Computer Visualization Modeling Based on Virtual Reality Technology

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Abstract: With the rapid development of computer technology such as computers and networks, computer visualization modeling is becoming increasingly widely used. Through computer visualization modeling, people can make more exquisite designs for various things. However, due to limited technology, computer visualization modeling still has many shortcomings today. This article studied computer visualization modeling based on virtual reality technology, aiming to improve computer visualization modeling through virtual reality technology. This article tested the accuracy of computer visualization modeling using virtual reality technology through experiments, with the highest accuracy of 95% and the lowest accuracy of 86%. The accuracy of traditional computer modeling was highest at 79% and lowest at 72%. In terms of modeling costs, the use of virtual reality technology reduced the cost of computer visualization modeling by at least 11% and at most 20%. Through these experimental data, it could be known that virtual reality technology could achieve good results in computer visualization modeling.

Keywords: Virtual Reality, Computer Visualization, Visual Modeling, Computer Modeling

1. Introduction

With the development of the times, computer visualization modeling has become the focus of people's research, because modeling can improve efficiency and save time, while also saving costs. Nowadays, computer visualization modeling is still not perfect and requires more in-depth research.

Many scholars have studied computer visualization modeling. Al Ghazo A T believed that the purpose of computer visualization analysis and evaluation was to examine and describe the morphological principles of urban morphology, which were more permeable to future planning and design research and practice [1]. Migal L V believed that computer visualized three-dimensional evaluation was a particularly important and challenging topic, which involved automatically predicting visual comfort levels based on human subjective judgments. The most advanced visualization models typically minimized the distance between predicted visual comfort scores and subjective average opinion scores by training regression models [2]. The experimental

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results of Sudarjat H on a newly established three-dimensional image database indicate that computer visualization modeling could achieve better performance compared to models trained on three-dimensional visualization [3]. Although there were many studies on visualization, there was not significant progress yet.

Computer visualization modeling requires more in-depth research. The research direction of this article was computer visualization modeling based on virtual reality. Virtual reality technology, like other emerging scientific and technological fields, was a cross disciplinary and integrated product. This article tested the specific effectiveness of virtual reality technology in computer visualization modeling through experiments. The experimental data showed that virtual reality reduced the accuracy and cost of computer visualization modeling, indicating that virtual reality technology did have **good effects in computer visualization modeling.**

2. Visual Modeling and Virtual Reality Technology

2.1 Method of Computer Visualization Modeling

Geometric modeling: any object can be considered as composed of multiple geometric objects, such as human models, architectural model, etc., and can be expressed and processed with geometric information. The geometric features of objects are relatively direct, so geometric modeling is the earliest and most common modeling technique. Geometric modeling can be divided into two types: One is voxels, which are used to construct atomic units of objects, and their selection determines the range of objects that the modeling system can construct; the second aspect is in terms of construction, which is based on voxels and combines them to form a new object. On this basis, a multi-level 3D modeling method can achieve good results. The establishment of a hierarchical model is based on the tree structure in the data structure, and each part is described in a hierarchical manner. For example, a building model is a hierarchy of several objects, including the entire building, lobby, stairs, gates, windows, etc. When simulating or modifying a hall, the first thing to do is to build a gate. If the gate has windows, it needs to be built, and changing the windows would cause changes to the gate and hall. Therefore, this hierarchical model can not only demonstrate the integrity of the object, but also demonstrate the flexibility of overall model modification.

Physical modeling: Physical modeling is a method that combines particle systems with fractal technology to establish a particle based physical model. Fractal is a good modeling method that can be used to describe objects with similar properties. For example, when modeling mountains, rivers, and rivers, a random terrain model can be created using a triangle, and its three midpoints can be divided into four. Each midpoint is then assigned a fixed value, which can be recursively used to obtain a more realistic mountain and river. This method can be applied to targets with irregular and complex shapes, especially stationary targets.

2.2 Overview of Virtual Reality Technology

Virtual reality technology has characteristics such as immersion, interactivity, and conceptualization. This allows users to enter virtual computer scenes and interact with the surrounding environment. At the same time, the system can also respond quickly to commands entered by users and make real-time modifications to virtual scenes. Virtual

environment is a type of virtual reality [4-5]. It is typically generated by a virtual environment generator. The virtual environment generator responds to the instructions of active devices, which are sensing devices directly related to the users of virtual reality technology, and can perceive human actions and instructions. At the same time, the virtual reality scene generated by the virtual environment generator would transmit virtual reality information to people through corresponding sensors such as vision, sound, and touch, creating an immersive feeling. In virtual reality technology, the interaction between people is at its core [6-7]. The key technology in virtual reality is environmental interface technology, also known as "human-computer interaction" technology, which is a window between humans and computers. All of this is the foundation for building a virtual world. Generally speaking, the response to computer instructions should be fast and simulated. Display technology is more related to the physiology of the human eye and computer stereo imaging technology, while sensor technology is aimed at solving perception problems in human-computer interaction [8-9].

2.3 Common Tools for Computer Visual Modeling in Virtual Reality

Virtual reality technology has put forward higher requirements for real simulation environments, which requires object modeling to have realism and practicality. In today's rapidly developing technology, many software companies are constantly developing new model languages and software [10-11]. Virtual Reality Modeling Language (VRML) is a simulation technique used to describe three-dimensional objects and their behavior. A mainstream open programming tool that can define its own set of object set nodes, establish the required model objects, and use it for modeling is relatively complex, especially for large scene models, which is almost impossible. However, it is easy to enhance static scene effects, animations, and behavior scripts [12-13]. Computer modeling software is used to implement modeling tools required in some complex virtual environments. Among them, new design software is the most typical and popular. By constructing scene models through new design software and installing corresponding output plugins, scene model files can be directly constructed [14-15].

In addition to basic modeling and real-time rendering, subdivision surface technology that is more convenient and comprehensive than language modeling can also be used, and surface tools and various technologies can be flexibly selected to better complete the design and production of virtual reality models. In terms of selecting modeling software, developers should not only grasp the difficulty of the computer and the software itself, but also consider the need to build models and how to improve the image quality of graphics, so as to enhance the interaction effect of graphics, and compress or optimize scene models, file encryption, etc., when publishing [16-17].

2.4 Application of Virtual Reality in Computer Visual Modeling

The requirements of virtual reality systems for simulated environments are realism, dynamism, and realism. Designers are often restricted by the hardware conditions and the real-time requirements of the virtual reality system, so the modeling in the virtual reality system is different from the animation modeling based on character modeling. Here, most of the modeling would use model segmentation, texture mapping and other

technologies. Currently, modeling of virtual reality environments is generally achieved through two methods: model based and image based rendering [18-19].

Geometric modeling methods: Among many modeling methods, mesh modeling is the most basic. Due to the limitations of mesh modeling in creating smooth surfaces, it is mainly used to create low-level parameter objects without many complex details, including 5 types of sub objects such as nodes, boundaries, faces, polygons, and elements. By organizing these sub object nodes, they become elements suitable for precise control of mesh objects. The operation of the mesh refers to the node operation, which involves transforming multiple nodes to move, scale, or rotate the faces or boundaries of the mesh object [20].

Image rendering: Image rendering is a very important computer graphics, which can be used to reconstruct a real image from an image. The existing image rendering technology can be roughly divided into four types: panoramic image based technology, image depth based technology, and light field based technology. At present, the technology based on panorama is relatively mature. In traditional graphic rendering techniques, most scenes are designed. Therefore, during design, there would be complex modeling, materials, lighting, and other operations. Although using a series of complex budget calculation techniques and scene geometry simplification techniques can correspondingly reduce the number of modeling surfaces, ordinary computer hardware still finds it difficult to model these simplified geometric scenes for some highly demanding scenarios, such as large scenic tourist areas, production lines in factory workshops, etc. Therefore, it is necessary to consider how to design realistic graphics in this situation.

Panorama is a new graphic drawing method designed to achieve this goal. It uses a camera or camera at a fixed point of view to rotate 360 ° around the axis at a uniform angle to obtain images, and then inputs the collected images into the computer for splicing, integration and other processing to generate seamless panoramic images. Finally, the computer displays them through the projector and provides local limited roaming functions.

2.5 Visual Modeling of Virtual Reality Technology in Scene Design

The overall framework of the design scenario: Scene visualization based on virtual reality technology is mainly achieved using Computer Aided Design (CAD) systems. The overall framework of the virtual design scenario is shown in Figure 1:

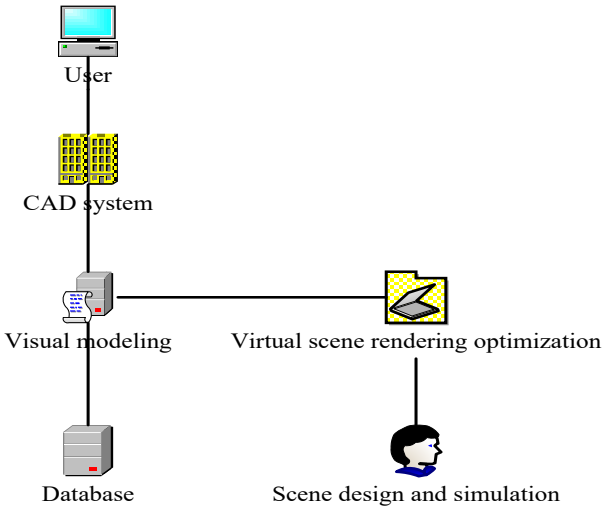

Fig.1 The overall framework of the virtual design scenario

Users can manipulate the parameters of the CAD system on the main interface, thereby controlling the design parameters during the scene visualization process. They can also use an immersive visualization modeling method based on realism to construct scene visualization, thereby optimizing the three-dimensional feel of scene visualization. The extraction of design material data is mainly carried out from the situational visual database. After adopting an immersive visual modeling method based on realism, the rendering effect of visualization was optimized.

2.6 Realistic Model Visualization Modeling Method

Combining virtual reality technology with scientific computing visualization technology is an immersive visual graphic expression method. When designing scene landscapes, designers can enhance their understanding of the internal characteristics of the environment. Due to the visualization methods in these two technologies, people can understand scene visualization works in an immersive manner, and also understand scene information in an immersive manner. The combination of the two can realize the rapid collection of 3D information of the scene, and plays a positive role in the determination of the vector space of the scene. Traditional geometric icons such as points and lines cannot accurately represent scene vectors, while technologies such as virtual reality and human-computer interaction enable geometric icons such as points and lines to accurately represent scene vectors.

2.7 Use of Algorithms in Virtual Reality Technology

People's perception of their surroundings is mainly achieved through visual channels, and the core technology of virtual reality technology includes visual channel design technology. When people look at external things with both eyes, the left and right eyes have binocular overlap, as shown in Figure 2:

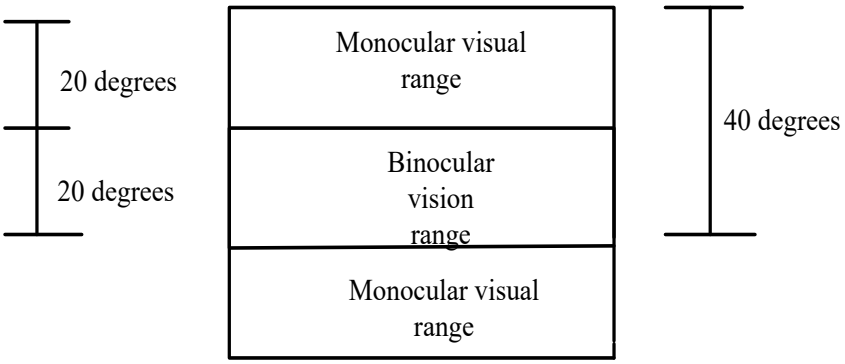

Fig.2 A condition in which the two eyes overlap

Therefore, in visualization, it is necessary to calculate the retinal image difference. If there are two objects in the front end of both eyes, the correlation between the distance a between these two objects and the lateral retinal image difference b is shown in Formula 1:

$$b = aH(R + aR) \tag{1}$$

In Formula 1, the distance between the left and right eyes is H, and the vertical distance between the right eye and the object is R.

The calculation method for the distance a between objects is shown in Formula 2:

$$a = \frac{bH^2}{H-b} \tag{2}$$

The calculation method for the distance H between the left and right eyes is shown in Formula 3:

$$H = R^2 + ab \tag{3}$$

3. Computer Visualization Modeling and Simulation Experiments under Virtual Reality Technology

In computer visual modeling, model segmentation, texture mapping and other technologies would be used for modeling. Therefore, the accuracy requirements for modeling are relatively high. This article focused on the effectiveness of virtual reality technology in computer visualization modeling. Therefore, this article would test the accuracy of modeling using virtual reality technology and traditional computer visualization modeling through experiments. This article conducted an experimental investigation on five sets of samples, and the test results are shown in Figure 3.

From the experimental results in Figure 3, it could be seen that the highest modeling accuracy of visual modeling using virtual reality technology was 95%, and

the lowest accuracy was 86%. The accuracy of traditional computer modeling was highest at 79% and lowest at 72%. From this experimental data, it could be seen that virtual reality technology had a significant effect on improving modeling accuracy. The reason might be that virtual reality technology could help better regulate the modeling process, thereby achieving more accurate modeling results.

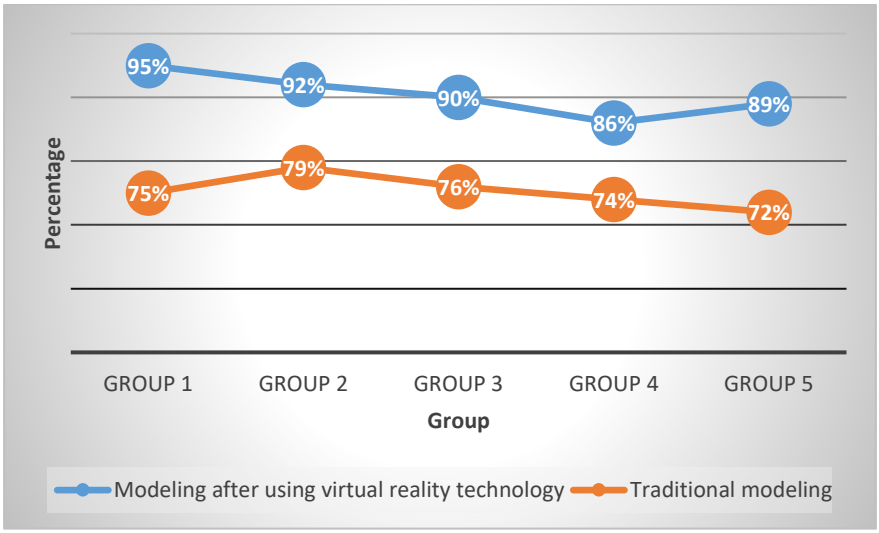

Fig.3 Comparison of modeling accuracy in computer visual modeling

Virtual reality technology could help better conduct computer visualization modeling, so this experiment aimed to test whether virtual reality technology could also have a certain effect on reducing modeling costs. This article selected seven groups of computer visualization modeling using virtual reality technology, and the degree of cost reduction compared to traditional computer visualization modeling is shown in Figure 4:

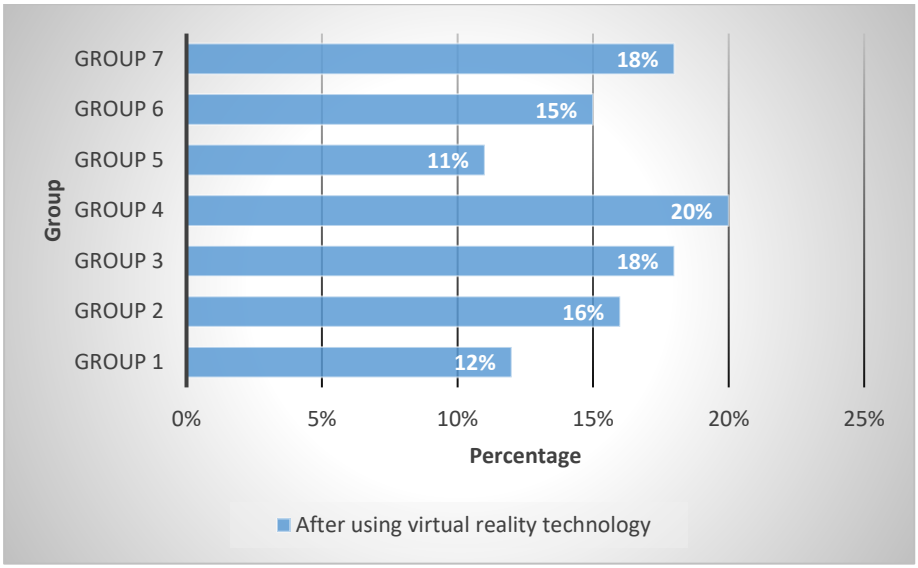

Fig.4 The degree of cost reduction compared to traditional computer visual modeling

From the experimental results in Figure 4, it could be found that the computer visualization modeling cost after using virtual reality was reduced by at least 11% compared to traditional methods, and the maximum reduction was 20%. From this experimental result, it could be seen that the cost of computer visualization modeling was significantly reduced after the use of virtual reality technology. The reason might be that virtual reality technology could simulate layout before starting modeling, which could reduce modeling errors and the costs.

4. Conclusions

Computer visualization modeling can be used in many fields and can play different roles in different fields. With the development of the information age, computer visualization modeling has become a familiar thing for people. However, due to the immature technology of computer visualization modeling, the effectiveness of visualization modeling is not good, so new technologies are needed to improve the effectiveness of computer visualization modeling technology. This article focused on computer visualization modeling based on virtual reality technology, which aimed to enhance the effectiveness of computer visualization modeling through virtual reality technology. With the support of virtual reality technology, computer visualization modeling would have better quality. This article tested the accuracy and cost of computer visualization modeling using virtual reality technology through experiments. The results showed a significant improvement in accuracy and a decrease in modeling costs. This proved that virtual reality technology could have good results in computer visualization modeling. Due to space limitations, the number of experiments conducted

in this article was not enough, and improvements would be made in the future. Finally, it is hoped that computer visualization modeling can become better and better.

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