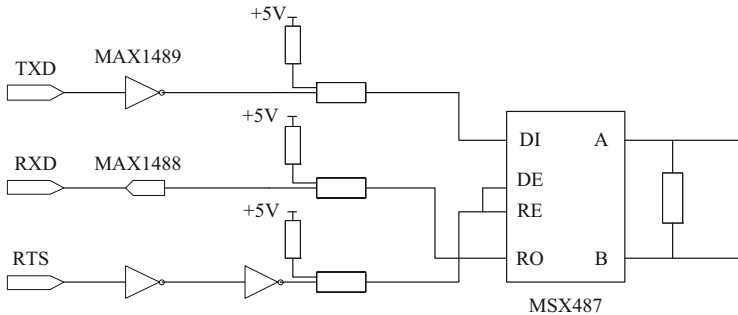
there are too many users, the pressure of the host server will be too large, resulting in a high occupancy rate of the host.

The cloud computing service technology can complete part of the operation in the cloud computing layer, and the use of this technology can reduce the computing load of the host, which has research value. Therefore, this study designed an English listening simulation teaching system based on cloud computing to reduce the host occupancy rate of the system.

## 2 System Hardware Design

The teaching system designed in this paper takes the PC as the main control computer, the single chip microcomputer of each subsystem as the slave machine, the serial ports of the master and slave computers are connected with each other through the bus, and the RS485 communication standard is adopted. PC communicates with MCU and transmits data by turn.

Among them, RS485 communication standard has the characteristics of simple interface, easy control and flexible use. RS485 is a half duplex mode with high sensitivity, and the transmission distance can reach 1200 m. When multi-point interconnection, it can save signal lines and facilitate long-distance transmission [6–8]. RS485 transceiver adopts balanced transmission and differential reception, which can effectively suppress common mode interference. The serial port of IBM-PC is RS232 standard, and the serial port of AT89C52 is TTL level. Therefore, with simple circuit, RS232-RS485 conversion and ttl-rs485 conversion can be realized [9, 10]. The RS232-RS485 converter is shown in Fig. 1.



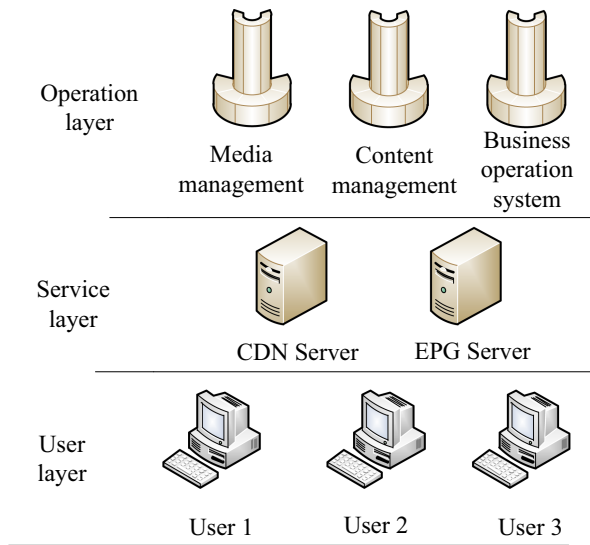
**Fig. 1.** Structure diagram of RS232-RS485 converter

In Fig. 1, MAX487 is the RS485 interface chip of Maxim company. With single +5V power supply, it can complete the conversion from TTL to RS232. RS232 adopts negative logic, and the output level is  $\pm 12V$ . Therefore, no matter the output or input of PC serial port, the level conversion should be carried out. MAX1488 and MAX1489 to complete the corresponding conversion function. The RTS signal line of PC serial port is used to control the receiving and sending state of MAX487.

### 3 System Software Design

#### 3.1 Cloud Computing Service Architecture Establishment

Cloud computing refers to the super computing mode based on the Internet, that is, the massive information and processor resources stored on personal computers, mobile phones and other devices are gathered together to work together [11, 12]. In order to improve the information processing ability and equipment collaboration ability of the teaching system, this system uses cloud computing as the service architecture of the system. The architecture design can be divided into three levels, as shown in Fig. 2.



**Fig. 2.** Cloud computing service framework

In the cloud computing service framework of this article, it is divided into three levels. The top level is the content management layer, which is the operation layer, responsible for content arrangement and related calculations. The second layer is the service layer, responsible for content storage, transmission, user authentication, etc., and the last layer is the user layer, which implements services through the docking with the service layer. In the cloud computing architecture, CDN is used for deployment. Data resources and collaborative computing are concentrated at the core of the cloud platform. The terminal does not retain data, and media materials are played in a streaming manner, and interactive evaluation is accepted. The CDN structure is shown in Fig. 3.

CDN network is usually composed of media resource description library, media storage source and distribution control center. Content management for CDN, routing, and organization. All program resources are stored in the central media center, and copies of popular currently available program resources are stored in each edge cache (video server). In the pre-distribution and distribution of the backbone network, the usual CDN is used, and the P2P method is used to evenly store the load among the regional node groups.

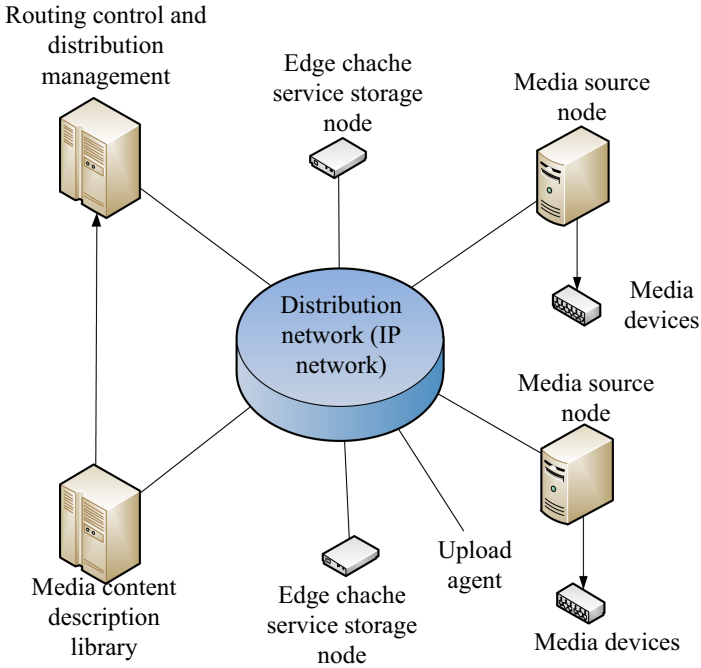


Fig. 3. CDN structure diagram

The CDN structure provides the program source copy and migration strategy for the teaching system, which involves pre-distribution of content (pre-distribution bandwidth control, resumable transmission capability, parallel distribution function), instant remote access (GFS + iSCSI, or third-party solutions) Content access and migration strategies such as real-time distribution (downstream limiting direct transmission, regional P2P distribution ---controlling P2P interference to the backbone network, etc.) also involve the space scheduling management of edge caches and program caching strategies.

### 3.2 System Server Connection Process

The implementation of the server is mainly composed of core services and processing modules. The core service is the interface between the user terminal and the processing module. The client sends or receives data information through RTP and RTSP, and the processing module is responsible for processing requests and sending packets to the client.

The implementation process of the streaming media server is described as follows: the main thread is responsible for checking the running status of the server and can control input and output; the idle task thread manages the periodic task queue, including timeout tasks and socket tasks, and sends the task queue to the processing module Idle task) module for processing; the event thread is responsible for receiving RTSP requests and RTP data packets, and transmits them to the corresponding task thread.

There are usually multiple task processes in task thread. RTSP request and RTP packet are received from event thread and placed in task queue. The task queue is sent to the process of processing module to request task module for processing. The send packet task module of the processing module sends the process request packet to the client. The task object mainly uses two methods. Signal is responsible for sending an event to the task object, and can send short messages to a process or a group of processes. If the same event is sent multiple times, only one will be put into the suspended queue of the receiving process. Run is responsible for specifying the processing time for the task object, and it will be called when there is an event to be processed. It can call the get events function to receive the current and previous events that have been signaled, and make the event automatically exit the queue.

### 3.3 System Node Settings

The ordinary node is the most basic operating entity of the system, and it can perform all operations in the system. In the design of this system, the common node mainly realizes the following 5 functional modules: user management, discussion group, electronic whiteboard, courseware management, homework management and online examination subsystem. The node settings are shown in Fig. 4.

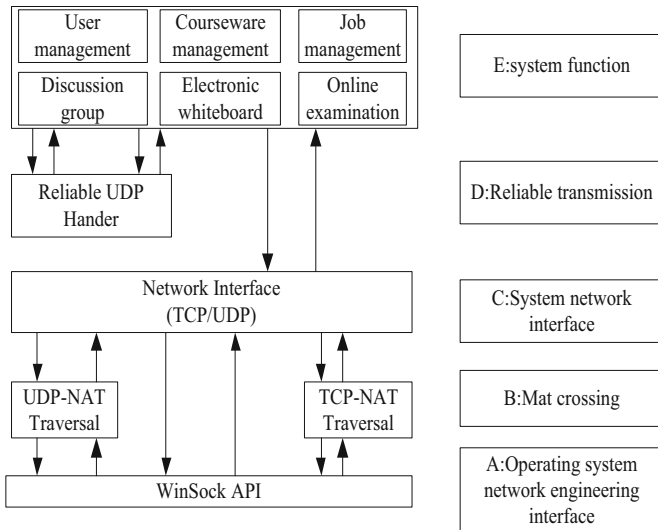
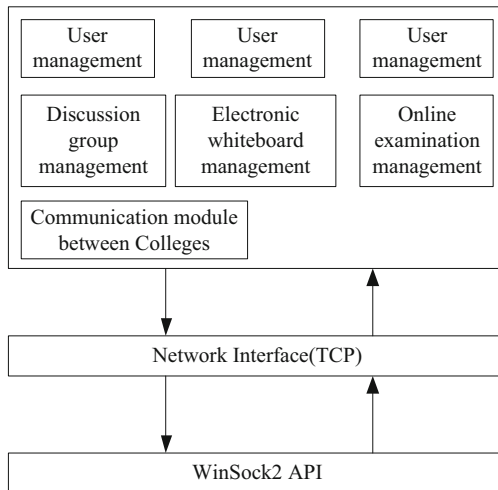


Fig. 4. Common node component diagram

In Fig. 4, the system section is divided into five layers. Layer a represents the network programming interface layer of the operating system, that is, the bottom layer of the system. This layer directly calls the network programming interface of the operating system. Layer B (NAT penetration layer) is used to penetrate the NAT devices of intranet users, so as to achieve the purpose of establishing a direct connection between any two

hosts. Layer C (system network interface layer) is the network interface layer of teaching system. It is responsible for distributing the network requests of the system, and judging whether it is necessary to call NAT penetration module. If not, it directly calls the function module of layer a. Layer D (reliability transport layer) is mainly used to ensure the reliability of transmission.

Among them, the TCP protocol is connection-oriented, and the reliability is guaranteed by the protocol itself; while the UDP protocol is non-connection-oriented, and data packets are easily lost. Therefore, the reliability of the UDP protocol transmission is guaranteed at the application layer through the Reliable UDPHandler interface. The E layer (system function layer) mainly implements five auxiliary teaching function modules: user management, discussion group, electronic whiteboard, courseware management and homework management. And add a super node in it, the role of the super node is to process user requests and give responses, and set up a series of management interfaces for the administrator. The design of the super node is divided into three layers, as shown in Fig. 5.



**Fig. 5.** Super node component diagram

The management of users, courseware, homework, discussion group, electronic whiteboard and communication module among students belong to the functional category of super node. Among them, the purpose of the latter is to find the school level courseware.

### 3.4 User’s Collaborative Filtering Recommendation Calculation

In this paper, the system calculates the user’s nearest neighbors and the recommendation degree of teaching resources based on the user’s teaching resource rating matrix. Offline calculation is used for calculation. Due to the large amount of calculation, the user’s neighbor and teaching resource recommendation matrix are updated regularly and the

data is stored in the database. The user's rating of teaching resources can be represented by a matrix. For example, matrix  $R$  is a matrix of  $m \times n$ ,  $u$  represents the number of users in the matrix,  $v$  represents the number of teaching resources, and  $R_i, R_j$  represents the score of the  $i$ th user for the  $j$ th teaching resource. The user-teaching resource scoring matrix is shown in Table 1.

**Table 1.** User-Teaching resources score sheet

User/Item	I1	...	Ij	...	In
U1	R1,1	...	R1,i	...	R1n
...	...	...	...	...	...
Ui	Ri,1	...	Ri,j	...	Ri,n
...	...	...	...	...	...
Um	Rm,1	...	Rm,j	...	Rm,n

According to the user-teaching material scoring matrix, the adjusted cosine similarity formula is adopted to find the neighbors of the target user, and the neighbor set is arranged in similar order. For target user  $a$ , his neighbor set is  $M, M = \{M_1, M_2, \dots, M_k\}$ , where  $a$  does not belong to  $M$ . The similarity from  $M_1$  to  $M_k$  is  $sim(a, M_k)$ , and the similarity is arranged from small to large, that is,  $M_1$  is the most similar to user  $a$ , and their interests are the most similar, while  $M_k$  is the least similar. Then the similarity  $sim(a, k)$  between user  $a$  and user  $k$  is as follows:

$$sim(a, k) = \frac{\sum_{p \in I} (R_{a,p} - \bar{R}_a)(R_{k,p} - \bar{R}_k)}{\sqrt{\sum_{p \in I} (R_{a,p} - \bar{R}_a)^2} \times \sqrt{\sum_{p \in I} (R_{k,p} - \bar{R}_k)^2}} \tag{1}$$

In formula (1), set  $I$  represents the set of teaching resources scored by user  $a$  and user  $k$ ,  $R_{a,p}$  represents user  $a$  is score for teaching resource  $p$ ,  $R_{k,p}$  represents user  $k$  is score for teaching resource  $p$ , and  $\bar{R}_a$  represents user  $a$  is teaching resource The average score of resource rating,  $\bar{R}_k$  represents the average score of user  $k$  is rating of teaching resources. In the neighbors closest to the target user, predict the score, calculate the recommendation degree according to the similarity, and recommend the teaching resources with the top  $N$  scores among all the teaching resources to the target user. It is estimated that the target user  $a$  is score  $P_{a,i}$  for the unrated teaching resource  $i$  is as follows:

$$P_{a,i} = \bar{R}_a + \frac{\sum_{k \in M_a} sim(a, k) \times (R_{k,i} - \bar{R}_k)}{\sum_{k \in M_a} (|sim(a, k)|)} \tag{2}$$

In formula (2),  $M_a$  represents the closest neighbor set with target user  $a$ , and  $sim(a, k)$  is the similarity between user  $a$  and user  $k$  calculated in the previous step.  $R_{k,i}$  represents

the score of user  $k$  on teaching resources  $i$ , and  $\overline{R}_k$  represents the average score of user  $k$  on teaching resources.  $\overline{R}_a$  represents the average score of user  $a$  on teaching resources.

### 3.5 Collaborative Filtering Recommendation Module for Teaching Projects

This module calculates the similarity and recommendation degree of teaching resources according to the user's rating matrix of teaching resources. It also uses offline calculation to avoid the system being too slow due to the large amount of calculation. Update the information in the library at a certain time. However, the similarity of teaching resources is similar to that of collaborative filtering. Firstly, the similarity of teaching resources is calculated, and the similarity between two teaching resources  $i$  and  $j$  is calculated as follows:

$$sim(i, j) = \frac{\sum_{a \in U_{ij}} (R_{a,i} - \overline{R}_a)(R_{a,j} - \overline{R}_a)}{\sqrt{\sum_{a \in U_{ij}} (R_{a,i} - \overline{R}_a)^2} \times \sqrt{\sum_{a \in U_{ij}} (R_{a,j} - \overline{R}_a)^2}} \quad (3)$$

In Formula (3),  $R_{a,i}$  represents user  $a$ 's rating of teaching resource  $i$ ,  $R_{a,j}$  represents user  $a$ 's rating of teaching resource  $j$ ,  $\overline{R}_a$  represents the average score of user  $a$ 's rating of teaching resource, and  $U_{ij}$  represents the user set of rating of teaching resource  $i$  and  $j$ . Then, the results are stored in the similarity table of teaching resources, and the results are arranged in descending order according to the similarity of teaching resources to predict the user's rating of teaching resources, and finally, the top  $N$  rated ones are recommended to the user. The calculation formula of User  $a$ 's estimated score  $P_{a,k}$  for teaching content  $k$  is as follows:

$$P_{a,k} = \frac{\sum_{n \in N_k} sim_{k,n} \times R_{a,n}}{\sum_{n \in N_k} |sim_{k,n}|} \quad (4)$$

In formula (4),  $sim_{k,n}$  represents the previously calculated similarity between teaching resource  $k$  and teaching resource  $n$ ,  $R_{a,n}$  represents the score of user  $a$  on teaching resource  $n$ , and  $N_k$  represents the neighbor set of teaching resource  $k$ , and the results are saved in the database.

## 4 Experimental Test Analysis

In order to verify the practical application effect of the above-mentioned design of English listening simulation teaching system based on cloud computing, a junior high school English listening teaching resource is added to the cloud computing library of the teaching system, and the simulation test experiment is carried out.

#### 4.1 System Test Environment Configuration

The experiment site selected the room No. 2, No. 6 and No. 7 of the students in a middle school, with a total of 158 student machines. The test participants included two computer teachers from the school and 147 students from class 3, Class 2 and Class 3. The configuration of the system server is: Intel dual-core E2140, DDR2 2G memory, 250G SATA hard disk. Student computer configuration: Intel P4, 2.66ghz, DDR 2GB RAM, 160G hard disk, 10/100m adaptive network card, 100 MB campus network. The network connection is LAN and the network is unblocked.

#### 4.2 System Function Test

Unit testing is also called functional module testing. Module testing is to test one module in the system design. Its focus is to test the relationship between module and module. Its purpose is to ensure that each module in the system can run correctly as a unit, so module testing is usually called unit testing. The test results of the system functional unit of the experiment in this paper are shown in Table 2.

**Table 2.** System function test results

Test serial number	Test child	Test steps	Test expectations	Test Results
1	Correct login verification	Enter the correct user name and password	Realize normal login	Meet expectations
2	Wrong login verification	Input wrong username and password	Unable to log in, return error message	Meet expectations
		Do not enter username or password	Warning user information cannot be empty	Meet expectations
3	Add courses correctly	Enter the course number and course name	Able to add courses correctly	Meet expectations
4	Verify courseware upload and assignment submission	Enter different types of assignments	Show that the job was successfully submitted and saved	Meet expectations

Due to the limitation of space, the system function test is not listed completely. In the experiment, most of the system function tests meet the expected requirements. However, the following defects still exist (Table 3).

**Table 3.** System function problems

Function name	Software error	Software defect	System limitations	Remarks
Upload courseware	Some webpage crashes	No	File size limit	Types are ppt and doc
Leave a message	No	Teachers cannot leave messages for teacher users	No	
User login	Possible SQL injection	No verification code input and verification	No	Registered user
Teaching video playback	No	Unable to control playback progress	No video download	Easy to download

**4.3 System Performance Comparison Test**

In order to further verify the application performance of this system, it compares with the traditional English listening simulation teaching system based on Moodle. After the functional test, all the students and teachers participating in the experiment were organized to conduct online learning together. The hard disk configuration of the computer room in the middle school is 160G, the CPU is running at 1.5GHz, and the network bandwidth is about 200M. The experiment was carried out under the condition of 147 people using the system.

Firstly, the response time of different systems was tested, and the average response time of 100 records, 500 records, 1000 records, 5000 records and 10000 records were respectively queried. The results are shown in Table 4.

**Table 4.** Comparison of the average response times of different systems

Test serial number	System of this paper			Traditional system		
	Number of records (items)	Recorded data volume (MB)	Average response time (ms)	Number of records (items)	Recorded data volume (MB)	Average response time (ms)
1	100	0.97	12	100	0.47	26
2	500	5.4	13	500	3.8	45
3	1000	12.7	18	1000	9.6	66
4	5000	44.5	415	5000	33.5	562
5	10000	102.6	655	10000	67.4	791

As can be seen from the test results in Table 4, in the response process of 100, 500 and 1000 records, the response time of the system in this paper has little difference. When the data is increased to 5000, the response time of the system in this paper increases significantly. However, in this test, the response time of the system in this paper is all within 1s, which is significantly less than that of the traditional system. It also records more data than traditional systems.

On this basis, the CPU utilization of different systems is tested. 300 users were simulated to input form data and save it. The experiment was divided into 50, 100, 150, 200, 250 and 300 hires for testing. The experimental results are shown in Table 5.

**Table 5.** Comparison of CPU occupancy of different systems

Test serial number	Number of simulated users	System of this paper		Traditional system	
		Memory usage	CPU usage	Memory usage	CPU usage
1	50	12%	17%	18%	20%
2	100	18%	17%	23%	21%
3	150	20%	21%	29%	29%
4	200	31%	25%	37%	36%
5	250	38%	29%	46%	53%
6	300	42%	31%	55%	71%

As can be seen from the test results in Table 5, the Memory and CPU usage of the system in this paper are both lower than 50%, which proves that the CPU and memory occupancy of the system is relatively ideal. However, when the number of simulated users reaches 300, the memory occupancy of the system in this paper reaches 42%, which meets the expectation but is too high. However, the memory and CPU occupancy of the system in this paper are lower than the traditional system.

## 5 Conclusion

The traditional simulation teaching system has a high host occupancy rate. To solve this problem, this study designed a new English listening simulation teaching system based on cloud computing. In the system hardware, remove the PC host, add RS484 converter to carry out the serial port control conversion. In the software program, ordinary nodes and super nodes with different functions are set up on the system nodes respectively, and then through collaborative filtering operation, the computation amount of the host is reduced and the pressure of the host is reduced. However, the compatibility of the system is low, and it is not suitable for more forms of teaching mode. The system compatibility needs to be further improved in the future.

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