



# Design of Online Visual Interactive Teaching System Based on Artificial Intelligence Technology

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**Abstract.** Based on the research results obtained, an online visualized interactive teaching system based on artificial intelligence technology is designed. The tools and technologies used in the system include Windows XP Professional SP3, Eclipse Flex SDK 4, etc. The RIA scheme based on Adobe Flex technology system is adopted as the client, and the development architecture adopts MVC pattern. Data access is implemented by JDO. The designed system running environment includes the server running environment and the client running environment. System function modules include system setting module, teaching resource management module, electronic whiteboard programming module, controller module, online visual interactive teaching module, database module. The interactive teaching of online visualization is realized by combining hardware and software. The test results show that the system has high throughput, short request waiting time and short request processing time, which proves that the system has good performance.

**Keywords:** Artificial intelligence technology · Visualization · Interactive teaching system · Development environment

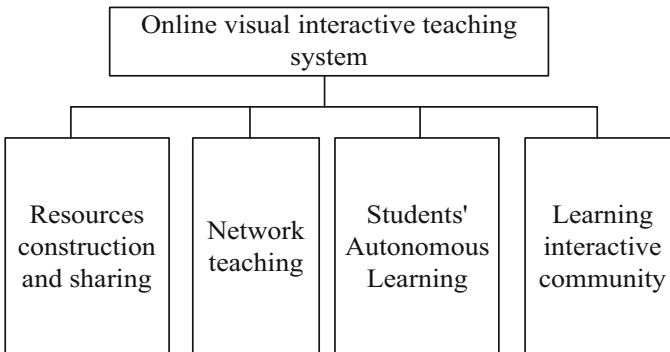
## 1 Introduction

The concept of interactive teaching is: in modern interactive education, in order to achieve the predetermined learning goal, students interact and interact in self-learning with teachers, classmates and others, with various teaching resources, and with media such as computers and the Internet [1]. From this concept, we can see that mutual communication and interaction are the essential characteristics of teaching interaction. Modern interactive education is the application of teaching interaction, to achieve the new form of education under the mutual exchange and interaction, thereby improving teaching effectiveness and achieving teaching objectives [2]. According to the difference between the subject and the object of interaction, generally speaking, interaction includes three levels: student-curriculum interaction, student-teacher interaction and student-student interaction. Experts in the field of pedagogy generally believe that modern interactive teaching is more efficient and more effective than traditional face-to-face

teaching by adopting more convenient and efficient network communication technology and multimedia technology to realize the interaction between teachers and students and between classmates because of their absence [3]. At the same time, the continuous development of our country's education has created a huge education information market. The interactive teaching system with the characteristics of "distance, interaction and cooperation" is gradually becoming an important development direction in the field of scientific research and application of modern education informationization in our country, and extends to various educational fields. With the deepening of teaching reform and the development of computer technology and application, the traditional teaching model can not meet the needs of modern society. Interactive teaching system have become a new generation of education technology which combines computer networks and multimedia technology. On this basis, the diversified teaching mode has been developed and used and achieved good results. Interactive teaching system, is the use of modern computer network technology as the transmission carrier of teaching content, make full use of multimedia technology, in the LAN or WAN teaching activities management, arrangement and implementation. Its advantage is that it has a good communication channel, can fully promote students, students and teachers between the exchange and communication, and second, it is flexible learning form, content can be visited at any time. All of these are necessary to improve the teaching quality of a course. The advantages of interactive teaching system are obvious, and its development prospect is immeasurable, which is worthy of our research, application and promotion. Under this background, the interactive teaching system is studied, and an online visual interactive teaching system based on artificial intelligence technology is designed.

## 2 Design of Online Visual Interactive Teaching System Based on Artificial Intelligence Technology

Using artificial intelligence technology to realize online visual teaching, the system function is shown in Fig. 1.



**Fig. 1.** Systems function diagram

## 2.1 Selection of Development Tools

The selection of development environment plays a very important role in the successful implementation of the project. Appropriate tool collocation and perfect server configuration need to be fully combined with the actual needs and the specific needs of users, comprehensively considering the benefits and costs to make trade-offs. The tools and technologies selected by the system are shown in Table 1 [4].

**Table 1.** List of system tools and technologies

Serial number	Project	Data
1	Operating system for development	Windows XP Professional SP3
2	Development tools and SDK version	Eclipse
3	Web server	Flex SDK 4
4	Database server	Apache + Tomcat + Axis
5	UML and database modeling tools	MS SQL Server
6	Client	Microsoft Office Vision 2003

## 2.2 Architecture Design

The RIA solution based on Adobe Flex technology system is used as the client, which is different from the traditional B/S interactive teaching system. After the server software is configured and distributed, the client user only needs to access the URL address of the Flex application on the pre-configured server by using the browser with Flash plug-in support, so as to realize the “zero” installation and “zero” configuration of the client. Users can directly access the Web server through the campus network, users of the public network or users of the outside campus, can directly access the Web server, and can also access the internal WEB server through the campus network through the VPN [5].

The development architecture adopts the MVC pattern, and from the front end to the back end is the Flex client presentation layer (.swf), the client-side business logic layer (.as->.swf/.swc) and the server-side business logic layer (.jsp), the database access abstraction layer (JDO) and the back-end data storage persistence layer. This design model makes the structure of the system clear, the functional modules at all levels work together and perform their own duties, which is very conducive to system function expansion and future maintenance and upgrading.

## 2.3 Data Access Layer Design

Data access is implemented by JDO. For developers, the great benefit of using JDO is that storing data objects requires no additional code at all, because JDO provides transparent object storage and shifts this mundane routine to the JDO product provider, allowing developers to focus on business logic implementation [6].

## 2.4 Operating Environment Design

### 1. Server-side operating environment

CPU: Intel E5200

Memory: 4 GB

Network environment: Campus network

HDD: 2T7200 to HDD 2, RAID1 array

System: Windows Server 2003

The above server configuration, for an ordinary class size of online interactive teaching activities, has been enough. Considering that there may be video sharing and playback for multiple classes and online interactive teaching, or in the case of high concurrent users, the server memory may be increased appropriately according to the actual needs, or the gigabit network card with better throughput may be replaced in order to obtain better throughput and concurrent volume of the whole system.

In addition, a large amount of audio, video or other document resources will be accumulated after a long time use of the interactive teaching system, which will occupy a large amount of hard disk space and can be used to expand the capacity of the server hard disk at an appropriate time to meet the demand for resource growth.

### 2. Client operating environment

The only requirement is that the client machine must have a browser that supports Flash Player, such as Internet Explorer, Firefox, Chrome, Safari, or Opera.

In addition, if you need to use electronic whiteboard interaction, you need to consider the client and the teacher's computer mouse sensitivity and precision.

Furthermore, if there is an online voice interaction or video sharing, playback situation, the client and teachers need to be equipped with available headphones for voice or video communication.

## 2.5 Functional Module Design

### System Setup Module Design

System setup module is divided into user management, role and authority management, access control management, login interface management and other 4 small functional modules [7].

Among them, user management to create, delete and edit basic user information, such as user name, password, and can view the user's login and operation history.

Role and privilege management: Users add, delete and modify roles, and can change the permissions associated with the role, and can also add or delete users under the role.

Role-based access control includes three concepts: user, user group and function, which are the basis of system dynamic easy-to-use user privilege management. Role-centered access control model can effectively separate the users from the functions of the system, so that the users and permissions are not directly related, but the role is used as the middle layer of users and permissions, which can increase the flexibility of

configuration. Users in a system can belong to one or more user groups; permissions can also be associated with one or more user groups; and an action permission can be associated with one or more roles. A user's permissions are essentially a union of all the permissions of all the roles to which the user belongs. After the user logs in, the system can read the authority configuration and the user group information, constructs the user function menu. In addition, when trying to access each authority module, the access legitimacy of the current logged-in user to the authority module is also detected.

A role is an abstract association concept that is created for system security. All users within a role have identical permissions configurations [8]. Roles can be flexibly set (added or deleted) according to the needs of the interactive teaching system, and similarly, users and their associations can be arbitrarily added and deleted without restriction.

Login interface management: in the interactive teaching system login interface, need to enter the correct user name and password to login. If the user does not enter a username or password, or if password authentication fails, the appropriate message is given and the user's login history is recorded on the server side. When the user name and password are correct and the user authentication is completed, the login history is also recorded, and the user's role list is read, user permissions are assigned, the main menu is initialized and the main interface is displayed according to the system settings.

### **Design of Teaching Resource Management Module**

The teaching resource management module is a background content management module of the system, which is digitized by the teachers or special administrators according to the needs of the teaching content, and then uploaded, published, and set the appropriate authority, so that the appropriate students can browse. Which mainly meet the file upload, format conversion, the corresponding records of information and related work [9].

### **Electronic Whiteboard Programming Module Design**

Electronic whiteboard programming module is used to program the writing demonstration and interactive communication of online interactive teaching. The electronic whiteboard brush binding implementation code is as follows:

```
Bind the user-set color and line width values for the brush
BindingUtils.bindProperty (this, "_ penLineWidth," hsplw, "value");//Bind the brush
line
BindingUtils.bindProperty (this, "_ penLineColor", cpplc, "selectedColor");//Binding
brush color
```

Where the value of the variable penLineWidth represents the thickness of the brush line and the value of the variable penLineColor represents the color of the brush line (hexadecimal, such as 0xff0000).

```
//Set Flex space and bind its associated property values
< mx: HSlider = "hsplw" value = "{_ penLineWidth}" />
< mx: ColorPicker id = "cpplc" selectedColor = "{_ penLineColor}" />
```

### Controller Module

The controller module designs three controllers, which are HttpServer controller, code classification controller and online integrated development environment controller. The HttpServer controller is mainly responsible for HTTP request parsing and response. Libevent is a low-level web library and is also an open source, lightweight, high-performance web library. Libevent has the following features: lightweight, high performance, network-focused, event-driven, cross-platform; support for multiple operating systems; support for events such as signals and timers; support for multiple I/O multiplexing methods. Libevent is a typical event-driven design pattern-reactor model, which has the advantages of simple and efficient programming interface, fast response, strong scalability, high reusability and so on.

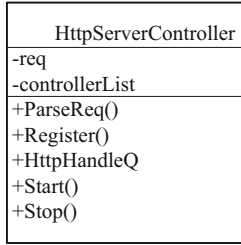
In view of these features and advantages of libevent, the system employs libevent to develop a lightweight and efficient http server that acts as an HttpServer controller responsible for receiving http requests from the front-end web, parsing http requests and processing them, while handing over specific requests to other controllers for processing and returning the results to front-end browsers for display [10]. The main steps of the HttpServer controller implemented with libevent are as follows:

- (1) Creating servers.
- (2) Register the controller with the server.
- (3) Open the server, listen on port 80, and wait for the http request.
- (4) Upon receipt of the http request, the http parameters are parsed and the request is forwarded to the corresponding controller.
- (5) The controller calls the corresponding processing function according to the parameters.
- (6) The processing function shall call the model to process the business logic as needed.
- (7) The controller reads the result of the model and returns it to the http server.
- (8) The http server organizes the results into packets and returns them to the front-end browser.

Figure 2 is a class diagram of the system implementing HttpServer, which is explained in Table 2. In Step 2 of the HttpServer, you need to register additional controllers, the Code Classification Controller and the Online Integrated Development Environment Controller, whose class diagrams and explanations are shown in Fig. 3, Fig. 4, and Table 3.

### Design of Online Visual Interactive Teaching Module

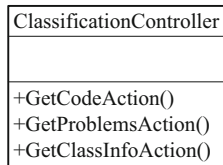
The online visualization interactive teaching module can realize the online visualization interactive teaching function. In order to realize the interactive teaching function of online visualization, it needs the cooperation of several sets of devices, and the main devices needed.



**Fig. 2.** Httpserver controller class diagram

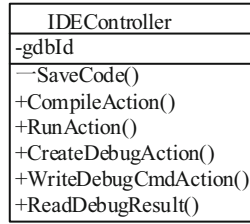
**Table 2.** Explanation of httpserver class diagram

Serial number	Class	Explain
1	REQ	This property is the request link
2	CONTROLLERLIST	This attribute is the controller list, that is, the controller registered in step 2. at present, the system only registers the code classification controller and the online integrated development environment controller
3	PARSEREQ	This function is responsible for resolving the request link REQ, getting the request address and request parameters, and passing them to the corresponding controller
4	REGISTER	This function is responsible for registering other controllers
5	HTTPHANDLE	This function is responsible for responding to the HTTP request, processing the request or transferring it to other controllers for processing, and then returning it to the requester
6	START	To start the service, perform step 3
7	STOP	Out of service



**Fig. 3.** Code classification controller class diagram

Including the teaching scene video capture system composed of the student panorama camera, the teacher mid-shot camera, the tracking host computer, the student tracking camera and the teacher tracking camera; the video playback system composed of the



**Fig. 4.** Controller class diagram of online integrated development environment

**Table 3.** Description of code classification and controller class diagram of integrated development environment

Serial number	Class	Explain
1	GETCODEACTION	This function is responsible for the processing of the request to get the source code
2	GETPROBLEMS	This function is responsible for the processing of the request to obtain the topic information
3	GETCLASSINFOACTION	This function is responsible for the processing of the request to obtain the classification information
4	GDBID	This attribute is the ID of GDB. after the GDB debugger is created, an id corresponding to a request will be generated to prevent the same request from creating multiple GDBS at the same time
5	SAVECODE	This function saves the code submitted by the front end to a file
6	COMPILEACTION	This function is used for compiling request processing
7	RUNACTION	This function is used to run code request processing
8	CREATEDDEBUGACTION	This function is used to debug code request processing
9	WRITEDEBUGCMDACTION	This function is used to write debug command request processing
10	READDEBUGRESULT	This function is used to read debugging results and request processing

projector, the electronic whiteboard and the large screen; the teaching scene audio playback system composed of the wireless microphone, the pickup device and the noise suppressor; the audio playback system composed of the mixer, the power amplifier and the sound box; the audio playback system composed of the audio playback system, the video playback system, the teaching computer and the recording host computer. Codec is the “throat” of communication in online visual interactive teaching. Only when the local video, audio and computer display signals are encoded, can they be input into the communication host and transmitted out; only after the signals from each other are decoded can they be restored to images and sounds. The communication host computer is the hub of the communication system. On the one hand, it transmits the live video, audio and teaching computer display signals collected by one party; on the other hand, it transmits the video, audio and teaching computer display signals collected by the other party; and the programmable central controller is used to switch the screen to display the signal source.

### **Database Module Design**

The system database adopts MYSQL database. MySQL is an open source relational database management system (RDBMS). The MySQL database system uses the most commonly used database management language, Structured Query Language (SQL), for database management, which has the following characteristics:

1. Large data with tens of millions of records may be processed.
2. Support common SQL statement specifications.
3. High portability, simple and compact installation.
4. Good operation efficiency and network support with rich information.
5. Simple debugging, management and optimization (compared with other large databases).

The database module covers the database structure as follows:

1. User service: user table, user expansion table, organization table, privilege table, role table, log table, user corner table, etc.
2. Booking service: booking information table, classroom information table, classroom equipment table, statistics table, etc.
3. Equipment services: equipment information table, equipment classification table, interface configuration table.

## **3 Simulation Experiment**

### **3.1 Experimental Design**

The system test platform constructed is as follows:

Platform server hardware environment:

CPU: Intel i5 processors;  
 Memory: 8G;  
 Equipped with sound card, headset, video capture equipment (camera) and other multimedia equipment.

Platform system software configuration:

WIN7 32-bit, WIN7 64-bit, WIN8.132-BIT, WIN8.164-BIT, WIN1032-BIT and WIN1064-BIT systems;  
 Platform browsers: IE10, IE11, Chrome.  
 MCU Multipoint Controller: Cisco MCU Controller.  
 Smart Classroom: Educational Large Screen and Related Equipment.  
 Terminal Equipment: Cisco Education Terminal.

The installation of the system mainly includes the installation of the booking platform of the teaching system, in which the system includes the booking service and user service, the installation of control service, the way of using the same installation package (exe form) for installation, the installation with one key and the instructions for use shall be marked.

On the system test platform, the online visual interactive teaching system based on artificial intelligence technology is tested.

After the system runs, the throughput, request waiting time and request processing time are tested and compared with each other using the AB test tool that comes with APACHE.

### 3.2 Experimental Results

The throughput test results of the online visual interactive teaching system based on artificial intelligence are shown in Table 4 under the condition of different concurrent numbers in response to the default WEB directory.

**Table 4.** Throughput test results

Serial number	Serial number	Throughput (REQS/S)
1	1	4055.35
2	2	3452.29
3	5	4229.63
4	10	4863.50
5	20	8080.25
6	30	8279.98
7	50	8687.23

(continued)

**Table 4.** (continued)

Serial number	Serial number	Throughput (REQS/S)
8	100	8687.23
9	150	4578.72
10	200	1621.00
11	500	398.26
12	1000	292.24

**Table 5.** Test results of request waiting time

Serial number	Serial number	Throughput (REQS/S)
1	1	0.264
2	2	0.528
3	5	1.157
4	10	2.534
5	20	3.060
6	30	4.979
7	50	8.483
8	100	10.998
9	150	23.552
10	200	185.479
11	500	1238.055
12	1000	3350.076

The test results of request waiting time are shown in Table 5.  
 The test results of request processing time are shown in Table 6.

**Table 6.** Test results of request processing time

Serial number	Serial number	Throughput (REQS/S)
1	1	0.264
2	2	0.219
3	5	0.263
4	10	0.249

(continued)

**Table 6.** (continued)

Serial number	Serial number	Throughput (REQS/S)
5	20	0.130
6	30	0.144
7	50	0.180
8	100	0.200
9	150	0.271
10	200	0.729
11	500	2.576
12	1000	3.306

According to the test results in Table 4, Table 5 and Table 6, the throughput of online visual interactive teaching system based on artificial intelligence technology is higher, while the request waiting time and request processing time are shorter.

## 4 Conclusion

The online visual interactive teaching system based on artificial intelligence technology has realized the purpose of online visual interactive teaching. However, due to many factors, such as the development technology and practical application framework adopted by the subject, the time of the subject is in a hurry and the software testing environment and so on, the research of the subject is not deep enough and perfect. We will try our best to study in the future. In the process, we should conduct further exploration and research.

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