

# The Design and Implementation of the 3D Educational Game Based on VR Headsets

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**Abstract**—Rapid popularization of VR equipment in human life has brought unprecedented convenience and entertainment experience. Cardboard, Oculus Rift, VR Gear and other VR headsets are gradually being accepted and recognized. The realization of VR educational games will become the key point of the application of VR technology in the field of education. This paper demonstrates how to the possibility of educational game by using VR Gear which is a VR display device produced by Samsung. The 3D educational game of a garbage classification is designed and implemented to cultivate students' green habits. This game promotes development in VR industry, provides educational resources and also supports students' autonomous learning.

**Keywords**- Virtual Reality; VR headsets; the 3D educational game; Environment Education

## I. INTRODUCTION

VR technology of specific application in people's life is becoming increasingly and common. 3D movies, a 3D printer, 3D scanner, Kinect depth cameras and other VR peripheral equipment, the rapid popularization of them bring an unprecedented experience of human life. VR researchers in the world make VR display equipment much better in recent years. The produced by Google "cardboard" is a representative. The appearance of VR headsets is "glasses" looking. And the working principle of VR headsets is similar to early VR Head-Mounted Display. This type of product has received extensive attention in the world in 2015. VR has more application fields, including medical, entertainment, military and aerospace, industrial simulation, electronic commerce, education and other fields. How can VR be combined with education? VR educational games based on VR headsets should be a good choice.

## II. RELATED WORK

### VR headsets

VR technology is that using computer technology as the core of modern high-tech means to generate realistic vision, hearing, touch, smell, and taste integrated into virtual environments, users with some special input / output devices, using the natural world with virtual objects interact, mutual influence, resulting in it is the feeling and experience of the environment.

According to Xiangyuan Fang (2015), TVR TIME MACHINE VR COMPANY, VR headsets are the kind of VR display devices that is based on the computer or mobile phone showing 3D content, usually embarking with lens box or plastic shell [1]. After wearing VR headsets display equipment, users could appreciate 3D content. The computer or mobile phone in VR headsets is the monitor and the combination of lens and box or plastic shell produces 3D effect. Currently popular VR display devices on the market are shown in Fig. 1.



Fig. 1. Currently popular VR headsets

### Educational games based on VR

Educational games are games that are designed to help people to learn about certain subjects, expand concepts, reinforce development, understand an historical event or culture, or assist them in learning a skill as they play. Second Life (SL), There, Worlds and so on are several social VR environments to available for the public. They could support experiential learning very well. The most prominent application of 3D virtual worlds is Second Life (SL), which provides an environment to connect lots of users to pick up knowledge, and get practical experiences at the same time. In addition, social VR not only provided students with the experiential learning but also enhanced collaborative information and knowledge sharing. Sandrine de Ribaupierre et al. discuss the educational theories explaining why virtual simulations and serious games are an important teaching tool, and finally suggest how to assess their value within an educational context [2].

According to the characteristics of 3I in VR, create interactive learning system to achieve the optimization of teaching effect, create the simulation of realistic situation in order to break through the learning space limit test results of different safety without damage, such as VR application in

the field of education advantage, so the VR in the field of Education of the general form for campus roaming, virtual experiment and skill training. Lina Liu (2011), Xi'an Electronic and Science University, in her master's graduation paper, design and development training system for railway locomotive crew based on VR [3].

As “wearable devices network” reports, for most people, the VR equipment more is as “gaming peripherals” perceived by everyone, but VR technology has many industries and fields used, and even has profound influence and change of each industry pattern, including the education industry [3]. Educational games are developed for the purpose of a particular education, with the characteristics of both educational and entertaining. Jianrong Ma, Sujing Zhang and Feng Li (2012) make design and implementation of an educational game based on somatosensory technology for parenting [5]. This educational game, through the Kinect somatosensory equipment to achieve the combination of VR technology and education, provides a valuable reference to the application of VR technology in the field of education. Jiali Liu (2015), postgraduate Sichuan Normal University, uses the Unity3D as game engine to achieve an educational game for children safety education as the main content [6].

#### Environment education

The forms of environmental protection education is relatively simple, most of them are words and pictures. When organizing the implementation of environmental education in kindergarten, it should follow the principles of permeability, interest and motivation, gradually improving the awareness of environmental protection, the creation of a suitable environment for environmental education, and other areas of education combined to guide the children to practice environmental protection in social life [7], according to Tian Su'e (2011). Lianying Lu, Xianhong Wei et al. (2004) thought that the severe environmental crisis and the weak awareness of environmental protection of contemporary college students fully explain the necessity and urgency of environmental education in colleges and universities [8]. A study was aimed at determining the environmental attitudes and environmentally responsible behaviors of the undergraduate students of Abant Ýzzet Baysal University toward environmental issues [9].

### III. METHODOLOGY

A learner model is a key component of any adaptive e-learning system as it maintains information about learners in order to provide them adaptation according to their current learning needs [10]. However, how to balance the educational and recreational educational games is one of the key issues in educational game research. The process of the game can give players a sense of immersion in the virtual world, this immersion can't be too much emphasis on the entertainment of the game, and it can't be too much of its education. Environmental education game design as an example is in this part, and the main process is shown in Fig. 2.

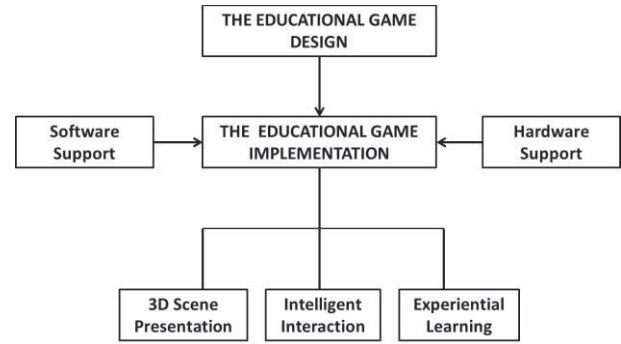


Fig. 2. Main process

#### Gaming design

The task of the game is to pick up the learning content, the design of the game task is based on the in-depth analysis of the content of the study. The design of the game task is from the learning content, they have a deep connection. Task design is too difficult or too easy to arouse the desire of the students exploring, profound learning experience is not expected. In the process of designing the game task of educational games, the task of the game is in accordance with the latest development zone of the learner, based on the detailed analysis of the characteristics of the learners.

The world of the game of this education is set on a beautiful tropical island, and the natural scenery is pleasant. Game storyline is increased along with the tourism and residents, and the island's environment is damaged as the reason that living garbage is not properly handled by tourists and residents. The game players take action on environmental protection in the first visual angle.

Players have to collect living garbage collection and make garbage classification correctly on the island within the specified time, making island's environment better and better. Collecting a quantity of garbage, classifying garbage correctly and no timeout, players could hold the key to go in the room, and rewarded.

#### Educational design

Education and entertainment is the main feature of educational games. Entertainment is the key factor to make the game more attractive. But the focus of educational games in the education game, it must be to ensure the physical and mental health of a game player. In the game to enjoy the joy of the process, players are able to absorb some of the educational knowledge, physical and psychological to be harvested. Therefore, education must be integrated into game.

The virtual nature of educational games is conducive to the creation of virtual situation. Interactivity is helpful for learners to collaborate with each other. Entertainment is advantageous for the learners to provide rich and interesting resources. Challenging and competitive is conducive to the subjective initiative of learners. So educational games can provide support for learning in the context of constructivism.

It selects the standard of Chinese garbage classification “The classification signs for municipal solid waste GB / T 19095-2008” as teaching content, so that users can get the knowledge of garbage classification.

Garbage should be divided into recyclable waste, hazardous waste and other types of garbage. Recyclable waste refers to the appropriate recycling and resource utilization of garbage, including paper, plastic, glass, metal, fabric and bottles. Hazardous waste refers to hazardous substances that require special treatment, including batteries, light tubes and daily chemicals, which are directly or potentially harmful to human health or the environment. Other types of rubbish mean that other than the above. According to the standard, recyclable waste containers are blue, and the color of other kinds of garbage containers is gray, as is shown in Fig. 3.

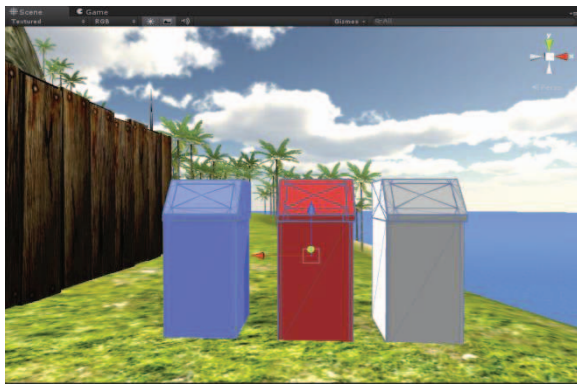


Fig. 3. Different colors of the garbage containers

#### Software support

Unity 5.3 version of the same time also launched the first official VR software development tutorial. Although the tutorial is not very similar, for developers, this tutorial has great significance for the development of VR educational games provide a basis for the software. In the course, the key to making the VR software resources that can be used on the VR hardware device is to render and build the steps. First, need to download the latest runtime Oculus 0.8 or higher, as well as the latest Unity 5.3 or higher. Enabling support for VR in the project is very simple, only need to select Edit > Rendering > Project > Settings > Other > Settings Player > Unity. Then check the “Reality Supported Virtual” in Inspector, as shown in Fig. 4.

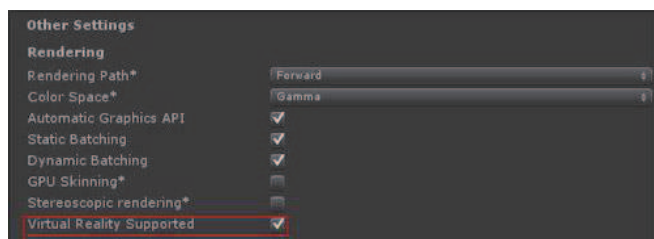


Fig. 4. The setting of Unity5.3 to generate VR resources

In Runtime, you can use the ‘UnityEngine.VR.VRSettings.enabled’ property to set the

code. When we have enabled Editor Unity in Support VR, but also connected to the mobile terminal VR headset display device, enter the Play mode can be displayed on the mobile terminal VR head display device game scene. This approach greatly improves the efficiency of development testing and iteration. Different from before, the developer does not need to compile and generate an executable project to see the VR application or game adjustment.

#### Hardware support

Before use, the MicroSD 16G card is needed to insert into VR Gear with the phone in a Samsung Note GALAXY 4 mobile phone and the phone system should be updated to the latest version. Samsung Note GALAXY 4 is regarded as the VR Gear device display, providing the relevant 3D visual experience effect. Then, open the black cover of Gear VR, fix Note 4 to Gear VR. After the installation is complete, VR Gear will be sent through the phone speaker Ding Dong, preparation is finished. After the user to take down the phone, install the corresponding software, including the operating system Home Gear and video player VR Video Oculus and other basic software, the whole process is very fast. After the installation is complete the user to re-install the phone with cover, Gear VR will be worn on the head, a built-in sensor automatically detects open the main menu, starting it. As shown in Fig. 5.



Fig. 5. The setting of Unity5.3 to generate VR resources

#### Interactive way

Because VR should be 3D media, 2D inputting way is not directly and accurately. Therefore, Gear VR takes ‘Touchpad’ as input tool. It is good for the user to play 3D games, as shown in Fig. 6. Touchpad is simple and comfortable enough, and the user can control all kinds of simple actions in the game through it, a natural human-computer interaction. For example, “move forward and back” means controlling the direction of role, “click” is to choose, “long press” refers to pick up objects in the game, etc.

VR technology can make educational games more entertaining and immersive, and educational games can be an effective way to practice VR technology in education. At present, most of VR technology applications are still in design or preliminary environmental simulation. VR hardware and software used in education researches are less, tying to use VR headsets equipment make 3D educational games implement. It will provide new ideas to the VR technology application in the field of education.





Fig. 6. Natural human-computer interaction : Touchpad

#### IV. CONCLUSION

In research, firstly it makes a short introduction about VR headset and educational games. It is mainly discussing how VR headsets support for 3D educational games. There is a 3D educational game for environment protection as example. VR technology used in the field of the game has gradually become mature, and educational games can be used as a bridge between VR technology and education field. Therefore, more 3D educational resources are implementation and development, such as based on VR headsets equipment. Not only to promote development in VR industry, also meaningful for educational resources information and students' autonomous learning.

#### REFERENCES

- [1] Xianyuan Fang, "Mobile Terminal VR Game Design and Development—Project Experience of Gear VR Game 'Finding'," *High-Technology & Industrialization*, Nov. 2015, pp. 66-73.

- [2] Sandrine de Ribaupierre, Bill Kapralos, Faizal Haji, Eleni Stroulia, Adam Dubrowski, Roy Eagleson, "Healthcare Training Enhancement Through Virtual Reality and Serious Games," *Virtual, Augmented Reality and Serious Games for Healthcare 1*, vol. 68, April. 2014, pp. 9-27, doi:10.1007/978-3-642-54816-1\_2.
- [3] Lina Liu, "The Design and Implementation of Train Crew Training System Based on Virtual Reality," M.S. thesis, Xi'an Electronic and Science University, Xi'an, China, 2011.
- [4] Wearable devices network, "Ten applications of virtual reality technology in addition to the game," [http://wearable.ofweek.com/2016-01/ART-8900-5011-29057180\\_5.html](http://wearable.ofweek.com/2016-01/ART-8900-5011-29057180_5.html).
- [5] Jianrong Ma, Sujing Zhang, Feng Li, "Design and Implementation of Parent-Child Interaction Game Based on the Somatosensory Technology," *China Educational Technology*, Sep. 2012, pp. 85-88.
- [6] Jiali Liu, "The Research and Implementation of Children's Safety Educational Game Based on Unity 3D," M.S. thesis, Sichuan Normal University, Chengdu, China, 2015.
- [7] Tian Su'e, "On the Current Environment Education in Kindergartens," *Studies in Preschool Education*, Nov. 2011, pp. 65-67, doi:10.13861/j.cnki.sece.2011.11.013.
- [8] Lian-ying Lu, Xian-hong Wei, Zhong-shan Yu, Dong-yun Du, "Stare at the education of the college students' environmental conservation," *Journal of Hubei Normal University (Natural Science)*, vol.24, Mar. 2004, pp. 86-90.
- [9] H. Müderrisoglu, A. Altanlar, "Attitudes and behaviors of undergraduate students toward environmental issues," *International Journal of Environmental Science & Technology*, vol. 8, Dec. 2011, pp.159-168, doi:10.1007/BF03326205.
- [10] Mohamed Ali Khenissi, Fathi Essalmi, Mohamed Jemni and Kinshuk, "Learner Modeling Using Educational Games: A Review of the Literature," *Smart Learning Environments*, Feb. 2015, pp. 2-16, doi:10.1186/s40561-015-0014-y.