Frontiers in Educational Research
ISSN 2522-6398 Vol. 3, Issue 11: 29-36, DOI: 10.25236/FER.2020.031105

Design of Human-Computer Interaction Teaching System Based on Virtual Reality Technology

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ABSTRACT. *Traditional experimental teaching has the problems of limited teaching resources, ABSTRACT. and difficult to understand teaching content, and high risk of teaching experiments. This article aims to provide virtual and realistic experimental scenes through the design of the experimental teaching system of virtual reality technology. The experimental teaching system designed in this paper includes graphic teaching, virtual scene construction, simulation experiment, teaching skill evaluation four functional modules. Use Photoshop, 3Ds Max, Maya, Unity 3D, etc. to complete the system development. In order to verify the actual use of the system, we conducted a survey on some students of mechanical design majors in colleges and universities, and concluded that the students were quite satisfied with the system's interface evaluation, functional design, interactive operation, and software operation. 72% of students believe that the system is stable and stable after the long-term operation, and the operation is relatively normal, with good performance and compatibility; 80% of the students think they can clearly understand every step of the experiment. The research of this paper has great application value for professional teaching with strong practicality.*

KEYWORDS: *Virtual reality technology, Human-computer interaction, Experimental teaching system, System design*

1. Introduction

The combination of virtual reality technology and human-computer interaction technology makes each other have their advantages simultaneously. If human-computer interaction is added to the virtual scene, then people will not only be immersive roaming experience in the three-dimensional virtual scene, but also can get it after adding somatosensory equipment Nearly real interactive experience [1-2]. The integration of virtual reality technology in human-computer interaction technology will make human-computer interaction modes more diverse. Humans can realize input through limbs, and the computer can also realize three-dimensional immersive output through virtual reality devices such as head-mounted displays and ring screens [3-4].

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Compared with traditional technology, virtual reality human-computer interaction has many advantages. For some objects, it can simulate the expected effect that the physical object can achieve by building a virtual scene through a virtual reality device without physical objects. At the same time, the virtual reality system can produce the corresponding expected effects by simulating different physical objects without changing the hardware equipment, thereby greatly avoiding the possibility of rework after the finished product and reducing the cost of repeated manufacturing [5-6].

Virtual environment information has always been a hotspot in research, development and application of scientific research workers, and the practice proves that the virtual reality application in all fields is of practical significance. Therefore, virtual reality man-machine interaction technology has been widely used in construction, military, medical, processing and other industries since it was proposed. For example, the virtual environment has been widely used in scientific research, business, medical, military, entertainment, design and other fields and has an immeasurable prospect [7-8]. At the same time, with the development of Internet technology, graphics technology, computer software and hardware, sensor technology and so on in recent years, virtual reality is constantly overcoming its ~~own~~ disadvantages and improving. It is a rapidly developing technology, which may cause a significant change, even change people's views on time and space, and update people's world outlook [9-10].

Based on the virtual reality technology, the experimental teaching system designed in this paper can simulate the real experimental teaching environment and break the limitation of time and space. The use of Photoshop, 3Ds Max, Maya, Unity 3D, etc. to complete the system development, through the actual inspection of the system's use effect, it is concluded that the system of this article has great application value in the field of experimental teaching.

2. Virtual Reality and Human-Computer Interaction

2.1 Human-Computer Interaction Technology

With the development of science and technology, human-computer interaction has gradually developed towards human-centeredness, and more and more attention has been paid to human feelings and experiences, aiming to achieve the most natural way to interact with the computer. Virtual reality human-computer interaction is one of the most cutting-edge applications of human-computer interaction technology. Different from the traditional desktop-level human-computer interaction, in the virtual reality system, the interaction is carried out through various sensor information including vision, hearing, touch, force, smell and so on. The operator can access the virtual scene through virtual reality equipment such as a head-mounted display, human posture sensor, etc., directly manipulate objects in the virtual scene, and obtain real-time operation feedback information, which is an immersion with multiple perceptions and high reality Interactive technology.

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2.2 Virtual Reality Technology

Virtual reality technology is a frontier and advanced simulation technology. It can give users more realistic experience and sensory enjoyment, and provides great convenience for human exploration of other fields. Virtual reality (VR technology for short) is a human-computer interaction tool based on the way people interact with the real world around them. At first, VR technology was mainly used in military and aerospace fields, but now it has been involved in many fields such as education, medical treatment, the interior design of buildings and cultural entertainment, making VR technology increasingly mature. In recent years as computer technology, sensor technology and other related hardware support technology and spatial localization algorithm, the human body joint algorithm, collision detection algorithm and related supporting the rapid development of software algorithm, the virtual reality technology to begin to enter the commercialization process, by the overwhelming majority of developers, investors pay attention to it. Virtual reality is also called a virtual environment, it uses the computer to produce a nearly real simulation environment. People can be done more natural behavior in the real world and get the right, actual response, or feedback.. Virtual reality technology is a science fiction, differ is limited to the real environment, the researchers can wanton spread their own imagination, using virtual reality technology to build some does not exist, don't possible scenarios.

3. System Development

According to the experimental teaching characteristics and teaching content, the system includes graphic teaching, virtual scene construction, simulation experiment, teaching skill evaluation four functional modules. The construction of virtual teaching scenes must have richness, authenticity, applicability and variability. It must be reformed based on real teaching scenarios. In the process of system design, full consideration should be given to the smooth interaction between humans and machines. Through the information interaction between humans and machines, the motivation and enthusiasm of learners can be mobilized. Students can operate after graphic teaching and virtual teaching to deepen their understanding and knowledge. Application. After learning and training operations, the assessment is conducted in the teaching skill evaluation module. The system automatically tracks every step of the student's operation, records the error points in the operation, and the assessment results are popped up after the operation is submitted, consolidating the students' understanding of the wrong knowledge points. System development mainly relies on these softwares, as shown in Table 1.

Table 1 System Development Software

Develop software	Name
Graphic software	Photoshop
Modeling software	3Ds Max,Maya

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Development engine	Unity 3D
Code editor	Visual Studio

4. System Design and Application Analysis

4.1 System Design Analysis

The development of virtual a experimental teaching system is inseparable from the support of computer graphics, multimedia technology application, network data dissemination technology, database technology and virtual reality technology. The teaching system in this paper includes 4 functional modules: graphic teaching, virtual scene construction, simulation experiment, and teaching skill evaluation. Use Photoshop, 3Ds Max, Maya to process graphics and models. After completing the model processing, import the model to the database where the model was created and integrate with other databases. Further integrate the information, add a label to each model in the model database, so that students can provide detailed information when they click on the location. Different from the traditional indoctrination-based way of acquiring knowledge, students independently learn through system graphic teaching, breaking the traditional two-dimensional learning method in virtual scenes, the system uses three-dimensional models to simulate and demonstrate the experimental process, strengthen students' understanding of principles and improve practice ability. The purpose of the simulation experiment is to allow students to deepen their understanding and application of knowledge through self-operation. Students watch the entire virtual teaching process in front of them and operate according to the operation page tool. If the operation is inconsistent with the operation data in the standard database, stop the operation. The system prompts the correct operation information, deepens the memory and understanding of the experimental steps, and strengthens its actual operation level. The teaching skill evaluation module evaluates the results of students' practical assessment. Students complete the experiment process without prompting. The system automatically tracks every step of the student’s operation and records the error points in the operation. After the assessment is completed, the assessment results and error points will automatically pop up, eliminating the time for teachers to correct the test paper and consolidating in real time. You can also check the previous test papers through previous records, which has the function of collecting wrong questions and improve the students' actual operation level. The specific content design is shown in Figure 1.

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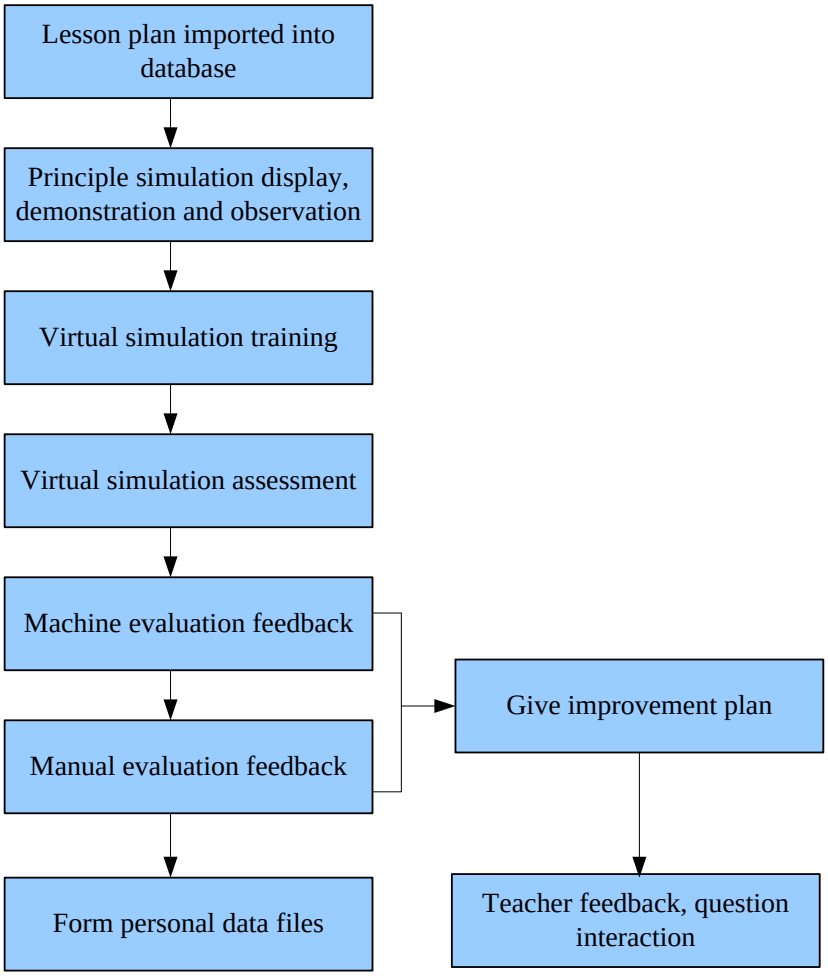

Fig.1 Content Design

4.2 Application Analysis of Experimental Teaching System

Testing is an important part of the system development process. It is used to confirm whether the quality or performance of a program meets some requirements put forward before development and whether it runs according to the design requirements. With the increasing complexity and scale of software systems, the reliability requirements of software are getting more and more attention. People gradually realize that software testing is the most effective way to ensure the quality of the software engineering process from the perspective of software quality control. It can perform security and usability testing from the perspective of end-users. The

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overall goal of software testing is to ensure software quality. In order to truly test the effect of using the system in teaching experiments, a survey was conducted on 50 students of mechanical design majors in A colleges. Without any explanation, the system was used, and then a questionnaire survey was conducted. The test survey results are shown in Table 2 and Figure 2.

Table 2 Analysis of Test Results

Test section	Percentage
After long-term operation, the system is continuous, stable, relatively normal, and has good performance and compatibility	72%
The interface function conforms to normal habits and the expression is clear	88%
Realistically simulated the appearance of the experiment, you can clearly understand each step in the experiment	80%
Facilitate communication with teachers	68%
Able to find some technical errors in time	92%
Satisfaction with the system	88%

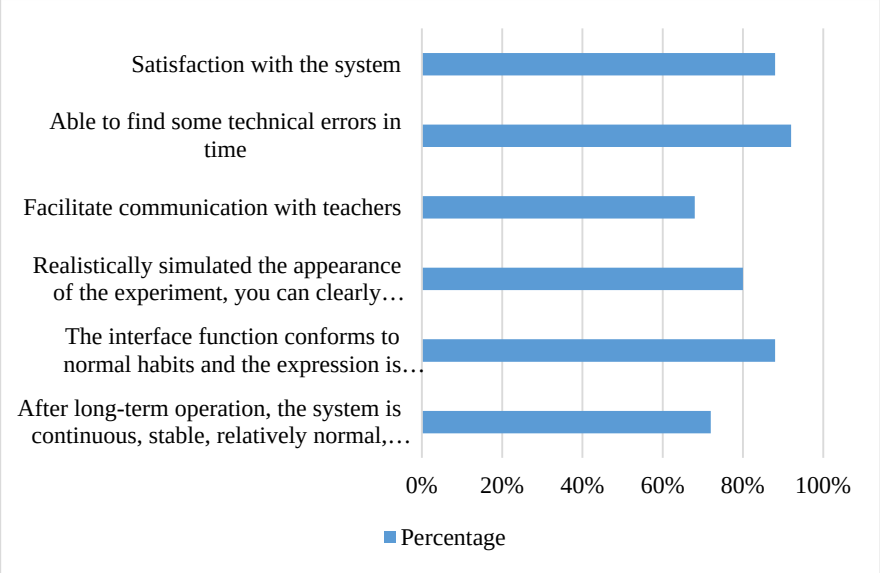

Fig.2 Analysis of Test Results

It can be seen that when testing the performance part, 72% of the students believe that the system is stable and stable after the long-term operation, and the operation is relatively normal, with good performance and compatibility; When testing the interface function, 88% of the students believed that the interface function conformed to normal habits and expressed clearly; When testing the

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functional part, 80% of the students thought that the photorealistic simulation simulated the appearance of the experiment, and they could clearly understand each step in the experiment; 68% of students think it is convenient to communicate with teachers; 92% of students think that the evaluation of teaching skills can find some technical errors in time; 88% of students are satisfied with the overall use of the system. Through the analysis of the data results, it can be seen that the students are still satisfied with the system's interface evaluation, functional design, interactive operation, and software operation. Most students believe that there are many differences between traditional teaching software. It feels more real, and the software interface is more beautiful. The virtual experimental teaching system can understand the experimental steps more clearly and intuitively, deepen the memory and understanding of the experiment, and strengthen the actual operation level.

5. Conclusion

With the rapid development of computer technology, virtual reality technology will have wide application and development prospects. The prospect of virtual reality technology in education is very attractive. We must pay close attention to the growth of virtual reality technology, apply it boldly to education, and achieve leapfrog development. In order to meet the increasing demand for virtual experiments on the Internet, this article develops and develops a virtual experiment teaching system based on the network, which exerts greater teaching benefits. With the rapid development and improvement of virtual reality technology, its application form in network distance teaching will be more diversified and its application will be more extensive. Many specific problems involving the application of virtual reality technology in distance teaching, especially in experiments, still require in-depth discussion and research. The work of this article has made some useful attempts in this respect. Due to the time and conditions, only some technical solutions and implementation methods have been discussed. There are many problems that need further research.

References

[1] Bastug E , Bennis M , Medard M , et al(2017). Toward Interconnected Virtual Reality: Opportunities, Challenges, and Enablers. IEEE Communications Magazine, vol.55,no.6,pp:110-117.

[2] Freeman D , Reeve S , Robinson A , et al(2017). Virtual reality in the assessment, understanding, and treatment of mental health disorders. Psychological Medicine, vol.47,no.14,pp:1-8.

[3] Elbamby M S , Perfecto C , Bennis M , et al(2018). Towards Low-Latency and Ultra-Reliable Virtual Reality. IEEE Network, vol.32,no.2,pp:78-84.

[4] Berg L P , Vance J M(2017) . Industry use of virtual reality in product design and manufacturing: a survey. Virtual Reality, vol.21,no.1,pp:1-17.

ISSN 2522-6398 Vol. 3, Issue 11: 29-36, DOI: 10.25236/FER.2020.031105

[5] Munafo J , Diedrick M , Stoffregen T A (2017). The virtual reality head-mounted display Oculus Rift induces motion sickness and is sexist in its effects. Experimental Brain Research,vol.235,no.3,pp:889-901.
[6] Padmanaban N , Konrad R , Stramer T , et al(2017). Optimizing virtual reality for all users through gaze-contingent and adaptive focus displays. Proceedings of the National Academy of ences of the United States of America, vol.114,no.9,pp:2183.
[7] Lipton J I , Fay A J , Rus D(2018) . Baxter's Homunculus: Virtual Reality Spaces for Teleoperation in Manufacturing. IEEE Robotics and Automation Letters, vol.3,no.1,pp:179-186.
[8] Peter Forbrig, Fabio Paternó, Annelise Mark Pejtersen(2017). Human-Computer Interaction. Encyclopedia of Creativity Invention Innovation & Entrepreneurship, vol.19,no.2,pp:43-50.
[9] Hibbeln M , Jenkins J L , Schneider C , et al(2017). HOW IS YOUR USER FEELING? INFERRING EMOTION THROUGH HUMAN-COMPUTER INTERACTION DEVICES. MIS quarterly, vol.41,no.1,pp:1-21.
[10] Tom Gross, Jan Gulliksen, Paula Kotzé, et al(2017). Human-Computer Interaction - INTERACT 2009. Lecture Notes in Computer Science, vol.5726,no.2,pp:131-141.