

Research on Visual Art Design Method Based on Virtual Reality

Peng Li, Zibo Vocational Institute, China

ABSTRACT

In today's society, computer technology has been deeply rooted in the hearts of people. Computers are wonderful tools for creative thinking. It is an extension of our visual function and the function of the visual cortex of the brain. Through this extension, we can see more scenes that we could not see before. As a computer simulation system that creates and feels virtual worlds, 3D digital virtual reality technology uses a computer as a media simulation or a real or imaginary scene. It is a system simulation of interactive 3D dynamic vision and entity behavior based on diversified information fusion. As the creator of visual arts, we must try to observe the world at a deeper level and establish a model that resonates with the viewer. At every level, our technology will convey the way we view the world more deeply. We will be more amazed at the richness of the real world. This chapter explores a visual art design method based on virtual reality.

KEYWORDS

Three-Dimensional Digitization, Virtual Reality, Visual Arts

1. INTRODUCTION

With the rapid development of computer technology, people's spiritual needs are increasing day by day besides material life. The demand for the quality of cultural life is getting higher and higher(Chen & Zhao, 2018). When our society enters an era of picture reading, that is, the age of information visualization. As the disseminator of culture in the information age, the art of visual design is getting more and more thorough(Hui, 2017). Visual art carries the concept of culture and disseminates cultural information. As its material manifestation, design works, with the design of images as information carriers, have a strong impact on the public life(Hasan & Yu, 2017).

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Nowadays, computer technology has been deeply rooted in the hearts of the people. Computers are a wonderful tool for creative thinking(Louis Harpham—Lockyer & Harpham-Lockyer, 2015). It is an extension of our visual function and the function of the visual cortex of the brain. Through this extension, we can see more scenes that could not be seen before. 3D virtual reality is the best way to show this scene. It not only has a proud achievement in art, but also plays an important role in various fields, such as medicine, military, education, science and so on(Mao et al., 2014). As a computer simulation system that creates and feels virtual worlds, 3D digital virtual reality technology uses a computer as a media simulation or a real or imaginary scene. It is a system simulation of interactive 3D dynamic vision and entity behavior based on diversified information fusion(Yi, 2014).

2. AN OVERVIEW OF VIRTUAL REALITY TECHNOLOGY

Virtual reality technology is a kind of advanced human-computer interaction technology that combines various technologies to create a realistic artificial simulation environment, and can effectively simulate the human visual, listening, tactile and other perceptive behaviors of human beings in the natural environment(Gatica-Rojas & Méndez-Rebolledo, 2014). It integrates many techniques such as computer graphics, multimedia technology, artificial intelligence, man-machine interface technology, sensor technology, highly parallel real-time computing technology and human behavior research. It is the high-level integration and intersecting of these technologies.

It gives the users a more realistic experience and provides a great convenience for people to explore the movement and change rules of things in the macro and micro worlds. It will fundamentally change the way people interact with the computer system. At present, virtual reality technology has been widely used in many fields, such as military, engineering, medicine, education and so on. And with the continuous development of virtual reality technology, it will show a wider application prospect(Bao et al., 2013).

2.1 The Fidelity of Virtual Reality Technology

Virtual reality technology is a virtual world of three-dimensional space based on the various senses and heart characteristics of human beings, which is produced by the computer and has a realistic stereoscopic nature. Virtual reality technology is the imitation of the real world, and the experienter can feel the sensory experience of being on the scene.

2.2 Interactivity of Virtual Reality Technology

In virtual reality system, the realization of Interactivity is different from traditional multimedia technology. From the invention of computer until now, in traditional multimedia technology, the interaction between human-machine is mainly based on one and two-dimensional interaction between keyboard and mouse(Chen et al., 2012).

The virtual reality system emphasizes the natural way between human and virtual world, such as man's walking, head turning, hand moving, etc. Through these, users interact with the virtual world. With the help of the special hardware in the virtual reality system, we interact in a natural way with the virtual world and produce the same perception in real world in real time. Even the user himself can not realize the existence of the computer.

For example, users can directly grab objects in the virtual world with their hands. When the hand feels the touch, it can feel the weight of the object, and can distinguish between the stone or the sponge, and the objects caught in the scene move immediately with the movement of the hand(##NO_NAME##, 2011).

The human being is an important factor in the virtual reality system. This is the prerequisite for all changes. It is because of the participation and feedback of people that there will be various requirements and changes of real time interaction in the virtual environment.

Real time means virtual reality system can respond quickly to user input. For example, the rotation of the head can produce corresponding changes immediately in the displayed scene, and the corresponding feedback can also be obtained. Moving an object in the virtual world by hand, the position of the object will change accordingly. Without the real-time performance of human-machine interaction, the virtual environment loses its sense of reality. The summary of this interaction is shown in Figure 1.

2.3 The Creativity of Virtual Reality Technology

Virtual environment in virtual reality is not real, it is imitation of reality. The objects in the virtual environment are executed on the basis of the physical laws of motion in the real world, such as the virtual street scene, which is designed and created according to the law of the real world's street movement. As shown in Figure 2 below.

Figure 1. Interactive summary of virtual reality technology

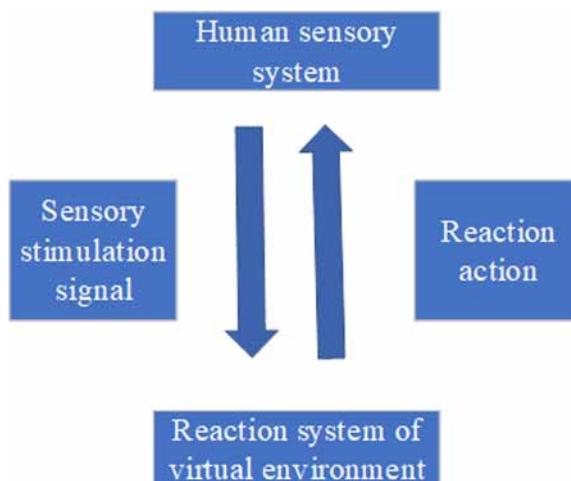


Figure 2. Virtual street scene



The application of virtual reality provides a new way for human to understand the world. First, through virtual reality technology, people can break through the space-time constraints and experience the past or future events. Second, we can explore the macro or micro world. Third, we can accomplish the things that are difficult to accomplish under the realistic conditions(Hu, 2010).

2.4 The Immersion of Virtual Reality Technology

Immersion refers to the fact that users feel as if they are completely in the virtual world, surrounded by the virtual world. The main feature of virtual reality technology is to make users feel that they are part of the virtual world created by the computer system. The users are transformed from passive observers to active participants, immerse in virtual world, and participate in various activities in the virtual world.

The ideal virtual world can make users difficult to distinguish between truth and falsehood, and even the immersive nature of virtual reality comes from the multi perception of virtual world. In addition to our common visual perception and auditory perception, there are also force perception, tactile perception, motion perception, taste perception, smell perception, and body sensation. Theoretically, the virtual reality system should have all the perceptive functions of human beings in the realistic and objective world. In terms of user experience, virtual reality system provides more sensory experience and enriches feedback on people. This feedback is multiple and is based on the relevant procedures set by the real sensory experience of the human being, with the aid of the corresponding transmission equipment, including the sensing and reaction devices of the kinesthetic class. These devices enable the virtual reality system to have a multi-sensory function and enable users to get a variety of perception in the virtual environment.

3. VIRTUAL REALITY ART

Virtual reality art is a kind of art based on virtual reality technology. Since 1980s, with the full development of virtual reality technology, it has gradually developed. Since the advent of virtual reality technology, artists have been paying much attention to it. When artists use this technology to create ideas and express feelings and sentiments, virtual reality technology becomes a creative tool, and the resulting works are not purely technical products. The characteristics of a work often have a direct relationship with its creative tools. The immersion, interactivity and conceivability of the virtual reality technology determine the virtual reality art that takes it as a creative tool.

The development of virtual reality art has a certain synchronicity with the development of virtual reality technology and has gone through a process from conception to implementation. The development of virtual reality technology in China is relatively late and most of the virtual reality systems are in the laboratory stage. So far, the typical virtual reality works are still relatively few.

4. 3D RENDERING TECHNOLOGY

Rendering technology is the process of simulating the illumination of the physical environment in the three-dimensional scene and the texture of the material in the physical world to get a more real image. Rendering is not an independent concept, it is the process of assembling all the work in the three-dimensional model, texture, light, camera, and effect to form the final graphic sequence. To put it simply, it is to create pixels that are assigned different colors to form a complete image. Rendering process requires a lot of complex calculations, which makes computers very busy. The current popular renderer supports global illumination and HDRI technology, while the simulation of caustics, depth of field and 3S material will also bring unexpected effects to rendering. Three-dimensional rendering technology is one of the core of virtual reality technology.

4.1 The Propagation of Light

In all aspects of the rendering, light is the most important element. In order to better understand the principle of rendering, the first choice to understand the way of propagation of light in the real world: reflection, refraction, transmission.

Reflection is a very important factor in reflecting the texture of objects. The reflection of light refers to the phenomenon of light touching and springback in the process of movement. It includes two ways: diffuse reflection and specular reflection. All visible objects are affected by these two ways. The first is color. When the object bounces back all the light, people will see that the object appears white. When objects absorb all light without bounces, objects appear black. When the object absorbs only part of the light and then returns the remaining light, it will show various colors. For example, when an object refers to a red light and absorbs other light, the surface of the object will appear red.

Followed by gloss, smooth objects, there will always be obvious highlights. For example, glass, porcelain, metal and so on, but objects without obvious highlights are usually rough, such as bricks, tiles, soil and lawn lamps. The smoother is the smaller the range of high light. As shown in Figure 3, the texture of the glossiness of the object.

Refraction of light is a phenomenon that occurs in transparent objects. As the density of matter is different, light will deflect from one medium to another. Different transparent materials have different refractive index, which is an important means to express transparent material. The effect of light refraction on transparent objects is shown in Figure 4.

Figure 3. VRay's glass, metal and ceramic texture



Figure 4. An effect diagram of a transparent object under refraction of light



As the density of matter is different, light will deflect from one medium to another. In the real world, when light meets transparent objects, a part of the light will rebound, while the other part will continue through the object. If the light is stronger, the light will penetrate the object and produce caustic effect.

It can be said that the texture of any object is expressed through the three kinds of light transmission. In the rendering process, it is applied to the rendering according to the light and shadow phenomena in nature, which can be more authentic.

4.2 HDRI

HDRI is the abbreviation of high dynamic range image. HDRI has a larger brightness range than RGB format (8bit brightness range). The maximum brightness of the standard RGB image is 255/255/255. Even the brightest white can not provide enough lighting to simulate the real world if the image is combined with light energy to illuminate a scene. The rendering results look dull and lack contrast because the image file describes the large range of actual lighting information in a single 8bit RGB image.

In addition to color information, pixels in the HDRI picture contain brightness information. If the color of the sky in ordinary photos is white, then it may show the same RGB color as a white paper. In the same color, in HDRI pictures, the brightness may be very high in some places. HDRI images are usually stored in panoramic pictures. Panorama refers to images that contain 360° range scenes. The panorama can be varied in form, including sphere form, square box form, mirror ball form, etc. Using HDRI images can make rendered images more lifelike.

5. 3D DESIGN AND RENDERING ENGINE

Three-dimensional design software first requires the establishment of a virtual scene. Visual designers can simulate objects in the real world in the creative scene and create models or scenes according to the shape and scale of the objects. If animation is made, we should also make motion tracks, virtual cameras and so on according to the established model. Finally, the specific material is given to the model according to the needs, and the lighting parameters are produced and adjusted, and finally rendered and output. In the whole production environment, rendering this part is the key to whether the scene is real or not, which includes elements of material and light. The early production of visual art, especially in the production of large scenes, needs to set up a lot of lights, not only complex programs, but also poor results. But with the addition of advanced renderers, this rendering process is optimized. When the rendering of the physical phenomena of the light in the computing scene is hung out to the 3D software to participate in the rendering, the effect we get is more real, and the lighting is set only according to the actual lighting.

In addition to the light mentioned above, the setting of material is also the key step in rendering the real effect. The material is the characteristic of the surface or surface of a specified object, which determines the characteristics of these planes in coloring, such as surface color, transparency, brightness, degree of self-luminescence, texture, etc. In creation, the role of material is not only its physical and chemical properties and functional utility, but also its artistic expressiveness. The available material library provided by mainstream software 3ds Max or Maya, storing material balls and adjusting parameter design. However, in use, we will find that the material inventory of the system is limited due to its slow rendering speed, too many adjustment parameters, and difficult to transfer special effects.

The rendering speed of 3D scene is determined by the number of faces of 3D models. For example, the creation of a residential building, the amount of detail of each detail is often over several million, which will lead to slow rendering speed. In addition, some of the internal parameters of the material ball are also involved in the calculation, and these additional computing parts are worse over time for the system's own rendering results. If we need to adjust a specific texture to a material ball, and sometimes we can't do it at all, even if we do the material with rich surface details, it will be the burden of rendering calculation. Therefore, in practice, we often use the third-party renderer instead of the renderer in 3D software. We use it to expand the programming of material or light, enrich material types and achieve the perfect visual effect.

In 3D virtual scene, we have to produce perfect picture effect. Whether static frame or moving frame should be selected in the production of reasonable renderer, the reasons are determined in many ways. If you choose a rendering algorithm based on rasterization. Under the premise of this design, the parameter data of the geometry, such as the index of the surface of the object, the spatial change rate of the texture coordinates, the BRDF, the change rate of the tangent space, and so on, will be relatively rough. Of course, these data will also appear in some of the more advanced game engines today. At this point, even if you consider these data requirements in the early design stage and show them in Render, it will not make any sense at last.

6. CONCLUSION

With the development of modern society with computer as the main media tool, the dependence on virtual reality scene technology becomes more and more intense in the creative activities of all visual arts in today's computer era. Creating 3D graphics on your computer is not just generating images. Working in 3D is to model and find the essence of the real world. In creating a three-dimensional scene, whether it's a moving frame or a static frame art, our goal is to express our creative vision in the simplest way. Building a shadow model is an example of finding these different levels of representation. A surface can have only one

color. At a deeper level, we use surface lighting to adjust brightness. Further, we build specular reflection highlights, add ray tracing, then global illumination, and finally scatter light in the surface. At every level, our technology will convey the way we view the world more deeply, and we will be more amazed by the richness of the real world.

REFERENCES

- Bao, X., Mao, Y., Lin, Q., Qiu, Y., Chen, S., & Le Li, R. S. (2013). Mechanism of Kinect-based virtual reality training for motor functional recovery of upper limbs after subacute stroke. *Neural Regeneration Research*, 8(31), 2904–2913. PMID:25206611
- Chen, G., Li, B., Tian, F., Ji, P., & Li, W. (2012). Design and Implementation of a 3D Ocean Virtual Reality and Visualization Engine. *Journal of Ocean University of China*, 11(04), 481–487. doi:10.1007/s11802-012-2112-6
- Chen, X., & Zhao, X. (2018). Virtual reality technology: The return of “body as a medium” in new daily life. *Yunnan Social Sciences*, (5), 179–184.
- Gatica-Rojas, V., & Méndez-Rebolledo, G. (2014). Virtual reality interface devices in the reorganization of neural networks in the brain of patients with neurological diseases. *Neural Regeneration Research*, 9(08), 888–896. doi:10.4103/1673-5374.131612 PMID:25206907
- Harpham-Lockyer, L. (2015). Role of virtual reality simulation in endoscopy training. *World Journal of Gastrointestinal Endoscopy*, 7(18), 1287–1294. doi:10.4253/wjge.v7.i18.1287 PMID:26675895
- Hasan, M. S., & Yu, H. (2017). Innovative Developments in HCI and Future Trends. *International Journal of Automation and Computing*, 14(01), 10–20. doi:10.1007/s11633-016-1039-6
- Hu, Y. (2010). Image-based modeling of inhomogeneous single-scattering participating media. *Chinese Science Bulletin*, 55(24), 2756. doi:10.1007/s11434-010-9986-8
- Hui, Z. (2017). Head-mounted display-based intuitive virtual reality training system for the mining industry. *International Journal of Mining Science and Technology*, 27(04), 717–722. doi:10.1016/j.ijmst.2017.05.005
- Mao, Y., Chen, P., & Le Li, D. H. (2014). Virtual reality training improves balance function. *Neural Regeneration Research*, 9(17), 1628–1634. doi:10.4103/1673-5374.141795 PMID:25368651
- Yi, L. (2014). Interactive operation of physically-based slender flexible parts in an augmented reality environment. *Science China. Technological Sciences*, 57(07), 1383–1391. doi:10.1007/s11431-014-5522-4
- Zhou, , Feng, , Rong, , & Wu, . (2011). Virtual Reality Based Process Integrated Simulation Platform in Refinery: Virtual Refinery and Its Application. *China Petroleum Processing & Petrochemical Technology*, 13(3), 74–84.