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Design and Implementation of Virtual Experiment Teaching Platform Based on Computer Network

Xiufang Wu*

Nanchang Institute of Science and Technology, Nanchang 330108, China

1334416490@qq.com

**corresponding author*

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Abstract: As the basic course of teaching information major in universities, computer network shows the characteristics of rich content, abstract theory and difficult understanding, which requires us to not only pay attention to theoretical teaching, but also experimental teaching also needs to be paid attention to in the study of this subject. This paper presents the design, implementation and test scheme for the current situation of computer network virtual experiment teaching. The system is based on B/S structure, and the design scheme adopts modular programming idea and development mode technology to divide students into different parts so that they can better learn and master each module function; then debug and modify each subclass and their problems involved to achieve the final goal requirements.

1. Introduction

At present, the computer network experiment teaching mainly takes the form of the computer room as the teaching place, which consumes a lot of manpower and material resources, but those computer network experiment teaching based on simulation has lost the practical significance of network teaching, and students can not really see the network data packets from it[1-2].

With regard to the virtual experiment of computer network, the relevant scholars have made considerable research results. Through the analysis of the characteristics of experimental teaching of computer network course, and in view of the shortcomings of the existing experimental teaching of computer network course, some scholars have studied and designed a set of computer network experimental platform based on virtualization. This can provide students with the required computer network experiment hardware environment and network environment, students experience the actual existence of machines and networks, through the Web environment to complete the course requirements or custom experiments, as if they were in the computer room to do experiments.

Meanwhile, CNEP can provide the network tool software that the user needs, meets the student study and the experiment request[3-4].

Although scholars have had a wealth of research in the past, but there are shortcomings in the aspect of teaching. This paper will design and develop a virtual experiment teaching platform about computer network from the point of view of teaching, students and system management, so as to help students improve their manual experiment ability and assist teachers to complete the teaching tasks[5-6].

2. Overview of the Computer Network Virtual Experimental Teaching Platform

2.1. Computer Network Virtual Experiment

Computer network technology is one of the core technologies that support the information age, and it has gradually become the pursuit of our current study, mastery and research. Practical teaching can improve students' practical ability and problem-solving ability, consolidate classroom theoretical knowledge and apply it to practice. Students' main practical skills are basically acquired through experiments. Laboratory is the main position of practical teaching at present, and it is also the scientific research place of teachers and students. The equipment level of laboratory is often used as an important symbol to measure the scientific research level and practical teaching in schools. However, due to various reasons, the present situation of experimental teaching in colleges and universities is not ideal. In colleges and universities, the laboratories are scattered and the hardware resources can not be shared; the network experimental equipment is easy to wear out in the experiment, and the updating speed can not keep up with the development of computer network technology. It is difficult to maintain and manage the network equipment such as computer, router and switch. It is generally provided to different students by hard disk restoration. Experimental teaching can not arrange students freely, must arrange time uniformly, and can not meet the needs of open experiment. In order to solve these problems, we can design a set of remote network experiment system, through Internet access system to enable students to learn without time and space restrictions, improve learning efficiency; system cost and maintenance costs are greatly reduced, only need to monitor the normal operation of the system; free and convenient to build network experiments, the experimental results quickly show the feedback of the experimental results[7-8].

2.2. Virtualization Technology

Before the advent of virtualization machines, models of traditional physical machines. The operating system runs on top of the hardware, where applications interrupt access to the hardware, including controller CPU, memory, hard disk, and network cards. The hardware scheduling work is given to the operating system to process. When multiple servers provide services together, some servers may be idle, some are busy, and the CPU utilization rate even reaches 100%. This imbalance of resource imbalance is easy to encounter by traditional physical machines and difficult to solve[9-10].

After the advent of virtualization technology, the physical machine model has changed. The model does not use the host operating system to manage the hardware, but adds a layer of virtual machine monitor in the middle, which overcomes the defects of the traditional physical machine and maximizes the utilization of the hardware. Virtualization technology abstracts and converts the hardware resources of computers, such as processors, processors, memory, networks and memory,

to the client operating system, so that the client operating system can make better use of these resources than the traditional methods. These virtual resources are not limited by the architecture, geographical location, or the physical state of the current hardware resource. It can increase hardware capacity and simplify the process of software refactoring. Virtualization processors can use a single processor to simulate the parallelism of multiple processors, which allows multiple operating systems to run simultaneously on one platform. Applications can operate in separate rooms without any interaction, which greatly improves the utilization and efficiency of physical machines[11-12].

2.3. Research on Key Technologies of Virtual Experiment Teaching Platform Based on Computer Network

Clustering analysis mining method is a very important branch of the current data mining, and plays an important position in the field of data mining. Based on the hierarchical clustering algorithm, this paper describes the key technology of the computer network virtual experiment teaching platform through the Chameleon algorithm. The Chameleon algorithm is an algorithm that improves clustering quality by merging two classes using higher standards in the merger. To generate the initial subclass, Chameleon first constructs a graph U (O, P), each of which the node v $\in$ V represents a data sample. If Ta is one of the K-nearest neighbors of Tb, there is a weighted variant of f (Ta, Tb) between Ta and Tb. The weight of each edge in U represents the similarity between the two samples, namely, the closer the two data samples, the greater the weight of the edge that connects him. The Chameleon makes minimal truncation on the U based on each recursive level, and we use a graph partitioning algorithm to repeatedly partition the graph U into many small unconnected subgraphs. Finally, each subgraph is regarded as an initial subclass, repeated on this algorithm until we meet our requirements. The algorithm is bottom-up, which gives a metric gauge to judge the similarity of two clusters, and can define the relative approximation of the clusters formed after Ta and Tb to the average internal approximation of Ta and Tb. SI (Ta, Tb) is given below:

$$SI(T_a, T_b) = \frac{\left|GC|T_a, T_b\right\|}{\frac{1}{3}(\left|GC_{T_b} + \left|GC_{T_a}\right\|)} \tag{1}$$

And relative similarity SK (TA, TB):

$$SK(T_a, T_b) = \frac{\overline{r_{GS}}}{\frac{T_a}{T_a + T_b}\overline{r_{GS_{T_b}}} + \frac{T_b}{T_a + T_b}\overline{r_{GS_{T_b}}}} \tag{2}$$

Here $GC_{|T_a, T_b|}$ contains the edge cuts of Ta and Tb, and $\overline{r_{GS_{T_a}}}$ is the average weight of the edges connecting Ta and Tb. Chameleon algorithm can find that chameleon can mine clustering data of arbitrary shape with variable density, but the selection of K is very difficult. K needs to be estimated manually, and it takes more than half of the time O (n2) to process n samples, so it has no effect on high-dimensional data processing.

3. Development and Implementation of Virtual Experiment Teaching Platform Based on Computer Network

3.1. Construction of Virtual Experiment Platform for Computer Network

3.1.1. Network Structure of Virtual Experimental Platform

The structure of the system directly affects the ability and efficiency of the experimental platform experiment, and the manageability of the background. In general, the heterogeneous of different platforms on the network and the distribution characteristics of the experimental sites. In addition, it should also have time change, manageability, openness and scalability. For the architecture, how to connect to the server is what way the user login to the experimental platform, is a very important question. The network structure is suitable for LAN network environment and is widely used in the client / service (Client/Server, or C/S) network structure. This network structure has been proposed as early as the 1980 s, and it has developed rapidly in recent years with the widespread popularity of large-scale application systems and Internet/intranet. However, with the deep research and application of such an architecture, its shortcomings became more obvious, so the researchers proposed a three-layer structure model above the C/S second structure, whose main application mode is browser / server (Browser/Server, B/S).

3.1.2. Virtual Experiment Platform Server Settings

IIS, the core service of web servers, mainly provides a complete set of Internet server service capabilities. While the latest version of IIS6.0 is fully integrated with Windows Server2003, FrontPage2002 Server Extension provides Front Page support for management and publishing sites. The virtual experimental platform studied in this paper, based on the previous exploration of its network architecture, is identified as the B/S mode. Its applications are concentrated on the server, and each application node has no programs, so it is particularly important to set up the functions of the server.

3.2. Design of Virtual Experiment Teaching Platform

3.2.1. User Management

The management module of the user mainly realizes the related operation of the user role, such as the management of the user information, the change, the application of the user right and the cancellation of the user right, and so on.

In all management systems, it is the relevant user who can implement the operation of the system. When the user first uses the system, the system must be registered before the system is assigned more permissions to the user. When the user logs on to the system, the registration interface will appear, the user will enter the information completely and submit the registration information, if the information input is not complete, the registration will be prompted to fail. In addition, based on the database of the system, the system will also automatically identify the user information, for some users who have successfully registered and the information is complete, the system will automatically identify, and the next time the user logs in, the user will automatically enter and assign the corresponding permissions, and the specific user login registration flow chart is shown in Figure 1.

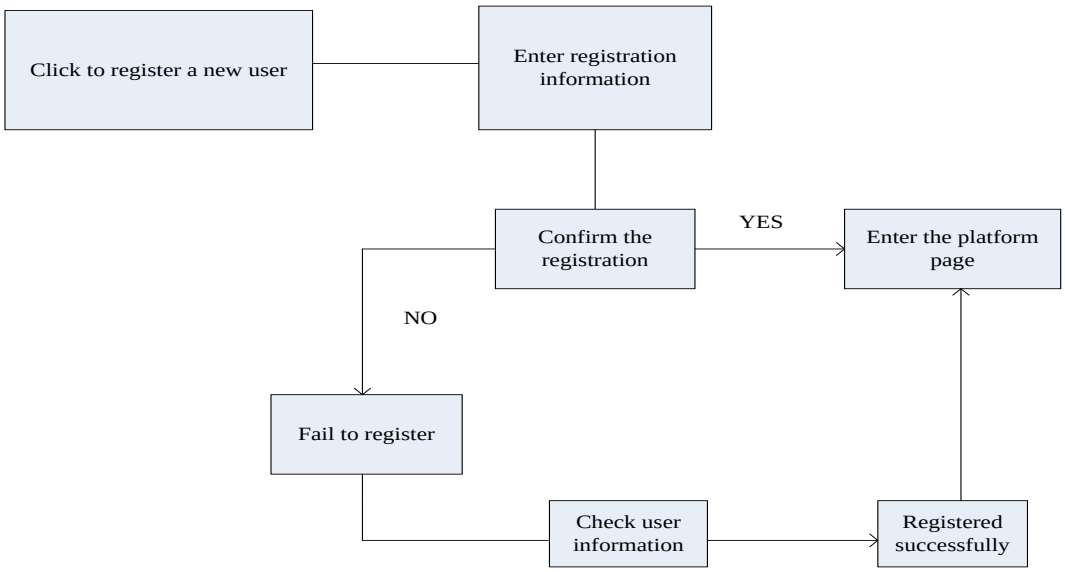

Figure 1. User registration process

3.2.2. Student Management

Student management module student management module is an important module in the computer network virtual experiment teaching platform. Student management module is mainly to manage students' personal information, curriculum information and teacher-student interaction information and so on. The student management module is limited to users who log in as students, and its basic framework is shown in Figure 2.

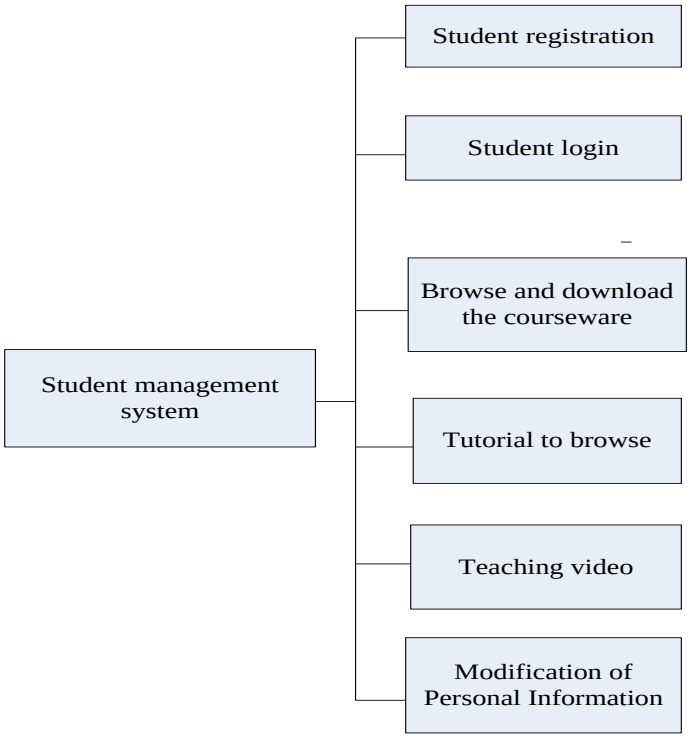

Figure 2. Functional structure diagram of student management module

(1) Student registration management. For the first time, students who use the online auxiliary instruction system need to register personal information online. The basic information of the students includes the school number, login password, name and so on. After the students have successfully registered, they can use this registration account to log in and use the relevant functions of the system.

(2) Students log in. This module is to complete the student authentication function. The student login system needs to enter the school number and the registered login password, as well as the verification code and other information to verify. If the detection passes, the system thinks that the user is a legitimate user, and the student can log in to the system to use the function.;If the test fails, the system prompts the user to log in again with a warning message.

(3) Browsing and downloading the resources such as experimental teaching courseware. After students log in to the system, they can browse the relevant classroom resources uploaded in the system, such as course handouts, after-school exercises and other information, and the information of the learned courseware can be downloaded in the form of attachments.

(4) Video teaching. This module is for students to browse the teaching video and can download the corresponding teaching video to learn.

(5) Personal information management. After students log on to the online auxiliary teaching system, they can improve the registration of personal information.

3.2.3. Teacher Management

Teacher management module is an important part of computer network virtual experiment teaching system. This module mainly manages courseware information, test paper, announcement information and video information. The teacher management module is limited to users who log in as teachers, and its basic framework structure is shown in Figure 3.

(1) Teacher login management. This module is to complete the teacher authentication function. The teacher login system needs to enter user name and login password, verification code and other information to verify. If the detection passes, the system thinks that the user is a legitimate user, and the teacher can log in to the system to use the function.;If the test fails, the system prompts the user to log in again with a warning message.

(2) Revision of personal information. After teachers log on to the online auxiliary teaching system, they can improve and modify the registered personal information on their own.

(3) Courseware information release management. This module is for teachers to publish tutorials and courseware information and other resources, teachers can upload tutorials, handouts, courseware and other materials to the system for students to download and learn.

(4) Courseware information management. This module is the function of teachers to modify or delete the uploaded courseware resources. The maintenance and management of courseware files needs to maintain the basic information of courseware and the maintenance of network teaching documents of university computer public basic courses related to courseware.

(5) Test paper management. This module is for teachers to add relevant questions, including chapters, relevant knowledge points, test questions, test questions, reference answers and so on. The teacher also has the function of modifying and deleting the test questions.

(6) Video publishing management. The module is the teacher to add relevant video materials, video information including video number video title, video address, upload date, uploading and so on.

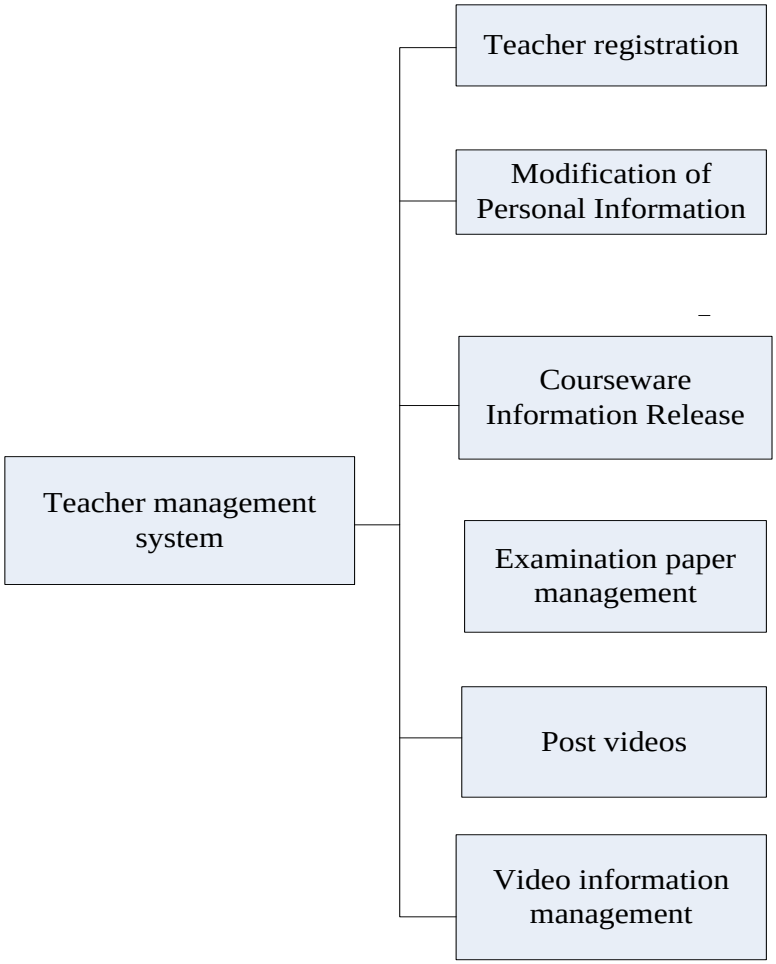

Figure 3. Teacher management module

4. Testing of Virtual Experiment Teaching Platform Based on Computer Network

4.1. Test Content

4.1.1. Purpose of the Test

System testing is an important part of the whole system development, many people will underestimate this link and ignore it, but as a part of system development, it naturally has its existence. The system test avoids many errors when the system is put into use, and ensures that the system can run normally. The system can run after analysis and design, but it needs to be modified in some details to make the system more reliable. The computer network virtual experiment teaching system realizes various functions, provides a good means for users in management, and the accuracy has been greatly improved, but there may still be some problems in the specific operation. These problems may be due to errors in the underlying code of the system, mainly due to the operational errors of the system developers at the time of writing. It may also be that the system interface is too complex, resulting in user operation errors, which is actually a problem for many systems. Because programmers have a high computer level, they think the operation of the system

is very simple. In a word, the purpose of system testing, that is, the final process, mainly includes reporting problems, verifying and solving problems, tracking problems and so on.

4.1.2. Test Methods

Because the system framework is different, the problem is that the problems encountered in the system development are also different, and there are naturally some differences in the test methods. But it doesn't change. The goal of system testing is to optimize errors in the system. According to the experience, we can judge whether the system is running smoothly or not. This approach is often time-consuming and labor-consuming, and because of the amount of code, it is often difficult for programmers to find problems, often in vain. The concrete operation of black box test is to judge whether the function of the system is correct and whether the main large module is normal through the corresponding input and output results.

4.1.3. System Performance

Performance test is generally accompanied with the function test, feeling the performance of the system, if the performance is good indicates that the system is no problem, if there is a serious delay or lag phenomenon indicates that the system is a problem, and further detection is needed. This section uses the automation tool Load runner test tool. The Load runner tool was developed and was commercially used by HP in 2006, and has since been iterated to the 12th version. The tool can automate the test process and simulate the system multi-user access to test the system load capability to better and quickly discover defects in the performance of the system.

4.2. Test Results

4.2.1. Functional Test Results

The overall function of this system is to meet the needs of multi-level users to access and manage the information of relevant university units on the network, to provide an efficient and safe management software for the network teaching management of university computer public basic courses, so as to improve the utilization rate of network teaching management of university computer public basic courses, and to standardize the internal management mechanism of grass-roots university units. And it has a good human-computer interaction interface. Computer network virtual experiment teaching management function structure model, in which the login system is selected for functional testing, and the system test results are shown in Table 1.

Table 1. Logon to the system function test

Test steps	Specific input	Desired output	Run the output
1	No password was entered while logging into the system	Please enter a password	Please enter a password
2	Password input error when the system is logged in	Please reenter the user name	Please reenter the user name
3	The user name was not entered while logging into the system	Please reenter the user name	Please reenter the user name

As you can see from Table 1, the platform system login function is good, when logging on to the system, the password error will be prompted and the re-input user name will be displayed, and the real running output will meet the expected output value.

4.2.2. Performance Test Results

System performance testing mainly uses Load runner, from response time, processor utilization, throughput, database load, etc. The simulated user is 5 million users. After using the virtual user resume, the test is completed after repeated testing. The test results are shown in Table 2.

Table 2. Performance test results

Test point	Test result
Response time	3s
The database occupancy rate	12%
Memory usage	4%
Cache occupancy rate	5 *

As shown in Table 2, each dimension of the performance test of the system meets the requirements of software design and meets the needs of users. From the functional point of view, the system has met the requirements of user requirements specification. It can achieve the user requirements specification on the function, to meet the needs of each functional unit.

5. Conclusion

The main research purpose of this paper is to develop a virtual network teaching experiment platform by using computer, so that the experimenters can understand the basic structure of parts conveniently, quickly and intuitively. It will feel the assembly effect naturally, and have a further understanding of the mechanism by simulating assembly. Through the virtual experiment platform, the experimenters can deepen the understanding of the structure and function of various parts.

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Data Availability

Data sharing is not applicable to this article as no new data were created or analysed in this study.

Conflict of Interest

The author states that this article has no conflict of interest.

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