# Research on Remote Online Teaching Assistant System Based on Human-Computer Interaction

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**Abstract.** In this study, human-computer interaction is applied to the design of remote online teaching assistance system. The camera module consists of a processor, a network camera and a microphone. The system software is composed of online examination module, course resource management module, online question-answering module, client module, video teaching module and personal information management module. Among them, the online examination module is divided into question bank management, examination management and other sub-functional modules; The course resource management module mainly completes the input and output of educational resources by uploading and downloading learning materials. Online Q&A module is mainly divided into question database management, question search and other sub-functional modules; The client module is mainly composed of Flash CS5; Video teaching module is mainly used to realize remote video teaching.

**Keywords:** Human computer interaction · Distance learning · Network camera · Soap format · Educational resources

## 1 Introduction

Today's society has entered the information age, and the information society has put forward new requirements for the training of high-level talents and high-quality talents. And information technology provides opportunities for the development of education, training of specialized talents and improving the quality of the labor force [1]. The development of information technology has gradually changed the traditional classroom teaching methods, and multimedia teaching and distance teaching have also been generally introduced into modern higher education.

Distance teaching provides students with individualized learning conditions and diversified learning environment, so that students can study pertinently, give full play to their strengths and improve their creativity while developing in an all-round way, thus promoting the development of quality education [2]. With the popularization of computer and the rapid development and application of computer network technology, some universities and educational institutions at home and abroad have launched distance teaching on the network, which has pushed computer-aided teaching to a higher


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level. Distance teaching has the characteristics of wide opening, extension, flexibility and diversity. The extensive openness of distance education is the most basic feature different from traditional education. Distance teaching makes the educational resources can be effectively used and shared in the whole society. At the same time, because distance education effectively spreads the relevant teaching content and teaching concept in the whole society through various media, and is enriched and optimized again in each communication link, which makes the teaching content selectively spread and extend, which is conducive to the improvement of the quality of teaching resources.

With the development of computer and Internet technology, information technology support methods have also been continuously innovated and improved, which can adapt to more different application requirements and management requirements. The remote online teaching assistant system is an important means to realize remote teaching, so this research conducts in-depth research on the remote online teaching assistant system and applies human-computer interaction to the remote online teaching assistant system. In this study, the processor, network camera and microphone constitute the camera module of the system, so as to complete the construction of the hardware environment, and then the online examination module, course resource management module, online question-answering module, client module, video teaching module, personal information management module constitute the software environment of the system. The experimental results also prove that the system has the advantages of short average response time, strong database connectivity and high security.

## 2 Design of Distance Online Teaching Assistant System Based on Human Computer Interaction

### 2.1 Hardware Design

The hardware configuration of the system is camera module, which is composed of processor, network camera and microphone [4]. The specific technical data of the processor is shown in Table 1.

**Table 1.** Specific technical data of the processor

| Serial number | Project | Data |
|---|---|---|
| 1 | Main frequency | 1 GHz |
| 2 | Name | Intel Core i8 |
| 3 | Memory | 32 G |
| 4 | Hard disk | 256 G |

Network camera, also known as IP camera, is composed of network coding module and analog camera [5]. The network coding module encodes and compresses the analog video signal collected by the analog camera into digital signal, which can be directly connected to the network switching and routing equipment. An embedded chip is built

into the network camera, and the embedded real-time operating system is used to control it. After being digitized, the video signal transmitted by the camera is compressed by an efficient compression chip and transmitted to the web server through the network bus [6]. Users on the network can directly use the browser to watch the camera images on the Web server, and authorized users can also control the actions of the camera's pan-tilt lens or operate the system configuration. Network cameras can realize monitoring more easily, especially remote monitoring, simpler construction and maintenance, better support for audio, better support for alarm linkage, more flexible video storage, higher-definition video effects and more perfect monitoring management [6]. In addition, IPC supports WIFI wireless access, 3G access, POE power supply (network power supply) and optical fiber access.

Microphones in the hardware environment are VHF segment microphones with frequencies ranging from 180 MHz to 280 MHz, which are subject to little environmental interference. In addition, VHF microphones adopt crystal frequency lock, so frequency conversion will not occur, and the receiving performance is relatively stable. The high frequency part of the microphone circuit adopts discrete processing, which makes it has the advantages of higher sensitivity and more stable performance. The audio processing part adopts 571 line.

## 2.2 Software Design

### 2.2.1 Design Online Examination Module

The online exam module is designed based on human-computer interaction. The online exam module is divided into four sub-function modules: question bank management, exam management, answer management and score management.

The main users of online examination are teachers and students [7]. The teacher establishes the corresponding test database according to the teaching plan, and updates and removes the test items according to the timeliness and popularity of the test questions. After students enter the online exam module, click start test. The module can randomly select the questions in the test database to generate the test papers randomly. Generally speaking, the examination time is 2 h.

The main function of the question bank management sub-module is to manage the question bank. In accordance with the requirements of the examination syllabus at the time, in combination with their own teaching plans and teaching arrangements, teachers set up examination questions of different difficulty in each teaching stage. Teachers can obtain excellent test resource resources through other media so as to better and more scientifically test the level of knowledge of students. In order to reduce the repetition of each set of test papers and do a good job of time management of test questions, the question bank must maintain a certain amount of test questions and update. The question bank management sub-module can remind teachers to manage the test question bank and update and revise the test questions in time. The questions in the test question bank mainly include multiple-choice questions and subjective questions. When the teacher enters the test question information, it will be entered together with the answer. It is convenient for students to check the correct answer to the question after checking the score, which is helpful for students to correct and summarize errors in a targeted manner.

The sub module of examination management will select 60 multiple-choice questions and 5 subjective questions from the question bank according to the frequency and difficulty of each test question, and the examination time is generally 2 h. The algorithm of examination management module follows two principles: random selection and time control under the premise of difficult and easy setting. The principle of random selection ensures the rationality and unpredictability of test paper preparation, which is conducive to comprehensive assessment of students' knowledge level from various aspects:

(1) Random principle: Each question will be marked with priority every time it is drawn. The system will combine the questions in a comprehensive consideration of the priority of the questions to realize the non-repetition of the test papers, avoid students from guessing the questions, and ensure the exam Fairness.
(2) Reasonable principle: in addition to priority identification, each topic also needs to have corresponding teaching chapters, corresponding grades, and estimated problem-solving time, so as to facilitate teachers to classify and select the difficulty degree of the test question resource pool during the test question extraction.
(3) Comprehensive principle: The test question bank contains multiple choice questions and subjective questions. Students only need to choose the correct answer from the test paper. There is no need to answer the process, which simplifies the examination process and is suitable for online examination. At the same time, taking into account the factors of examination time, the sum of the estimated time to solve the selected questions should not exceed 2 h in principle, and can be adjusted according to the degree of difficulty [8].

In addition, when uploading teaching resources, teachers need to give answers and some necessary calculation process of answers at the same time, so as to help students who participate in distance education to achieve 100 points after the test conveniently.

The main function of the score management sub-module is to manage test scores. After the student submits the test paper, the result of this test will be given. Score query is also indispensable as a key application after the exam. Query results needs to be quick and easy. Generally speaking, you need to enter the student's name to find out the corresponding results. This function should be open to groups that care about performance, such as teachers, students, and parents. Teachers can effectively formulate follow-up teaching plans by inquiring grades, helping students with poor academic performance to check for deficiencies, and at the same time help students with excellent grades to further improve. Parents learn about their children's learning situation by inquiring about their scores, discuss with their children to find out the problems, and improve their academic scores as soon as possible.

The online examination process of online examination module is shown in Fig. 1.

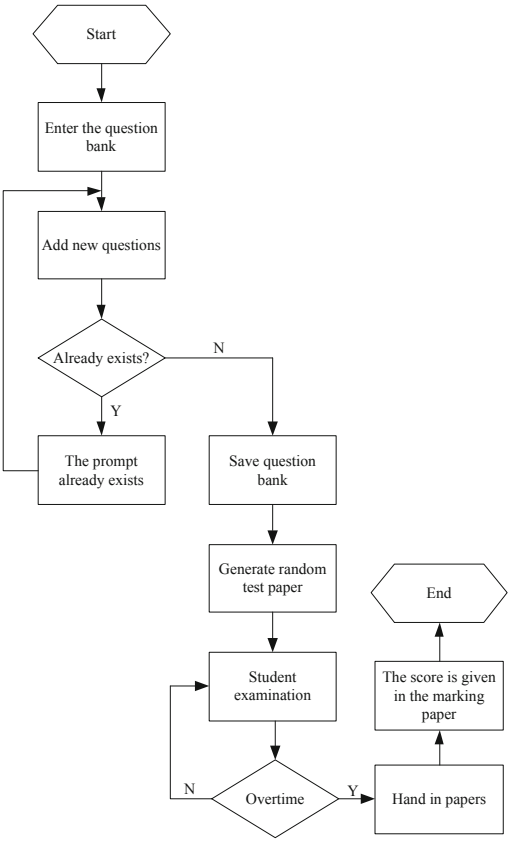


**Fig. 1.** Online exam process of online exam module

### 2.2.2 Design Course Resource Management Module

The course resource management module is an important functional module to realize distance education teaching. It mainly completes education output by uploading learning materials, downloading learning materials to complete education input, and resource management to complete the management of teaching resources.

Uploading learning materials means that teachers upload teaching courses, course analysis, and exercise solutions to the system database in various ways, such as electronic courseware, video and audio, for students to download remotely. The user clicks the browse button to find the path of the file to be uploaded, and then clicks to start uploading. After the upload is successful, the user will be prompted with a message. This can realize the function of single file upload and multiple file upload at the same time.

Downloading learning materials refers to listing the electronic courseware, teaching plan, syllabus and other teaching documents uploaded by teachers one by one in the course materials listed in the resource library, which are downloaded by students according to the current course progress and their own needs. The download process is relatively simple, you just need to click download directly to complete.

Resource management refers to the gradual increase of teaching resources with the development of teaching courses. In order to improve the quality and efficiency of the server database, it is necessary to screen and optimize the relevant teaching resources, clean up the resources that have not been downloaded for a long time, and reclaim the storage space.

### 2.2.3 Design Online Q&A Module

The online question answering module is mainly divided into four sub function modules: question base management, question search, online question and question answer.

The sub module of question bank management refers to that more and more questions are submitted to the system by students with the development of teachers' answering work. For some typical representative questions, the teacher or administrator will keep the questions, and further add research and analysis results to clear up the answers and questions, and do some optimization work on the display interface to remind students to pay attention to them; for some problems that have little access, teachers or administrators will delete the questions according to the actual situation.

The question search sub-module is mainly for students to search the questions that have been asked in the question library, find out the questions they are concerned about, and at the same time inquire related analysis and answers. The user can enter the question number in the question number single-line text box, or enter the question title in the question title multi-line text box. After inputting, click the query button to view the successful query page.

The online questioning sub-module is mainly for students to initiate a new question and wait for the teacher's answer when they cannot find the answer to the relevant question in the question search.

In problem solving sub module, the teacher to students at a certain time period the question list, select some typical or suitable teaching progress to solve the problem, and associated directly with the answers to answer questions, the students in the "search" project can directly search for the answer.

### 2.2.4 Design Client Module

The client module is designed based on Flash AS3.0, and the module uses the event listener mechanism. In the development process of the system, the client part mainly uses Flash cs5 to complete [9]. There is no corresponding component when using Flash cs5. At this time, you need to manually call soap and xml classes to communicate with the Web Service. To use soap and xml to connect to the Web Service, you need to construct the access request in soap format by yourself to bypass the security sandbox restrictions of Flashplayer. The format of SOAP is shown in Fig. 2.

```
1. POST /WebService/test.asmx HTTP/1.1
2. Host: 192.168.33.106
3. Content-Type: text/xml; charset=utf-8
4. Content-Length: length
5. SOAPAction: "http://92.168.33.106/say"
```

**Fig. 2.** Schematic diagram of the format of SOAP

When using the URL Request Header of flash AS3.0 to construct soap request header, post, host and content length are not supported. At the same time, it is unnecessary to set the content type and soapaction. Add the relevant information through the Request Heade URL Request Headers. Push method, as shown in Fig. 3.

```
1.var r:URL Request=new URL Request("http://
www.roading.net/WebService/Test .asmx?op=say");
2.r.method=URL RequestMethod.POST;
3.r.request Headers.push (newURL Request Header ("Content-
Type", "text/xml;charset=utf-8"));
4.r.requestHeaders.push(newURL Request Header
("SOAPAction", "http:// 192.168. 33.106isay"));
```

**Fig. 3.** Diagram of information joining process

Then the corresponding Web Service method can be accessed through the constructed URL Request object R.

The data obtained after the access will be stored in the data attribute of r in the form of xm1, and the relevant results can be obtained by accessing the data attribute.

The protocol used to connect to Flash Media Server 3 is RTMP: Real Time Messaging Protocol. The latest RTMP is RTMPE (E stands for encryption).

The first thing to determine when using the RMTP protocol to access the FMS3 server is the RMTP address to be accessed. This address consists of three parts, as follows:

rmtp:// 192.168.3 3 .106/deux.

This address consists of protocol name, server address and application name. The application program on FMS3 is different from the general application program. Its application program is only the name of a directory corresponding to the relevant location. As long as the directory exists, FMS3 can complete most of the media functions (connection control and other functions still need to be completed by script).

Flash client connects to FMS3 server mainly using the connect method of NetConnection object, and uses RMTP address as the connection parameter. After the connection is successfully established, the video stream can be obtained on the connection, or the video stream can be published.

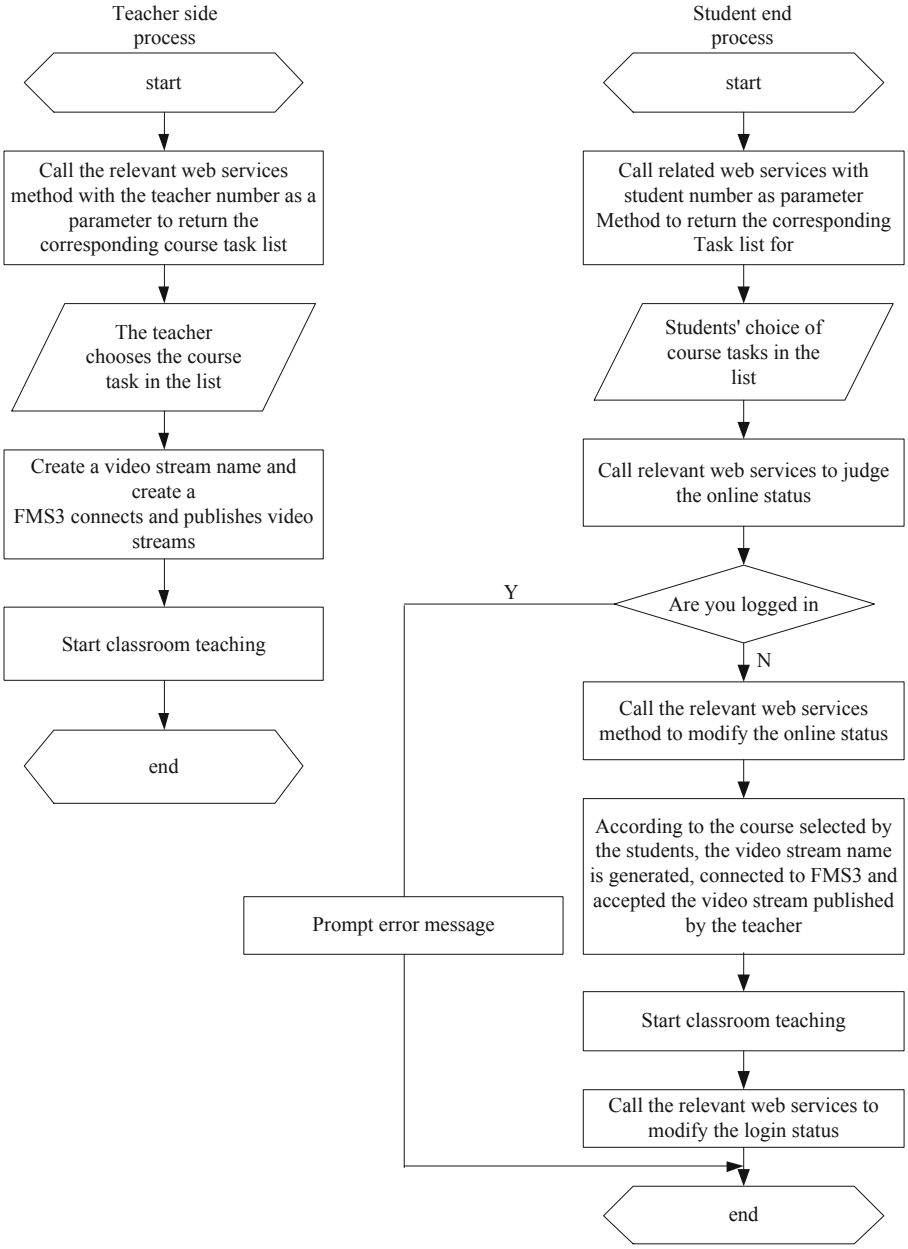


**Fig. 4.** Teacher side process and student side process

### 2.2.5 Design Video Teaching Modules

In the video teaching module, identity authentication and other functions are completed by the login page. The client focuses on the implementation of the corresponding course video teaching tasks, and mainly uses the methods provided when data and verification judgment are needed. When the teacher completes the video setting and publishes the video stream, the teacher and student can carry on the video teaching. In this process, the server can count the number and identity of connected users for class roll call and other functions. The main functions of the student side of the video teaching module are basically the same as the teacher side. However, due to the large number of students, the system needs to prevent malicious users from repeatedly logging in or non authenticated users logging into the classroom, which will have adverse effects on the classroom order.

Among them, the teacher-side process and the student-side process are shown in Fig. 4.

### 2.2.6 Design Personal Information Management Module

In the personal information management module, after the educational administrators add students and teachers to the system, the corresponding students and teachers can query and modify their own information. The query and modification process of the two users is basically similar. Taking student users as an example, students need to use the student number information when they query their own information. At the same time, in order to prevent users from modifying the information of other users, we should only extract the student number from the information stored in when the user logs in, and query. When modifying students' personal information, we should pay attention to whether the original information has been changed, so as to avoid unnecessary operation. When updating the information, the information generated when the user logs in shall also prevail, so as to avoid modifying other user information. When the student user enters the personal information page, the information generated during login is extracted first, and then the information to be displayed in the web page is returned by querying the database. If the information is wrong or there is no information, it will jump to the login page directly to prevent users from maliciously tampering with the information. When the student user clicks the Modify button, the information submitted by the user is compared with the original data. If the information has not changed, no operation will be done; if there is a change. Then the new student information will be updated to the database.

## 3 Experimental Verification

### 3.1 Experimental Design

In order to prove the effective performance of the remote online teaching assistance system based on human-computer interaction, experiments are conducted to verify it. The experimental environment data is shown in Table 2.

**Table 2.** Experimental environment data

| Serial number | To configure | Project | Data |
|---|---|---|---|
| 1 | Hardware configuration | CPU | Intel(R) Core(TM)2 Duo GPU E8400@3.OO GHz |
| | | Memory | 2 GB DDR3 1066 MHz |
| | | Hard disk | 320GB SATA |
| | | Graphics card | GeForce GTX 460 |
| | | Quantity | 3台 |
| 2 | Software configuration | Operating system | Microsoft Windows 7 |
| | | Browser | Microsoft IE 6, Microsoft IE 7, Microsoft IE 8, Mozilla Firefox<br>Sogou high speed browser, Tencent TT browser |

The experimental network topology is shown in Fig. 5.

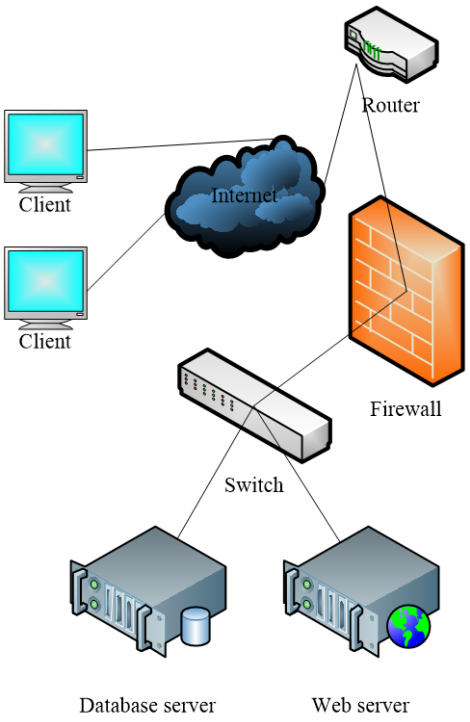


**Fig. 5.** Experimental network topology

In the environment shown in Table 2 and Fig. 5, the performance verification of the remote online teaching assistance system based on human-computer interaction is carried out, and the system performance data is obtained as experimental data. Select some key application scenarios for testing, including randomly selecting test questions to generate test papers, score calculation time, query score time, test paper answer query, question search time test, etc.

### 3.2 Result Analysis

The experimental data of the average response time of the remote online teaching aid system based on human-computer interaction is shown in Table 3.

**Table 3.** Experimental data of system average response time

| Test component | Connection times/times | Average response time (ms) |
|---|---|---|
| Test paper generation | 100 | 2.756 |
| Score calculation | 100 | 1.792 |
| Student performance query | 200 | 3.201 |
| Class results query | 50 | 2.067 |
| Time answer query | 100 | 1.593 |
| Problem search | 200 | 1.285 |

From the experimental data of the average response time of the system shown in Table 3, it can be seen that when 100 students connect to the system for online exams, the average response time of the test system is about 3 s, and the average response time of online question search is about 1 s., To meet the requirements of user applications.

The experimental results of system security test are shown in Table 4.

**Table 4.** System security test results

| Test components | Test times/time | Times of being broken |
|---|---|---|
| Student landing | 1000 | 2 |
| Teachers landing | 1000 | 1 |
| Administrator login | 2000 | 0 |

According to the experimental results of system security test in Table 4, when students log in for 1000 tests, teachers log in for 1000 tests, and management log in for 2000 tests, the number of times they are broken is 2, 1, and 0, respectively. Therefore, the security of the system is relatively high.

**Table 5.** Experimental results of system database connectivity test

| Test components | Connection times/times | Connection failure times/time |
|---|---|---|
| Student score query | 10000 | 22 |
| Class grade inquiry | 10000 | 11 |
| Time answer query | 20000 | 9 |
| Student information inquiry | 20000 | 9 |
| Teacher information query | 20000 | 9 |

The system database connectivity test results are shown in Table 5.

According to the experimental results of database connectivity test in Table 5, the number of connection failures is 22, 11, 9, 6 and 9 respectively in the test of student score query, class score query, time answer query, student information query and teacher information query test, and the successful connection power is 99.78%, 99.89%, 99.91%, 99.94% and 99.91%, respectively. It is proved that the success rate of database connection is high after the application of this system.

The system uses the LoadRunner test tool for stress testing, setting 30 Vusers, and each User repeatedly visits the system page and performs 6 clicks to view operations. The operation was repeated 2031844 times during the 9-min run, and a total of 2031844 successful return results were returned. In the end, it succeeded 21,901,245 times, an average of 1,9004.8 per second, and failed once. After the stress test, the result proves that the system can support hundreds of users to click simultaneously.

## 4 Conclusion

In this paper, a new remote online teaching aid system is designed based on human-computer interaction. Through the processor, network camera and microphone constitute the camera module of the system, so as to complete the construction of the hardware environment, and then by the online examination module, course resource management module, online question-answering module, client module, video teaching module, personal information management module constitute the system software environment. The experiments show that the system has short average response time, strong database connectivity and high security, and its performance can meet the user's requirements, which has great significance for the development of distance teaching application.

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