VR Open Computer Network Virtual Laboratory Based on Big Data Technology

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Abstract. The rapid development of computer technology and network bandwidth has produced unprecedented influence on the way of human learning. Along with the humanized development of computer software technology and high-level program language, experimental teaching is gradually becoming virtualized. Not only a variety of multimedia teaching courseware emerges one after another, but also a large number of virtual laboratories appear on the network. Virtual laboratory is essentially the simulation of real experiment scene, in which students should have similar experience and the same learning effect as real laboratory. Therefore, the virtual laboratory should be able to satisfy the students to carry out autonomous exploratory operation. The purpose of this paper is to study the open computer network virtual laboratory based on big data technology. This paper first introduces the meaning of big data technology, then studies the content of video decoding technology, and then introduces the definition scope and characteristics of virtual reality technology. This paper designs and implements VR open computer network virtual laboratory based on big data technology. The test results show that the system designed in this paper has good performance. The CPU consumption rate of the system server designed in this paper only accounts for 4.5%.

Keywords: Big Data Technology, Virtual Reality, Virtual Laboratory, Research and Practice

1. Introduction

With the deepening of the teaching reform in colleges and universities, the role of practice education has become more and more prominent. Following the pace of building a "smart city", building a modern and intelligent "smart campus" and providing students with better practical environment and more practical opportunities has become the goal pursued by our university¹-². At present, many colleges and universities are open to the laboratory construction has carried on the preliminary
attempt, through laboratory information management system of experimental teaching resources for centralized control, can replace the past paper office, solve the booking record easily lost, students experimental process and the difficulty of information statistics, complicated issues, make up for the deficiency existing in the traditional laboratory management, very good experiment teaching results have been achieved[3-4]. However, with the continuous expansion of teaching scale and more and more experimental courses, the demand of students for computer experiments is also increasing. Many experiments require the installation of large software as the environment, which requires the host machine to have higher performance and requires schools to invest more manpower to manage and supervise the experiment process[5]. In addition, in terms of the arrangement of experimental courses, manual arrangement is generally adopted, which is inefficient and prone to conflicts[6-7].

To study the open laboratory management system based on virtualization technology, virtualization technology, big data technology and a new mode of open laboratory used in experiment teaching of colleges and universities, can solve a series of problems of laboratory management, design a suitable to their own characteristics of open laboratory management system, implementation of centralized control and computing resources allocated dynamically, effectively reduce the laboratory construction cost[8-9]. While improving resource utilization, the complexity of system upgrade and maintenance is reduced, the workload of laboratory management and maintenance is reduced, and more experimental opportunities are created for student[10].

This paper first introduces the meaning of big data technology, then studies the content of video decoding technology, and then introduces the definition scope and characteristics of virtual reality technology. This paper designs and implements VR open computer network virtual laboratory based on big data technology. The test results show that the system designed in this paper has good performance. The CPU consumption rate of the system server designed in this paper only accounts for 4.5%.

2. Technology Related to Virtual Laboratory System

2.1. Big Data Technology

Cloud Computing is to collect Computing resources and information on the network through network integration, management and scheduling of network connections, and form a Shared resource pulp that can be formed. It can quickly acquire and release various software and hardware Computing resources according to user needs, and provide users with on-demand services. Cloud computing is a huge change of the traditional information system construction mode, and the relevant users of information system (including system users, builders and investors) do not need to know the details of the infrastructure in the "cloud", do not need to have the corresponding professional knowledge, and do not need to directly control.

2.2. Video Decoding Technology

Discrete cosine transform (DCT) is used to predict the residuals, and the unit is 4x4 blocks. Energy can be concentrated on a few coefficient terms in the transformation domain to further eliminate the spatial redundancy in the video data. The one-dimensional n-point discrete cosine transform can be expressed as:
$$y_k = C_k \sum_{n=0}^{N-1} x_n \cos \left( \frac{(2n + 1)k\pi}{2N} \right)$$

(1)

Where $x_n$ is the nth term in the input time domain sequence, $y_k$ is the kth term in the output frequency domain sequence, $C_k$ is defined as follows:

$$C_k = \begin{cases} \sqrt{1/N} & k = 0 \\ \sqrt{2/N} & k = 1, 2, ..., N-1 \end{cases}$$

(2)

2.3. Virtual Reality Technology

Virtual reality (VR) technology is also known as artificial or psychological environment technology. It is a simulation system that integrates a full range of computer-generated computer graphics, computer simulation, artificial intelligence, sensing, display, network parallel processing and other technologies. VR technology is characterized by the compilation of a three-dimensional model built with computer graphics into a computer to generate a virtual environment that is mainly a visual experience, but also includes an overall sense of hearing and touch. The sense of this environment, in this environment, can directly observe, contact, operate, detect the internal changes of the surrounding environment and things, and interact with it, so that people and computers can be well combined, giving people a sense of immersive.

3. Experimental Design of Virtual Laboratory System

3.1. System Architecture

The system architecture of virtual laboratory designed in this paper includes experiment module, discussion module, login module and help module. The experiment module consists of two parts: text description (mainly presents the text information related to the experiment, playing the role of assisting learners to conduct experiments) and virtual reality (including the modeling of virtual elements, virtual environment, and the interaction between three-dimensional virtual elements).

3.2. Experimental Environment

The platform consists of cloud servers and network devices, and the thin client is J60. Each client is assigned an IP address to connect to the remote server according to the school's networking structure. By configuring the network so that each machine is connected to each other within the LAN, clients can directly access the server to get the cloud desktop. The experimental environment is shown in Table 1.

| Development environment | Parameter |
|-------------------------|-----------|
| Auxiliary database      | MySQL     |
| System framework        | Express   |
3.3. Test Indicators

This paper tests the performance of the designed system in terms of server CPU consumption growth rate, server memory consumption growth rate and bandwidth consumption growth rate.

4. Analysis of Experimental Results of Virtual Laboratory System

4.1. Experimental Results and Discussion

In the test of network bandwidth, thin client protocol machines were used to access the cloud platform respectively, and Thunderray player was opened to play the movie application. Then thin client machines used RDP to access the cloud platform. When RDP played the movie, the traffic was mainly within the range of 1.2-1.6Mbps, and the network delay was less than 1.3s. In the implementation of the system, we adopted Jiyun J60, and the management software adopted the mode of Hyper-v+Deskpool to manage the cloud desktop. The video playing quality of the client is good, which can well meet the user's needs. The performance test results of the thin client are shown in Table 2 and Figure 1.

| Test content | Server CPU consumption rate(%) | Server memory consumption rate(%) | Bandwidth utilization of the server(%) | Client video playback quality |
|--------------|---------------------------------|-----------------------------------|--------------------------------------|------------------------------|
| Test value   | 4.5                             | 4.5                               | 4.3                                  | 4.8                          |
4.2. Suggestions for Virtual Laboratory Design

(1) Scientific principles

Science is an important principle that all subject education needs to follow. Virtual science experiment teaching cannot give up the requirement of scientific principle because of its virtual characteristics. Virtual science experiments and traditional science experiments are only different from each other in terms of experimental scenes and experimental objects, but they are basically the same in terms of teaching objectives and subject characteristics. The design and development of virtual scientific experiments must be based on the scientific nature of scientific subjects, the selected experimental content must be scientific, and the experimental process and methods must not violate the scientific laws. Only in the experiment teaching, no matter it is virtual experiment or traditional experiment, pay attention to its scientificity, can we expound the scientific law correctly, grasp the scientific phenomenon accurately, can we cultivate students' scientific accomplishment fundamentally and cultivate high-quality talents.

(2) Principle of interactivity

The principle of interactivity means that only when virtual experiments have strong interactive functions can learners give full play to their subjectivity and conduct exploratory experiments and cooperative operations. Only when learners participate in the operation and practice in the experimental process can they have a better understanding of experimental phenomena and experimental principles. Therefore, it is necessary to follow the principle of interactivity in designing virtual experiments and design a human-machine system that is convenient for learners to operate and control. In this way, learners' subjective initiative can be brought into play to a greater extent.

(3) Aesthetic principles
Teaching is not only a science but also an art. Through learning this art, guidance will be full of glory, bring students happiness and beauty, but also stimulate students' enthusiasm for learning. The beauty of science is the expression of the true nature of scientific law and the reflection of the essence of scientific law. The external expression of the beauty of science profoundly reflects the intrinsic nature of the beauty of science. The design of virtual science experiment should not only reflect the inherent aesthetic feeling in the field of science, but also conform to the aesthetic psychology of users.

(4) Education and psychology

In 2002, Jiang Zemin pointed out in his report to the 16th National Congress of the Communist Party of China that "training socialist builders and successors who are well developed morally, intellectually, physically and aesthetically" is the purpose of China's education and the general policy guiding our educational work. All our educational and teaching work should be conducted around this policy. This requires that all of our teaching activities must have educational significance and conform to the pedagogy principle is its primary requirement. Although the virtual science experiment teaching is implemented in the virtual learning environment, its design must follow the pedagogy principle, which is in essence consistent with the educational purpose of our country. In addition, according to Piaget's theory of cognitive development stage, students' thinking is in the stage of formal operation, and they can find the relationship between propositions, solve problems according to logical reasoning, induction or deduction, understand the meaning of symbols, metaphors and similes, and make certain generalizations. Therefore, in the teaching design of virtual science experiments, it is necessary to design autonomous experimental operation activities suitable for students to learn according to their psychological development characteristics.

5. Conclusion

With the progress of higher education informatization, the construction of virtual experimental teaching center in colleges and universities conforms to this trend, which not only realizes the deepening reform of experimental teaching in colleges and universities, but also improves the teaching ability and quality of colleges and universities. Compared with traditional laboratory, virtual laboratory is a new model with richer teaching methods and more flexible expression forms. Virtual experiment is a new teaching mode. As a complement and perfection of traditional experimental teaching mode, it meets the needs of talent training in colleges and universities. In order to better serve the teaching and research ability of colleges and universities, the virtual simulation laboratory will also follow the trend of The Times and realize further development. The rapid development of science and technology and the overall progress of the modernization of education, this textbook, the simple demonstration of the educational model is only dependent on the development of science and technology does not catch up, experimental education is an important part of educational activities. The emergence of virtual laboratory has solved many problems existing in the existing experimental teaching and multimedia teaching and is more suitable for the current teaching needs.

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