



# Design of Distance Teaching System for Textile Pattern Design Course Based on Online and Offline Integration

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**Abstract.** In order to reduce the CPU utilization of the distance teaching system of textile pattern design course, this paper designs a distance teaching system of textile pattern design course integrating online and offline. The hardware design part includes power supply module, wireless communication module, logic control module and data reading module. The software design adopts B/S architecture to establish a three-tier structure model. Microsoft SQL server is adopted as the database management system; Use Hadoop framework to build cloud computing platform; Pick KX algorithm is used to realize dynamic load balancing and allocate server resources; Correct the difference of data name by entity alignment; Through ASP Net script file to design web interactive page. The test results show that when the number of concurrent users is 200 and 500, the maximum CPU utilization of database server is 53.7% and 65.5%, and the maximum CPU utilization of web server is 47.5% and 56.7%, which reduces the CPU utilization of the system as a whole.

**Keywords:** Online and offline integration · Textiles · Pattern design · Distance learning system

## 1 Introduction

Education is not only the basis of national competitiveness, but also an important embodiment of comprehensive national strength. In China, the development and reform in the field of education are under the heavy pressure of great challenges. The combination of education and big data technology has become an inevitable trend in the development of education. In the whole process of educational activities, all data related to educational activities and the collection of data used to create potential value for educational development are collectively referred to as educational big data. Under the current research situation in the field of education at home and abroad, from a strategic perspective, education data can be positioned as a scientific help to promote the transformation of new strategic assets in education, drive comprehensive reform in the field of education and the basis for the development of intelligent education. With Web 2.0, the scale of data on the Internet has increased sharply. For educational resources, thanks to

the vigorous development of educational informatization, a large number of educational resources with rich content and various forms have been accumulated on the network.

With the increase in online teaching demand and users, the amount of curriculum resources for online distance teaching is increasing explosively [1]. Textile pattern design course is the main discipline of design major. In teaching, students express the things inspired in their own minds by relying on the existing basic pattern elements [2]. Combining the textile pattern design course with the online and offline integrated distance teaching system opens up a new idea for the teaching of art specialty, breaks the thinking imprisonment of traditional pattern design, improves the utilization of high-quality teaching resources and promotes the process of informatization of textile pattern design education. Therefore, the academic circles pay more and more attention to the distance teaching system of textile pattern design course.

In the traditional method, Li Peiyun et al. [3] designed a distance multimedia teaching system based on virtual reality. In Hardware design, the system uses 3D scanner to model in the way of 3D stereo detection; In Software design, the small plane is used to simulate the physical surface, and the module size in the virtual teaching scene is adjusted with reference to the error function; Adjust the module pixels according to the pixel resolution formula to build a virtual scene; Simulate the equipment function through VRML language program; The distance teaching system completes the triggering of teaching program, data transmission and layout conversion according to the response function. Zhang Ling [4] proposed the design of distance teaching system based on artificial intelligence network. In Hardware design, the student learning module is composed of teaching cooperation agents and multiple other agents, which are responsible for the presentation of teaching materials and the solution of teaching problems. In Software design, Knowledge sharing is realized through cooperation mechanism to provide personalized teaching basis for the system. The teacher teaching module mainly provides students with corresponding teaching strategies according to the curriculum requirements and provides intelligent guidance for the problems encountered in the teaching process. The evaluation module uses the evaluation rules to comprehensively evaluate students' learning behavior, learning attitude, learning effect and learning ability. Man machine interface is the communication medium between students, teachers and the system. Students and teachers complete personal login through the login interface.

The research on the above distance learning system can innovate the teaching mode and provide power for students to change their learning methods, but it does not fully consider the characteristics of node resources in the system cluster, resulting in unreasonable differentiated allocation scheme of system node resources and high CPU utilization.

In order to reduce the CPU utilization of the distance teaching system, taking the textile pattern design course as the research object, this paper designs a distance teaching system of textile pattern design course integrating online and offline. The system can provide teaching and learning services anytime and anywhere when the network environment allows, and improve the teaching efficiency of textile pattern design course to a certain extent. The hardware design of the system includes four modules: power supply module, wireless communication module, logic control module and data reading module. The software design part adopts Microsoft SQL server as the database management system; Build a data cloud computing platform using Hadoop framework; Innovatively

pick KX algorithm is used to realize dynamic load balancing and reasonably allocate system server resources; Using ASP Net scripting system. The experimental results show that the system designed in this paper can significantly reduce the CPU utilization and has high application value.

## 2 Hardware Design of Distance Teaching System for Textile Pattern Design Course with Online and Offline Integration

The overall structure design of the software and hardware of the distance teaching system is shown in Fig. 1:

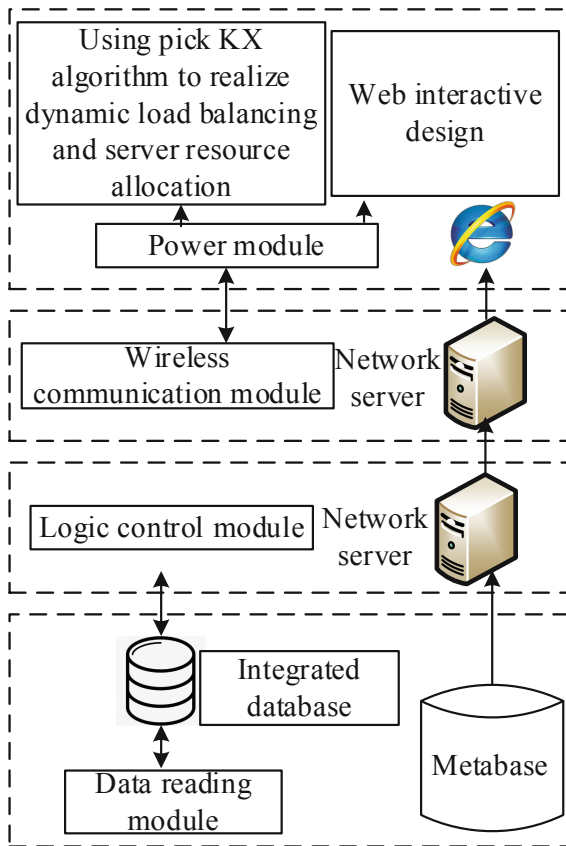
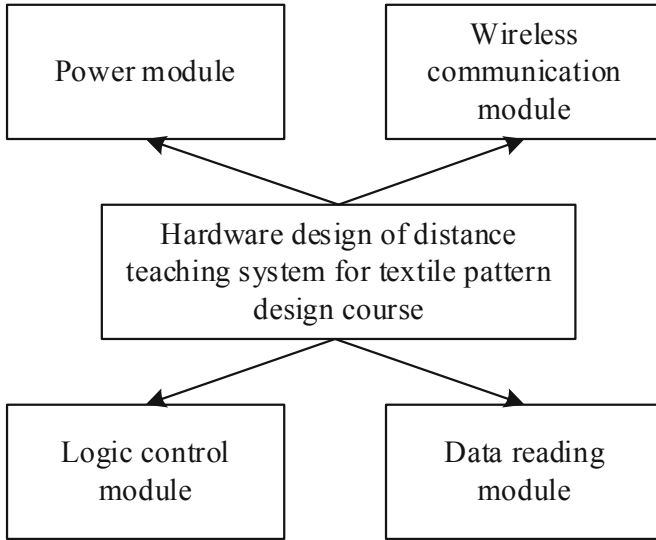


Fig. 1. Overall software and hardware design framework of the system

According to the Fig. 1 and design requirements of the remote teaching system of online and offline integrated textile pattern design courses, the hardware structure framework of the system is established as shown in Fig. 2.

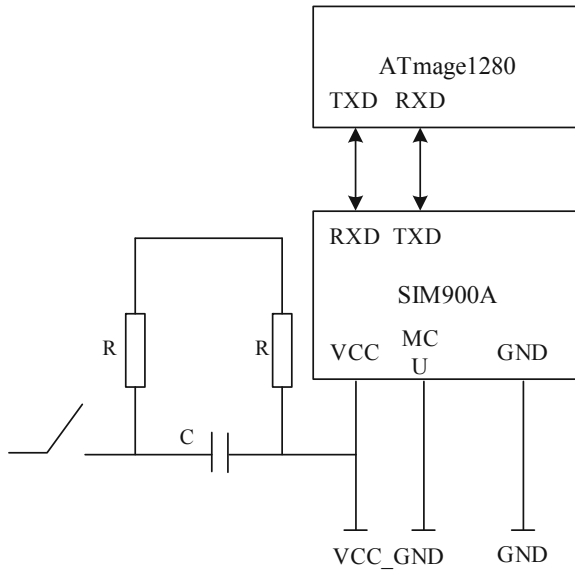


**Fig. 2.** System hardware structure framework

As shown in Fig. 2, the hardware design section of the system includes four modules: a power supply membrane block, a wireless communication module, a logic control module, and a data reading module.

The logic control module consists of FIFO queue and CSR (control and status logic) response queue. Before adding the msgdma IP core to the qsys system, the FIFO queue depth needs to be initialized, and its maximum depth can be set to 256. The PC side only initiates DMA read and write tasks for the cyclic buffer addresses with four consecutive physical addresses. Considering the alignment of pages (the page size is set by PCIe hard core parameters), the maximum number of memory descriptors used to complete a DMA read-write operation is 8. The logic control module needs to save the read-write address of each memory block to the read-write memory descriptor FIFO queue in the module. In the process of starting DMA transmission, read and write memory blocks in turn according to the address in FIFO queue until the whole queue is empty, and then complete this DMA operation process, so as to realize sgdma function.

The wireless communication module adopts serial communication, which provides two groups of TTL interfaces. One group is a 2.85v-ttl interface with level matching, which can be directly connected with 3.3V single chip microcomputer; The other group uses pin VCC\_ MCU is a 5v-ttl interface with level matching, and can be compatible with single chip microcomputer with 5 V, 3.3 V and other voltages. The power supply voltage of atmage1280 single chip microcomputer is 5 V, and its communication with sim900a module adopts 5v-ttl interface. The wiring method is shown in Fig. 3.



**Fig. 3.** Schematic wiring diagram

Sim900a module contains two indicators, namely power indicator and network indicator. We can roughly judge the working state of the whole module by observing the working state of the two indicators. When the power indicator of sim900a module is on for a long time and the network indicator flashes slowly, the sim900a module is in normal working state, and the normal communication of system hardware can be carried out at this time.

The data reading module is responsible for reading data from the register and converting the data into a high-speed Avalon data stream. The data reading module includes four ports: read command, read response, data master and data sink.

The power module is the power source of the whole system. The system is powered by 5V voltage. The power supply circuit adopts the step-down switch type integrated voltage stabilizing chip LM2596 produced by Texas Instruments (TI)\_ ADJ The chip has a receiver and a transmitter, and the highest transmission rate is 5mbps, which meets the design working environment and requirements. In order to achieve greater output current, several three terminal voltage stabilizing circuits need to be connected in parallel. When n voltage stabilizing circuits are connected in parallel, the output current increases n times. It is required that the chip model of each branch must be consistent with the manufacturer, otherwise the stability of the output current is poor, and even the circuit is burned in chain.

### 3 Software Design of Remote Teaching System for Textile Pattern Design Course Integrated Online and Offline

#### 3.1 System Structure Framework

The software design of this system using the three-layer structure model of B/S architecture standard is shown in Fig. 4.

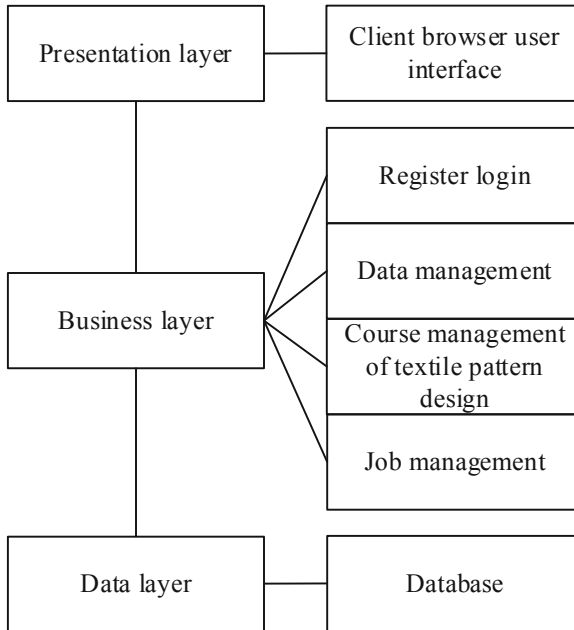


Fig. 4. System software structure framework

As shown in Fig. 4, the user terminal puts forward an operation request to the system through the browser operation interface; The server side of the system runs based on the web server in the form of website, and the background links the MySQL database server to fetch data through the SSH framework based on J2EE; The server file system uses Hadoop framework to build a cloud computing platform. The platform supports the storage, viewing and downloading of textile pattern design teaching course resources and homework files, calculates and analyzes the data in the database and the files in the file system, and returns the results to the client browser.

The module software code of distance teaching system of textile pattern design course mainly includes the following aspects: first, this kind of code file is mainly used to process distance learning information and make learning records, which can effectively help teachers master students' learning situation in time, and then automatically save it, so as to provide reference for future teaching. Second, this kind of code can provide students with convenient operation services, simplify the previous cumbersome operation procedures, and meet the basic requirements of actual production. Third, this kind of code in the

document is mainly for users to help students formulate a scientific and reasonable textile pattern design teaching plan, provide high-quality services for students to find leaks and fill vacancies, and quickly solve difficult knowledge in learning. Fourth, in this kind of code file, it is mainly to conduct a comprehensive and reasonable evaluation of the course and provide targeted guidance for students' self-learning in the future [5].

Each functional module of the system uses the cloud computing distributed file reading and writing method based on Hadoop framework to ensure the upload and download efficiency of data files and the stable operation of the system under the condition of high concurrency of big data. The distributed fliesystem object remotely obtains the datanode node path of the first few blocks of the file through RPC. The namenode will return the datanode node containing the block copy according to the actual network topology. If the requesting client node itself is a datanode and there is a block copy on its own node, it can be read locally directly. The current allocation method does not fully consider the characteristics of node resources in the cluster to allocate nodes differently. This system design adopts pick KX algorithm to realize dynamic load balancing. Pick KX algorithm is used to realize dynamic load balancing and reasonably allocate server resources. The process can be expressed as follows:

$$\vartheta_b = \frac{R_a}{\sum_{a=1}^a h_a} \quad (1)$$

In formula (1),  $\vartheta_b$  represents load assignment probability;  $a, b$  represents node location serial number;  $R_a$  represents load of each node in the cluster;  $h_a$  represents the current load of the server; The calculation formula of  $R_a$  is as follows:

$$R_a = \frac{H - h_a}{H} \quad (2)$$

In formula (2),  $H$  represents the total load. When the probability  $\vartheta_b$  is larger, it indicates that the current load of this system is the minimum.

At this point, the request submitted by the user can be dynamically allocated to the server for processing. Textile pattern design course management mainly includes a number of contents about learning and course, which realizes the effective storage of information. In the whole module, it mainly operates the corresponding table. In the course management of textile pattern design, students can get the corresponding information through the system, and then bind the course with data. Students can make repeated inquiries in combination with the current situation, so as to improve the effect of actual processing.

### 3.2 Design the Database Structure

Database is the infrastructure for the normal operation of the whole system, which directly affects the success or failure of system design, especially the function of system operation. The system uses Microsoft SQL server as the database management system, and most of the information on the server side is stored as this. If you need to change

the database system, you can achieve the goal by partially changing the configuration file of Spring or the persistence class of Hibernate.

The database of the teaching system consists of multiple data tables, including: teacher and student information table, teacher courseware table, test paper management table, practice management table, student transcript, analysis table, question bank table, etc. The object entity model is the carrier of the system for data transmission and persistent storage process. The digital education resource management system includes many object entity models corresponding to users, resources, administrators and other entities [6]. The entity user attributes include user ID, account number, password, permission rule, creation time, etc. User ID is the ID number, which is unique. The account and password are used to log in to the system. The system judges the legitimacy of the user's permission by reading the permission rules. Entity resource attributes include resource number, resource name, resource type, resource content, resource address, creation time and change time. The resource number is manually set and used for form records. The resource type sets the grouping category of the resource. The resource address saves the location information stored by the resource. The same entity name extracted from different educational resources may be different, resulting in inaccurate results. Therefore, this difference needs to be corrected through entity alignment [7]. Entity alignment can be judged by extracting the similarity between entities. Entities with high similarity may be different representations of the same entity. The formula for calculating the entity similarity can be expressed as:

$$\lambda = \frac{PQ}{|P||Q|} \quad (3)$$

In formula (3),  $\lambda$  represents the entity similarity;  $PQ$  represents the inner product of two vectors;  $|P||Q|$  represents the product of the length of two vectors. The greater the cosine similarity, the smaller the angle between vectors, and the more similar the entities are, the more likely they are to be different representations of the same entity. The entities with high similarity are screened out by setting the threshold, and whether they belong to the same entity is judged manually. All forms in the system are created, edited and submitted by the user, and then approved by the administrator with high authority. However, each user may participate in a variety of businesses, so each user may produce many submitted forms, so there is a one to many relationship between user entities and form entities. When an administrator approves a saved form, an administrator may approve multiple forms. Therefore, the relationship between the administrator entity class and the form entity class is also a one to many relationship.

### 3.3 Function Realization of Textile Pattern Design Course System

The login system module is mainly responsible for managing the user's login, registration and deletion functions. Users of the system need to confirm their identity before use. Only the authorized user name and its corresponding correct password can use the functions of the software system and conduct the relevant operation. This section is designed and mainly includes three functions: registration, login and management. Each type of user (administrator, teacher, and student) has different permissions, and different types of users will enter different operating interfaces after logging in.

The data management function module consists of three sub-modules: data download, data upload and data maintenance. Student users download the data information through the data download interface, so the information download function depends on the data information entity; the teachers upload the data information, so the data information entity; the administrator user includes data maintenance through the data maintenance interface, so the data maintenance function also depends on the data information entity.

Textile pattern design curriculum system can organize various types of multimedia teaching resources, can build multimedia database for text, pictures, video and other multimedia, and the text and gallery management separately, set up navigation system, realize the centralized teaching resources management and rapid retrieval and call of teaching resources function. Resources can be released in the form of courseware for teaching demonstration. Due to the special and important position of graphics in textile pattern design courses, the remote teaching system sets a variety of display methods for image resources, which fully meets the needs of teaching demonstration.

In order to realize the display and interaction function of the system, through ASP Net script file for Web interactive page design. Each page design should correspond to the corresponding logical processing class structure. Class structure is mainly used to record relevant information and provide corresponding operation interfaces, so as to facilitate students' learning, course learning, formulate learning plans and improve learning efficiency. The function module of homework interaction management consists of three sub modules: student homework, teacher homework and homework maintenance. The student user operates the student homework through the student homework interface, including homework information, so the student homework function depends on the homework information entity; The teacher user carries out the teacher operation through the teacher operation interface, which also includes the operation information, so the teacher operation function also depends on the operation information entity; The administrator user carries out job maintenance through the job maintenance interface, which also includes job information. Therefore, the job management function also depends on the job information entity.

## **4 System Test**

### **4.1 System Function Test**

There will be errors and deficiencies in the process of system development. In order to ensure the complete and normal operation of the distance teaching system, the black box test is used to test the function of the system. Test the function of the system editing module to see whether it is perfect and whether it can run correctly. The test items mainly include teaching plan entry, editing drawings and notes, multimedia resource integration and teaching resource release. After testing, all editing items can be realized normally. Test the function of the system teaching module to see whether it is perfect and whether it can run correctly. The test items mainly include courseware import, courseware playback, view switching and related data. After testing, the teaching items of textile pattern design can be realized normally. The data set used in this paper system

comes from the teaching course resources and homework file data of the textile pattern design major in a certain university.

## 4.2 System Performance Test

This experiment mainly tests the CPU utilization rate of the design system. Test the maximum database server CPU usage and the maximum Web server CPU usage, with concurrent users of 200 and 500, respectively. The performance test results of the designed remote teaching system are compared with the remote teaching system based on virtual reality and AI network. The results of the database server CPU maximum utilization comparison are shown in Tables 1 and 2.

**Table 1.** Maximum CPU usage of database servers with 200 concurrent users

The number of experiments	Maximum CPU usage of database server (%)		
	The remote teaching system of the textile pattern design course is designed	Distance teaching system based on virtual reality	Distance teaching system of textile design based on AI network
1	53.4	59.4	60.5
2	53.8	58.7	61.4
3	52.5	57.8	59.8
4	54.6	58.6	60.5
5	55.2	59.7	62.6
6	53.5	58.2	61.3
7	52.3	57.3	59.2
8	54.2	58.5	60.5
9	54.0	59.2	60.4
10	53.4	58.1	59.0

**Table 2.** Maximum CPU usage of database servers with 500 concurrent users

The number of experiments	Maximum CPU usage of database server (%)		
	The remote teaching system of the textile pattern design course is designed	Distance teaching system based on virtual reality	Distance teaching system of textile design based on AI network
1	64.4	68.4	70.8
2	65.8	69.7	70.4
3	66.6	70.5	70.7
4	64.5	70.6	69.8
5	66.9	70.9	68.5
6	64.5	66.8	69.6
7	66.2	69.5	69.5
8	65.6	70.4	70.8
9	65.3	70.1	70.9
10	65.2	70.2	69.0

According to the results of Table 1, when the number of concurrent users was 200, the maximum database server CPU utilization rate of the remote teaching system of the designed textile pattern design course was 53.7%, 4.9% and 6.8% lower than the remote teaching system based on virtual reality and based on artificial intelligence network. According to the results of Table 2, when the number of concurrent users was 500, the maximum database server CPU utilization rate of the designed textile pattern design course remote teaching system was 65.5%, 4.2% and 4.5% lower than the remote teaching system based on virtual reality and AI-based network. The Web server CPU maximum utilization comparison results are shown in Tables 3 and 4.

**Table 3.** Maximum web server CPU usage with 200 concurrent users

The number of experiments	Maximum CPU usage of Web server (%)		
	The remote teaching system of the textile pattern design course is designed	Distance teaching system based on virtual reality	Distance teaching system of textile design based on AI network
1	48.4	55.0	56.2
2	47.7	55.5	58.4

(continued)

**Table 3.** (continued)

The number of experiments	Maximum CPU usage of Web server (%)		
	The remote teaching system of the textile pattern design course is designed	Distance teaching system based on virtual reality	Distance teaching system of textile design based on AI network
3	47.8	56.2	56.7
4	48.5	55.0	58.8
5	46.6	57.4	57.9
6	47.2	57.8	55.6
7	46.5	56.6	58.3
8	47.9	57.5	57.5
9	47.6	55.9	55.2
10	46.5	56.5	56.5

**Table 4.** Maximum web server CPU usage with 500 concurrent users

The number of experiment	Maximum CPU usage of web server (%)		
	The remote teaching system of the textile pattern design course is designed	Distance teaching system based on virtual reality	Distance teaching system of textile design based on AI network
1	57.4	65.4	64.4
2	58.7	66.5	67.8
3	57.8	64.6	64.9
4	54.5	62.2	65.6
5	55.6	64.0	67.0
6	56.9	63.5	68.3
7	55.5	65.8	67.5
8	58.8	67.9	66.2
9	57.2	65.3	67.6
10	55.0	66.2	66.8

According to the results in Table 3, when the number of concurrent users is 200, the maximum utilization rate of web server CPU of the distance teaching system of textile pattern design course designed this time is 47.5%, which is 8.8% and 9.6% lower than the distance teaching system based on virtual reality and artificial intelligence network. According to the results in Table 4, when the number of concurrent users is 500, the

maximum utilization rate of web server CPU of the distance teaching system of textile pattern design course designed this time is 56.7%, which is 8.4% and 9.9% lower than the distance teaching system based on virtual reality and artificial intelligence network. Based on the above system test results, the maximum CPU utilization of the designed system does not exceed 70%, which meets the expectation of performance requirements, and the operation efficiency is higher than the two control systems when the number of concurrent users is 200 and 500, which has a good application prospect.

## 5 Conclusion

After the test, the function of the distance teaching system of textile pattern design course integrated online and offline is basically normal, meets the design and application requirements, and the design and implementation are basically successful. However, due to the short time, the function of the system is not very perfect, and there is still room for further improvement. In terms of system functional design, limited by time and development experience, this paper only develops and realizes the basic functions of distance teaching. In the future, the functionality and practicability of the system could be optimized and expanded according to the actual application needs of the industry, so as to realize a more intelligent distance teaching system.

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