



Design of Dance Action Simulation Teaching System Based on Cloud Computation

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Abstract. In order to improve the performance of the dance movement simulation teaching system, cloud computing technology is used to realize the optimization design of the dance movement simulation teaching system from the three aspects of hardware, database and software. In terms of hardware, the system's network environment, processor and video capture module have been modified and optimized, and the internal connection network of the hardware system has been adjusted. Collect dance moves and related teaching resource data in the teaching system, install them in a certain format to form a database table, and obtain the design result of the system database through the logical relationship between the database tables. With the support of hardware equipment and database, a cloud computing framework is constructed to collect and process complete dance motion simulation video data as the basic content, and to realize the functional design of the system from both the classroom and the students. Through the system test experiment, it is concluded that compared with the traditional teaching system, there is no obvious difference in the function of the design system, but the operating performance of the system has been improved, which effectively improves the safety and stability of the system. The system has certain practicability and can be used in dance teaching to improve the accuracy of dance movements of students.

Keywords: Cloud computing · Dance action · Simulation teaching · Teaching system

1 Introduction

Dance is the most unique form of artistic expression in artistic aesthetics. It can not only express emotions, but also express beauty. It combines time and space to show a harmonious rhythm. It is not only an art that beautifies human movements, but also transcends the flesh. And the appreciation of the beauty of the soul [1]. Dance education is to display artistic images through aesthetic methods and to infect, inspire and educate people subtly. In order to improve people's dance appreciation ability, dance education is needed [2]. Popular dance education is mainly for non-dance major students and amateur dance enthusiasts, training them in dance aesthetics, dance training and basic performance. Dance teaching uses the body and cooperates with music, costumes, props, lighting and other artistic methods. Due to the influence of time and space, it is impossible

to develop on a large scale. Through mobile learning, the use of live video or rebroadcast provides new ideas for popular dance education [3]. Dance simulation teaching is online learning at any time and any place with the help of mobile terminals, breaking the boundaries of traditional teaching in practice and space, and is of great significance to improving the level of popular dance education.

The dance movement simulation teaching system takes dance movement as the teaching content, and is an activity system that involves the participation of teachers and students to achieve the teaching goals. It is composed of teaching staff, teaching information, teaching materials and equipment. It includes three subsystems: control, execution, and feedback. The control system determines the movement direction and work content of the entire system, and adjusts the work of other subsystems. The teacher plays the main role of control and implementation. At present, domestic and foreign distance teaching systems are mainly developed for traditional teaching subjects, including Web-based teaching systems, multimedia-based teaching systems, and project-based teaching systems. However, traditional teaching systems are applied to dance among the subjects, there will be problems such as poor processing of dance motion simulation video and video playback failure. For this purpose, a dance motion simulation teaching system based on cloud computing has been designed.

The dance movement simulation teaching system based on cloud computing introduces cloud computing technology on the basis of the traditional teaching system. Cloud computing is a super computing model based on the Internet. There are many calculation modes, which are executed on dedicated supercomputers. There are mainly parallel computing, distributed computing and grid computing, utility computing and network storage. It has the characteristics of virtualization and load balancing, and is the result of the integrated development of computer technology and network technology. Cloud computing can integrate computer resources to increase the computing power of devices horizontally, and has strong disaster tolerance and less inter-device dependence. Through the application of cloud computing technology, it will no longer need to spend a lot of financial resources to purchase dance equipment and dance environment, thereby greatly reducing the hardware cost of its teaching resources. At the same time, cloud computing can provide high security performance for data storage centers to ensure the security of all data. Teachers and students do not need to worry about data loss caused by viruses and hacker attacks, and can conduct interactive teaching on the network platform any-time and anywhere [4]. Finally, in the cloud computing environment, the resources of various schools can be shared, which is conducive to the balanced distribution of teaching resources, and greatly improves the utilization of teaching resources in various universities.

2 The Hardware System Design of Dance Action Simulation Teaching

Before starting the design of the dance movement simulation teaching system, first conduct a demand analysis. From the perspective of functional requirements, it can be divided into two aspects: student client function and teacher client function. The student client requires the system to download and play dance resources. Search and

other functions, and the teacher client is required to be able to perform functions such as uploading teaching resources and setting dance courses. In addition, the analysis of non-functional requirements mainly analyzes the number of users and the speed of response time. The system is required to operate stably when 500 people access the platform at the same time. When users use dance resource uploading and other functions, the response time can be appropriately delayed, but not more than 10 s, the response time of other functions is within 3 s [5]. When the dance movement simulation system fails to run, the administrator needs to eliminate the fault in time and restore the system to run, but the troubleshooting time cannot exceed 6 h, otherwise it will seriously affect the dance students' learning.

Based on the results of system requirements analysis, following the design principles of economy, safety, scalability, advancement, reliability, practicability, simplicity, etc., specific optimization designs are carried out from the three parts of hardware, database and software. And get the final dance action simulation teaching system optimization design results. The basic hardware connection structure of the system is shown in Fig. 1.

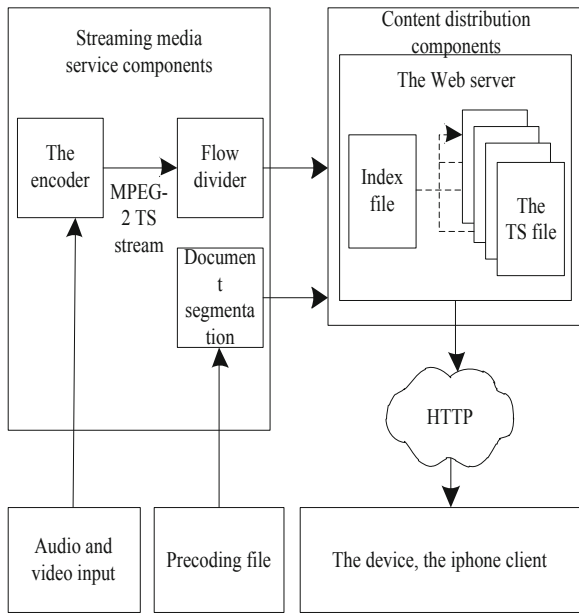


Fig. 1. Hardware system structure diagram of dance movement simulation teaching

2.1 Communication Network Design of Analog Control Board

The network structure design covers the interface type used by the user, the network protocol used, and the type of network wiring that may be used. The top layer contains the database server, application server and client; the first layer contains the firewall, numerous clients and network structures.

2.2 Dance Action Simulation Video Acquisition Module

Cameras are divided into two types: digital cameras and analog cameras. With digital camcorder video capture devices, analog video signals can be converted to digital, and then stored in a computer. The video signal captured by an analog camera must pass through a specific analog video capture card, first converted to digital mode and compressed before it can be converted to use on a computer. Digital video cameras can directly capture images, and then display them on the computer screen via serial, parallel or USB interfaces. Choose the latest USB camera. According to the USB standard, the longest transmission distance of a USB device is 5 m. This design can extend the transmission distance through the USBHUB (active hub can amplify or regenerate the signal), each additional HUB can be extended by 5 m, a total of 5 HUBs can be added, that is, the extension is 5 times, so the longest can be extended 25 m.

2.3 Embedded Processor

By choosing ARM chips to realize the modification of processor devices, first choose from the ARM core. One of the decisive factors is whether the ARM core has its own MMU function, because some embedded systems can only run on chips with MMU functions. ARM cores above ARM720T all have ARM chips with MMU function, ARM720T, ARM920T, ARM922T, ARM926EJS all have MMU function. Secondly, choose the system clock frequency of the ARM chip. The system clock frequency determines the processing speed of the ARM chip. What needs to be considered again is the number of external interface controllers built into the ARM chip [6]. The selected ARM chip must have or can be extended to the following peripheral interfaces: RS232 serial interface, USB interface, Ethernet interface, LCD/touch screen interface, audio interface, JTAG interface, SD card interface. At the same time, it is better to integrate a DMA controller in the ARM chip, so that a large amount of high-speed data transmission can be carried out with the outside world. After comparing the performance of all ARM chips on the market, the AT91SAM9263 chip was finally selected as the processor chip of this teaching system, and the traditional chip was replaced to realize the modification of embedded processor equipment.

2.4 Circuit Design and Debugging

The system needs two voltages of different sizes for the chip and each peripheral to use, 3V3 voltage and 1V2 voltage, respectively, for the system's memory module and ARM chip. Because there is only one input voltage from the mother board to the daughter board, that is, the 3.3 V power supply voltage, a level conversion circuit should be designed in the hardware design to convert 3V3 to 1V2. In addition, the crystal oscillator circuit is an indispensable part of the embedded hardware circuit, and the ARM chip obtains the master clock by using an external crystal oscillator for frequency multiplication. According to the requirements of the ARM chip S3C2440, it is designed to provide two crystal oscillators of 16.9344 MHz and 32.768 MHz with different frequencies for the ARM chip, which are used in normal working mode and sleep mode respectively. The reset circuit is an essential part of the embedded hardware circuit. The reset circuit

in the design can be used for power-on reset or reset by manual button. At the same time, because the network interface chip CS8900A requires a high-level reset, a 74HC14 inverter is added to invert the negative pulse of the system reset signal to obtain a positive pulse reset signal.

The audio interface of the system is realized by connecting the audio codec AD1981 through the AC97 interface provided by the ARM chip [7]. AC97 controller provides two serial data lines, clock lines and control lines to the external AD1981. AD1981 has expanded three interfaces, namely: headphone jack, microphone jack, and audio conversion interface.

3 Database Design of Dance Movement Simulation Teaching System

For the system, the design of the database structure largely affects the efficiency of system access and user experience. Therefore, the analysis and design of the database during the system development process should follow strict specifications. Under the premise of ensuring data consistency and integrity, the degree of data redundancy should be reduced as much as possible [8]. The dance movement simulation teaching system uses a database to store each entity object. It mainly includes courseware table, faculty table, professional table, system parameter table, class table, transcript table, forum topic table, forum discussion table, etc. The courseware and video release status of dance action simulation courses are shown in Table 1.

Table 1. Dance action simulation courseware and video release form

Field name	Field type	Field constraint	Field description
Video slide id	Int	Primary key, automatic number, not empty	Numbering
Publisher	Varch (50)	Not empty	Publisher
Upload date	Datetime	Not empty	Upload time
Video slide url	Varch (50)		File name
Download times	Mt	Not empty	Download times
Title	Varch (50)	–	Title
Description	Varch (50)	–	Description
Tag	Int	–	0 Means teaching courseware, 1 Means instructional video
Course_id	Int	Foreign key, not empty	Course code

In the same way, the storage structure and content of other system data can be obtained, and the link between the databases is formed according to the relationship between the data.

4 Software Function Design of Dance Movement Simulation Teaching System

The dance movement simulation teaching system is divided into 7 modules according to functions. They are user registration and login module, file management module, score management module, courseware release and download module, system maintenance module, teacher-student communication module, and distributed file management system module. Among them, the user registration module includes student registration and other user registration, and file management includes file upload, download, and modification [9]. The score management includes the entry, modification and query of scores. The release and download of courseware includes courseware upload, download, delete, etc. System maintenance includes setting up user role maintenance and system functions. The teacher-student communication module includes the management of teacher and student forum messages. The distributed file system module includes file system configuration and data node configuration, etc. With the dual support of hardware equipment and database, cloud computing technology is used to optimize the design and realization of system functions.

4.1 Build a Cloud Computing Framework

Services under the cloud computing framework are mainly composed of three roles: service provider, service consumer, and service registry. The service released by the service provider is based on the service under the cloud computing environment. This service consists of four levels: cloud computing service physical layer, cloud computing service virtual machine layer, cloud computing service management layer, and cloud computing service application layer [10]. In the cloud-based framework, the relationship between the three service roles is shown in Fig. 2.

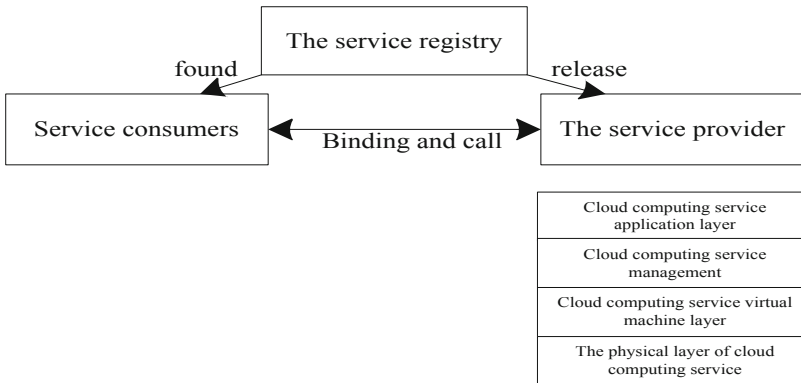


Fig. 2. Cloud computing framework

The service provider in Fig. 2 is a node on the network, which provides service access for software using the service interface. In cloud computing, service providers often have

to provide services to multiple consumers at the same time, so service providers need to have strong computer processing capabilities. Using cloud computing structure to build service providers is a good choice in cloud environment. The cloud computing service application layer is user-oriented, and it provides a service interface on the Internet that can be accessed by all service consumers uniformly. These application layers publish services to the registry, and users can find specific services they need through the service registry. After selecting the service, directly bind and use the service with the service interface provided by the service application layer. The cloud computing service management layer mainly realizes the management of cloud service requests and cloud service responses [11]. It plays a decision-making role for services in the cloud computing system. Service consumers are also nodes on the network. Through the service registry, it can bind with service providers and use the services published by the providers. Usually, it can use multiple services, then integrate and integrate these services, and finally realize the specific business logic it needs. In the cloud computing environment, any user who uses the cloud service interface is a service consumer. The service registry is also a type of node on the network. It stores service interface description information, and providers can publish their own services on it. In the service use process, the service registry plays the role of an agent. Consumers find the specific location of the service they need on the service registry. After finding the location information of the service, the consumer can bind with the service provider and use the service provided by the provider.

4.2 Dancing Motion Simulation Audio and Video Processing

In the system environment, a cloud computing framework is used to build a 3D basic model. First, a new data project called `algorithmskeleton` is created through the 3DsMax system, and then the basic framework model spliced with the basic model is used to execute instructions in batches. After running, get the basic skeleton model needed. Disassemble the body parts that need to be converted in 3Ds Max, and then save them in separate files. The purpose is to consider that the number of loaded files is too large, so it needs to be disassembled into parts and used, which can simplify the later stage of the program. Call the procedure. A `Skeleton` class is defined in the `ADD3ds.h` file. Collect the disassembled parts of the body in need, and include the definition of the project's drawing mode, the acquisition method and the setting method in this class [12]. Set the mobile conversion and rotation conversion programs respectively to realize the control of the virtual environment model. The actual video of the dance action is converted into an action track, imported into the environment, and a simulation video of the dance action is obtained through the control program.

4.3 Teacher's Function Design

The core functions of the teacher end include the production and release of teaching courseware, the production and release of teaching videos, the assignment of coursework, the evaluation of homework, the organization of teaching resources, the setting of classes, the addition of students, and the construction of courses.

Teacher-end users can select the semester they want to start on the main interface of the system, click “Apply to start”, and enter the page of applying for starting a course and creating a new course. When creating a new course, you must first select the semester and type of course to start. You can create a new course and enter the course name. If there is no matching course in the background, a new course number will be generated in the background; you can also click “Associate Course”, to choose from the existing courses, first select the department, and after selecting the starting department, search and associate the existing courses. After you find the associated result, click to select the course, and then click OK to complete the association.

When a user logs in with teacher authority, the teacher can upload teaching videos and related teaching courseware materials for students to watch and download online for learning. After logging in, users can choose to query and download courseware and related sports dance videos according to the type of video and the applicable people. Each user can upload his own recorded dance video, but, except for the administrator, after logging in, each user can only delete or modify the data uploaded by the current user. The materials uploaded by other users can only be browsed and watched online, and have no right to delete them.

4.4 Student-Side Functional Design

The main function of the student terminal is to realize the learning of dance courses, so you can search, download and play dance video information in the system environment, upload student homework and online questioning, and realize dance online exams after the phased learning is over. And other functions. Among them, the search of dance resources is to use dance resource attributes to search for matching dance resource information. The student enters the resource name and other attributes in the main interface of the system, and the system uses the check method to check whether the keyword meets the requirements, and prompts the student if it does not. Use XML files to store search keyword information, and then use HTTP protocol to transfer XML information to the server [1, 13, 14]. The server needs to parse the content in the XML file and obtain search keywords. After obtaining the keyword, it is necessary to generate the select SQL statement, and use the statement object to execute the dance resource query SQL. Perform a matching query in the dance resource table. After the results are obtained, the XML files are assembled to store the search results, and then the XML files are returned through the HTTP protocol. The mobile terminal parses the XML file and displays the search results. In the same way, the functions in the system can be used to run the program to realize other functions and realize the students’ dance movement learning needs in the system.

5 System Test

The current development environment is Microsoft Windows 7 Professional Edition + Microsoft Visual Studio 2018 + Microsoft SQL Server 2000, and the system’s development and operating environment is adjusted according to the hardware design results. The principles of system testing specifically include the completion of testing

of the software system and the search for various types of error repairs hidden in the software system. The software testing link requires that the software system fully meet the actual requirements of the requirements analysis specification. In this system design, the system test content is divided into two parts: function test and performance test. The function test is whether the system can output the expected result after inputting instructions from the teacher and the student. The performance test is the changes in the operating parameters of the system and the changes in response speed as the number of online users increases. In order to form an experimental comparison, the traditional dance movement virtual teaching system was also set up in the system test experiment as the experimental comparison system, and it was developed and operated in the same environment.

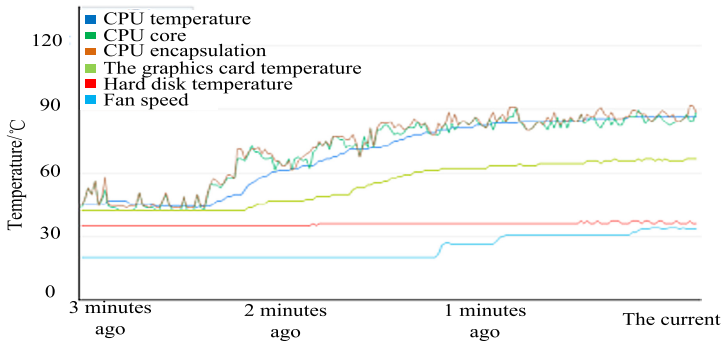
The video data and instruction data of the experiment are prepared in the experimental environment. The video data comes from on-site recordings of students and teachers in major dance departments of major universities, and the instruction data set integrates the high-frequency instructions used in the system over the years.

Import the same instruction data into the two system environments at the same time, and get the corresponding function execution results.

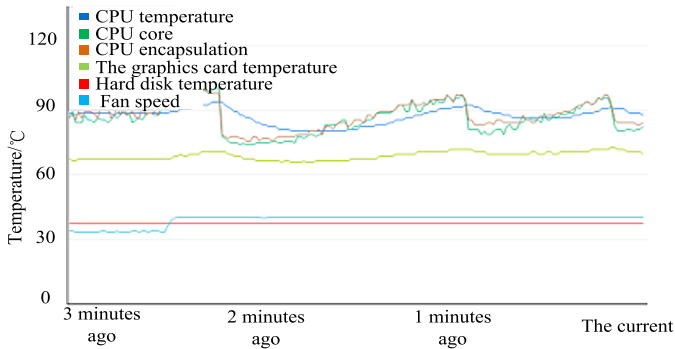
From this, the results corresponding to all the functional commands can be obtained. After statistics and comparison, it is found that the design system and the traditional system have no obvious difference in operating functions.

With the gradual increase in the number of users, the running performance of the test system, the performance test results are shown in Fig. 3.

The test results show that in terms of different requirements, the online system can meet the required design maximum concurrency of 1000. During this process, the server performs well. From the test data, the concurrency is around 800. The performance is the best in all aspects, and the data is also compared. Meet the current scale of system operation. After a vertical comparison of the two systems, it is found that when the number of users in the traditional system gradually increases, the CPU temperature, CPU package, CPU core, graphics card temperature, hard disk temperature and fan speed also gradually rise, which means the corresponding CPU share And the graphics card share began to rise. In Fig. 3(b), there is a repeated situation, which shows that the system has a self-protection mechanism. When the CPU or memory occupancy rate reaches a certain stage, the computer system automatically turns on the internal protection mechanism to prevent the hardware from being caused by excessive temperature. Irreversible damage to other institutions. Therefore, the designed dance movement simulation teaching system based on cloud computing has a certain degree of stability and security, and provides a foundation for the majority of universities to carry out similar teaching work.



(a) Performance change curve of traditional system



(b) Design system performance change curve

Fig. 3. Teaching system performance test results

6 Concluding

By testing the function and performance of the dance course online teaching system, and comparing it with the previous requirement analysis and design documents, you can see that the results show that the system is fully functional and well-performed, which meets the actual needs of users, and can be launched and officially invested Operation, but also foreshadowed the development of similar distance education courses.

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