



Design and Development of Safety Education System in Colleges and Universities Based on Virtual Reality Technology

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Abstract. Under the guidance of existing technologies and theories, aiming at the problems existing in the field of safety education in colleges and universities, this paper makes use of the advantages of virtual reality technology, deeply integrates virtual reality technology with safety education in colleges and universities, and constructs a safety education system in colleges and universities based on virtual reality technology, and publishes the system on the Web for users to log in and use. The system is built by using 3Dmax, HTC VIVE and Unity3D engine. The application of this system in specific education and teaching will improve the safety awareness and skills of teachers and students, and finally achieve the goal of high-quality teaching. The design and development of the system has important reference significance for other related teaching activities in schools.

Keywords: Virtual Reality Technology · Safety Education in Universities · Design and Development · 3Dmax

1 Introduction

Safety education is the general term of educational activities that human beings carry out according to their own experience and cognition to make people gradually aware of the dangers in the environment and to improve their ability to protect their own safety and reduce accidents. Safety education in colleges and universities means that colleges and universities carry out various forms of safety education for college members by adopting various methods and means. It aims at improving the safety awareness and skills of college members and ensuring the safety of college members and campus. Safety education in colleges and universities mainly includes consciousness education, knowledge education, skill education, legal education and moral education [8]. Safety education in colleges and universities has the functions of guidance, restraint and innovation. The function of guidance refers to the good safety consciousness and concept gradually established by teachers and students through college education and teaching. The function of restraint means that teachers and students can actively understand safety knowledge by restraining and standardizing behaviors, consciously abide by and restrain and standardize their own behaviors according to the requirements of school safety management

system. The function of innovation means that safety education can breed new safety ideas, concepts and scientific and technological achievements. Although safety quality education is not only the basic requirement of human development, but also the most basic and necessary quality education in university comprehensive quality education, it is often neglected. Therefore, safety quality education should be emphasized in comprehensive quality education of college students. At present, there are some problems in safety education in colleges and universities, such as nonstandard teaching, backward teaching methods and lack of systematic education mechanism. Therefore, the blessing of technology has become an indispensable force to promote safety education [4].

With the rapid development of information technology, new teaching media are constantly appearing in safety education in colleges and universities. Virtual reality technology is one of them. This technology not only enables users to experience all-round safety education, but also is one of the most developed and applied emerging technologies, which plays an important role in the process of safety education in virtual environment. Virtual reality technology is a general term of comprehensive technology, which includes system simulation technology, sensing technology and so on. In essence, virtual reality technology is to create a virtual world with high simulation effect for people by sensing through virtual pictures and sounds with the help of people's various sensory organs. In this virtual world, people can form a human-computer interaction mode through language, gestures and other forms, thus giving people a better sense of experience. People are immersed in the virtual world because of the immersion, interaction and conformational characteristics of virtual technology. Virtual reality technology can promote the high-quality and efficient development of college education and teaching from its advantages and characteristics. For example, applying this technology to college education and teaching can promote and assist the teaching design, experimental analysis and skill training [5]. Therefore, this paper holds that the safety education system in colleges and universities based on virtual reality technology will be an attractive way of learning. It not only solves the problem of lack of knowledge, but also provides practical opportunities for teachers and students, which increases the safety awareness, safety knowledge and skills of teachers and students, and at the same time improves the participation of students in safety education and teaching activities.

2 Introduction of Related Application Technology

2.1 Virtual Reality Technology

Virtual reality refers to real-time simulation and interaction through multiple sensing channels, which is also called VR. This technology involves a variety of disciplines, and it forms a virtual environment that is extremely close to reality by building a three-dimensional virtual world with the help of computers, so that users can have an extremely real feeling visually. Its conceptual model is shown in Fig. 1. This technology has the characteristics of interactivity, immersion and imagination [3]. Immersion means that users can clearly feel everything in the virtual world. Interactivity refers to the natural degree of feedback for users' actions in the virtual world. Imagination means that users can acquire new knowledge in the virtual world, and then inspire new ideas, and improve their cognition in rationality and sensibility. Virtual reality systems are divided into four

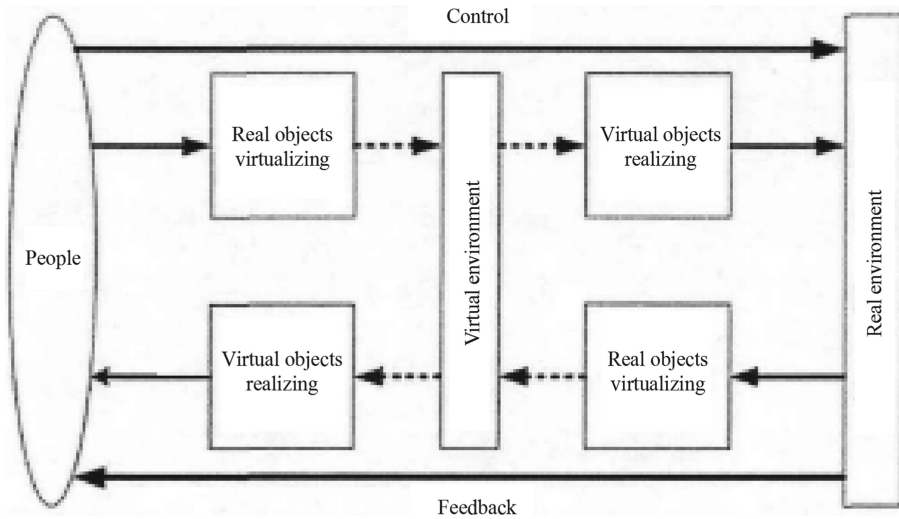


Fig. 1. Conceptual model diagram

categories, namely desktop VR system, immersive VR system, enhanced VR system and distributed VR system. This technology has been applied in military aerospace, architecture, medical care, art, cultural relics and historic sites and other industries. For example, the application of virtual reality technology in education and teaching has the following advantages: improving teaching efficiency, stimulating students' interest in learning, making learning environment safer, not limited by time and place, saving costs and supporting remote application and management.

2.2 3Dmax

3Dmax is a 3D production software, often called 3Ds max or MAX, which is produced by Autodesk Company. It is used for the production and rendering of models and animations. It has the characteristics of powerful modeling function, good expansibility, simple operation, strong compatibility and high simulation. And it can import files in FBX format into Unity development environment, and complete editing, rendering and other operations in Unity platform. In addition, it has high production efficiency. 3Dmax is widely used in advertising, film and television, industrial design, architectural design, multimedia production, games and other fields, such as opening animation and video game production in TV and entertainment industries. The most representative work is Laura (Laura is the heroine in the British video game "Tomb Raider"). The development direction of 3Dmax software will gradually be diversified and intelligent, and will develop with the development of modern information technology and big data era.

2.3 Unity3D

Unity3D software is the operating engine to realize virtual reality technology. After importing resources, it can edit related functions only by using its own functions.

Unity3D is an engine for virtual interaction. It has many characteristics. First, it is very convenient to import resources. Second, the Shader can be used to render models and scenes, and the system map can also be used to import homemade maps. Third, it can support C# and JavaScript. If there is a MonoDevelop script editor, it can be edited by Visual Studio. Fourthly, the UGUI interface development system attached to it has good visualization and operability, which can register events very conveniently and realize logical functions. Fifth, it has strong compatibility and can be used in various platforms. Sixth, it has a wide application range and can be well compatible with HTC VIVE [9].

2.4 HTC VIVE

The working principle of VR device depends on the PC host computer, game host dedicated to games or mobile phone, which mainly includes display interface screen, input device, computing device and output device, as shown in Fig. 2. The working principle of HTC VIVE is to use tracking technology to identify the user's position. Images are transmitted by the computer to the display through the data line and then projected into the user's retina. The main components of HTC VIVE are a helmet, two base stations and two handles. The laser emitted by the sensors in the base stations can lock the positions of the helmet and handles and other parameters, so as to finally count the parameters generated by the user's movement. The development tools of HTC VIVE include Steam VR platform, Steam VR Plugin plug-in and Virtual Reality Toolkit SDK development kit [2].

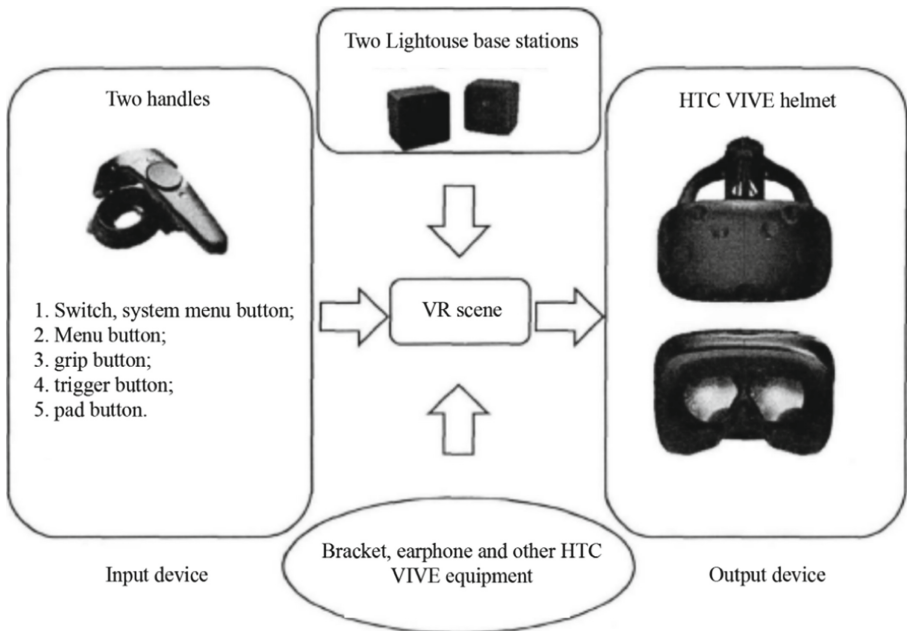


Fig. 2. HTC VIVE input and output mode display diagram

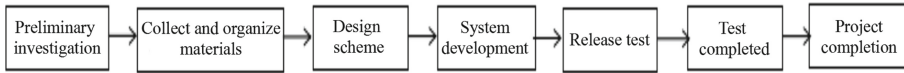


Fig. 3. Development flow chart of safety education system in colleges and universities based on VR technology

2.5 Development Environment

According to the usage requirements of the above related application technologies, we can complete the construction and deployment of the development environment. The virtual development environment is mainly composed of three parts, specifically using 3Dmax to model the objects in the scene, HTC VIVE to provide hardware for VR display and interaction, Unity3D engine to integrate the materials and scripts in the scene, etc. Hardware requirements: HTC VIVE requires more than 1050 computer graphics cards, and the CPU is Windows7 operating system. Software requirements: 3Dmax modeling software is the main modeling application, and the Unity3D engine is needed for scene building and interaction, because it has high compatibility, and its own OpenGL is also the rendering technology needed by the system. The development language is C#. Publish the system to the Web with B/S architecture. As shown in Fig. 3, it is the development flow chart of safety education system in colleges and universities based on VR technology.

According to the above explanation of key technologies, we have determined the overall environment of system development, the configuration of related software and tools, and also made clear the technical feasibility of the overall project of safety education system in colleges and universities based on virtual reality technology.

3 Requirement Analysis

3.1 System Requirements Analysis

From the perspective of human and social development, safety is one of the most important and basic factors affecting rapid development. For college students, safety is the basic premise to ensure students to successfully complete their studies, and it is also the key factor for students to grow up healthily [7]. In order to ensure the smooth development of safety education in colleges and universities, it is necessary to analyze the needs of safety education from the perspectives of students and teachers, as follows: (1) From the perspective of students: contemporary college students grow up under the care of their parents before entering university, and spend all their time studying, which leads to students' lack of social experience, lack of safety awareness and prevention awareness of various things, and easily become the object of infringement. In addition, there are some problems in safety education in colleges and universities, such as insufficient attention [10]. Therefore, improving students' safety awareness, learning safety knowledge and mastering safety skills have become the teaching objectives of safety education in colleges and universities. (2) From the perspective of teachers: as a teacher, there are some hard demands in the process of teaching safety education to students. For example, the traditional teaching methods of safety education are conducted by video, PPT and dictation, and there is no correct understanding of laboratory practice. This is

because the actual training time is not available or very short, and each student cannot be guaranteed to operate at least once [1]. Therefore, strengthening laboratory construction in teaching activities has become an urgent need of educators in safety education and teaching activities.

In view of the above requirements, in order to achieve the goal of improving students' safety awareness, learning safety knowledge and mastering safety skills, it is necessary to design a system with interest, high teaching efficiency and authenticity, and the system can run stably.

3.2 Global Design

The system in this paper needs to be based on Web technology, B/S architecture, Java Script as front-end language. Net as server language, MVC as server architecture and Mysql as database. The design of the system firstly analyzes the requirements of safety education in colleges and universities, and then designs the teaching mode of safety education in colleges and universities according to the interesting, interactive and authentic characteristics of virtual reality technology, thus designing the system framework model and development process. Secondly, taking 3Dmax as the system scene modeling, the virtual reality function module based on Unity engine is constructed, which realizes the functions of teaching scene simulation, user interaction training, data management and control, thus completing the safety education system in colleges and universities based on virtual reality technology. Then, the VR helmet in HTC VIVE hardware platform is used for experiments. Through function evaluation and application effect analysis, it is proved that the system can really improve the safety education effect. The following is the framework diagram of safety education system in colleges and universities based on virtual reality technology (Fig. 4).

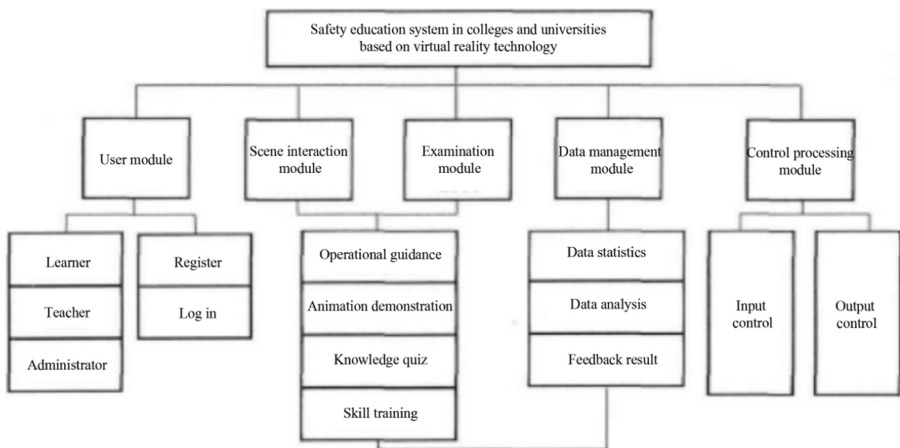


Fig. 4. Framework diagram of university safety education system based on virtual reality technology

4 Detailed Function Realization

The system is divided into five modules, including user module, scene interaction module, examination module, data management module and control processing module. The following mainly explains the user module, scene interaction module, examination and data management module. Users log in to the system, and students can freely choose the modules they want to enter, such as the scene interaction module and the examination module, and then carry out related learning. Teachers can log in to the system to upload materials needed for teaching, check students' test scores, and learn about students' learning by checking the data management module. After the administrator enters the system, he can control the contents of the system as a whole, such as the improvement of functions.

4.1 User Module

The user module mainly involves the registration, login and modification of users. Users log in to the virtual system to learn. The module has the following requirements: First, the interface design must cater to the current college students' psychology, and the screen has a strong sense of impact, which can stimulate students' motivation to study in the system. Second, the background music should be interesting and can set off the atmosphere. Third, the interface design should have better interactivity, which makes the interaction between users and the interface more convenient. The interface design in the user module needs to use Photoshop to design pictures, then import the pictures into Unity3D, then use UGUI plug-in to complete the interface design, and then add dynamic and static effects and background music at will, so as to achieve the best experience effect.

4.2 Scene Interaction Module

Scene interaction module is the most important part of the safety education system in colleges and universities, which is divided into four parts, namely, operation guidance, animation demonstration, knowledge quiz and skill training. They can be interpreted as follows: First, operation guidance means that the system will guide the user to operate, such as the prompt of "next step" operation. Secondly, the animation demonstration is to show the safety knowledge by animation, which makes the image more intuitive and interesting. This part of knowledge can be used as the basis of safety education. Third, the knowledge quiz section refers to the knowledge detection link, in which thousands of safety knowledge are set up, such as general knowledge, chemical experiment safety, biological safety, radiation safety, large-scale instrument and equipment safety, emergency handling of safety accidents, etc., and these knowledge can basically be divided into two categories, one is basic knowledge, and the other is extended knowledge. The setting of knowledge question and answer content needs to be scientific. Operation guidance, animation demonstration and knowledge question and answer in this module can switch and select each scene by sending rays through the handle. Fourthly, skills training, in which various virtual scenes are set up, such as simulated earthquake escape, laboratory safety accidents and so on. In this part, students can experience the whole process of the accident and take measures to deal with various results caused by the accident.

Therefore, it is required that the setting of this part should be authentic, interactive and scientific. The authenticity and interactivity of the module need to be realized by HTC VIVE equipment, specifically, the virtual environment is reflected to the user's retina through the helmet, and then the action of the characters in the scene is realized by the operation of the handle. The scientificity is to ensure that the content involved is not exaggerated and ideal [6].

4.3 Examination Module

This module is based on knowledge question and answer and skill training. After the examination, the scores will be displayed directly. The grading standard is that knowledge quiz accounts for 40% of the total score, and skill training, that is, practical test accounts for 60% of the total score. This module can not only detect students' learning situation, but also make students tacitly understand their practical skills.

4.4 Data Management Module

The data management module includes personal information and system data information. The data of this part can be used as the basis for the final evaluation of teachers and students. In fact, the data management module can also be called the data center, which is the most important part of the system and the place where the system stores data. Using virtual reality technology to test the system can easily find out the defects in the system and display the configuration problems in an easy-to-understand way, so that administrators can easily solve these problems.

5 Conclusions

The design and development of safety education system in colleges and universities based on virtual reality technology is designed by taking the needs analysis of colleges and universities and the advantages of virtual reality technology as the breakthrough point and using the tools of modeling, drawing and rendering in virtual reality technology. The safety education system in colleges and universities studied in this paper not only gives full play to the advantages and functions of virtual reality technology, but also solves the problems of lack of knowledge and insufficient attention. It can not only stimulate students' interest in learning, but also optimize the teaching mode, providing a demonstration system for the development of traditional education mode to modern teaching mode, and pointing out the direction for promoting the high-quality development of college education and teaching and the sustainable development of higher education.

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