Research on Urban Architecture Landscape Design Based on Virtual Reality Technology

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Abstract. With the continuous escalation of architectural design requirements, the continuous complexity of architectural models, and the integration of computer technology, virtual reality technology in architectural design has also emerged. The application of virtual reality technology in architectural design deepens the communication between professional architects and non-professionals, makes the architectural effect more intuitive, and effectively solves the communication barriers between architects and non-professionals. This article discusses the basic theory of virtual reality technology, and studies how to apply virtual reality technology in the landscape design of modern cities. On the premise of analyzing traditional landscape design methods, analyze the disadvantages of traditional landscape design methods; by studying the advantages of virtual reality technology, we choose to construct some scenes of urban architectural landscape design for virtual reality models. The article combines virtual reality technology with architectural design to effectively solve some of the shortcomings of traditional urban landscape design.

1. Introduction

In the traditional urban architectural landscape design, due to the lack of advanced drawing tools, designers mainly use manual hand-drawn methods when drawing design drawings. In this case, in addition to requiring designers to have good architectural design knowledge and skills, they also need to have a solid freehand drawing ability, which increases the designer's workload both tangibly and invisibly [1]. With the continuous development of computer technology, designers have gradually accepted the use of new technologies, new methods, and new technological media to help them create more valuable results. Computer technology and its application in architectural design have become an important part of architectural design itself, running through the entire process from architectural creation to final construction. Virtual reality technology (also known as "VR" technology) has emerged at the end of the last century. It is a comprehensive information technology that integrates visualization technology, artificial intelligence, multimedia technology, control theory, sensors, and network technology [2]. Through computer-aided design, three-dimensional simulation of real scenes is carried out, and a special virtual environment with realistic vision, hearing, and touch is generated at the same time. Virtual reality technology plays an important role in many disciplines with its strong fidelity, interactivity, and immersion. The requirements of modern landscape design are increasingly focusing on individualization [3]. This is the opportunity and challenge faced by the landscape design industry. The advent of virtual reality technology provides landscape designers with new creative ideas and extends their creative ideas and ways of thinking. At the same time, it also opened up new areas for landscape creation.
2. The Definition of Virtual Reality Technology and Its Architecture

2.1. Virtual reality technology definition
Virtual Reality, or VR for short, is also known as illusion or spiritual technology. It uses computer hardware technology and image processing technology to enable users to perceive a virtual environment through visual, auditory, tactile, and olfactory perception methods. With the help of unique output and input devices, to tour in a virtual environment, the virtual environment gives feedback to users, so that people can feel and experience as if they are in the real environment [4].

The virtual world generated by virtual reality technology can be called a "three-dimensional virtual world supported by computer technology, generated by a computer and carried inside a computer". The emergence of virtual reality allows people not only to feel the things in the objective world through the virtual world, but also to break the limitations of time and space and experience feelings that cannot be experienced in the real world. Virtual reality is essentially a computer that provides people with visual, auditory, and tactile sensations, and at the same time they can truly and naturally feel the virtual world, which is extremely convenient for people to use, thereby reducing people’s workload and making it a high job effectiveness [5].

2.2. Architecture of Virtual Reality Technology
Virtual reality technology is a comprehensive technology that combines computer graphics, sensor technology, interactive technology and network technology. The most basic requirement for virtual reality technology is to be able to realize real-time interaction with users [6]. Therefore, a basic virtual reality system is mainly composed of computers, input and output devices, application software and databases, as shown in Figure 1.

![Figure 1. The composition of the virtual reality system](image)

The virtual reality environment is an environment generated by the computer through the construction of a geometric model and a physical model that exists inside the computer and needs to be experienced with some special equipment. In this environment, it must be able to interact with the user in real time, and the user has absolute autonomy to be called a virtual reality environment. The structure of the virtual environment is shown in Figure 2.
3. The advantages and core technologies of virtual reality technology in urban landscape design

3.1. The advantages of virtual reality technology in urban landscape design

By using virtual reality technology to transform two-dimensional drawings into three-dimensional virtual scenes, users can experience design effects in a virtual environment, identify problems, improve work efficiency, and solve the scale problem between abstract thinking and actual space. Virtual reality technology can also play a great role in the construction process. As the engineering structure is becoming more and more complex, the existing computer technology can no longer meet the requirements of users [7]. However, through the use of virtual reality technology, it can target the actual project Supporting facilities are simulated and configured in a virtual environment to improve the accuracy of the project budget and try their best to reduce the impact of unreasonable planning during construction and cause rework.

3.1.1. Assist the designer to design the plan. The landscape designer makes plans by observing the plane, section and three-dimensional landscape, and chooses the material and spatial volume according to his personal imagination and past experience. The designer has an intuitive experience of volume, space and material through the sand table model, and the observation perspective Unlike the bird's-eye view method, designers cannot experience the simulation effect more realistically through other technologies. People use human-computer interaction and apply virtual reality technology to create virtual reality scenes. By clicking the mouse, they can experience and observe the design scheme from multiple angles. The design is more free and the sense of space is better grasped, so that the choice is more reasonable. The materials, space, lighting, volume, etc. can be compared with different schemes and combinations, weigh the pros and cons, find and repair existing problems in time, and reduce design errors. When designing, integrate yourself into the environment, give full play to imagination and design inspiration, and expand your thinking mode [8]. The above traditional observation and design thinking cannot be realized. In the design, the quasi-realistic technology is used to expand the space for use, making some undesignable landscapes simple. Using the human-computer interaction mode, the designer can better design the landscape plan with the assistance of the system. In actual application, by using virtual reality technology to create a three-dimensional space, breaking the traditional "horizontal vertical section" two-dimensional space model, extending the design perspective to the virtual environment, better control the size of the space, and more intuitive design of landscape solutions.
In order to highlight and create an overall landscape environment atmosphere, the expression means of landscape design has become the most important part of landscape design. By using the virtual reality environment space, the designer can more fully express the multi-dimensional space and form of the landscape, and provide unexpected expression methods for the details of the landscape environment. Compared with traditional landscape roaming animation, virtual reality technology has the advantages of high interactivity and relatively short introduction time. Designers can control the layout of the scene very conveniently and can make creations that cannot be completed in the traditional mode. When designing the landscape, the designer combined with actual needs to design many different types of landscape plans [9].

3.1.2. Multi-dimensional display design plan. The traditional landscape plan is realized in four ways when it is displayed, namely, section elevation, animation roaming, plane and rendering. The above-mentioned image display effect becomes better with the improvement of drawing level. Elevation, plan, and cross-sectional views are two-dimensional images that cannot display three-dimensional images. Animation roaming is a three-dimensional image in motion. The observation path and perspective cannot be changed. The observer is just an audience. The emergence of virtual reality technology has had a revolutionary impact on the design industry. Observers can give full play to their subjective initiative, observe and complete project design from multiple different angles. Observers can truly feel hearing, taste, vision, and perception in the virtual reality system; the design plan is connected to the Internet through distributed virtual reality technology, and the plan is released for others to experience the plan. After the designer completes the plan design, the observer uses real-time interaction and multi-dimensional panoramic mode design experience, and experience a feeling that is closest to reality. Traditional sand table miniature models, renderings, and roaming animations cannot be realized.

3.1.3. Realize the visualization of the construction process. Virtual reality technology can simulate the entire construction process of a landscape project, allowing construction personnel to demonstrate the rationality of the construction plan. Before the implementation of the project, it is necessary to analyze the forward-looking construction process, scientifically and reasonably control the construction progress, arrange the construction sequence, reduce hidden dangers in the construction process, reduce waste, and finally achieve a visualized construction process.

3.2. The core technology of virtual reality technology in urban landscape design

The establishment of a virtual reality environment is realized on the basis of a three-dimensional model, which can give full play to the characteristics of virtual reality technology. The small number of models, accurate modeling, and less storage space are the most basic requirements for building a three-dimensional model, and the three-dimensional model can be smooth in the virtual scene Basic guarantee of operation.

The production of three-dimensional models has always been an important focus of people in landscape design. After the completion of modern landscape design, the design plan needs to be displayed in renderings or landscape roaming animations, but different display methods have endless effects. The same, the production requirements for the model are also different.

In the process of designing landscape roaming animation, the requirements for comparison with static renderings are relatively high, and higher requirements are put forward on the number of model faces, because when roaming, the user's perspective changes with the movement of the lens. However, the landscape roaming animation is displayed to the audience in a fixed roaming path, and the audience can only passively browse along the established route. Therefore, the landscape animation can reduce the defects in making the model, which is difficult for the audience to detect. In the virtual reality scene, the audience will not be constrained by a fixed route. They can browse the scene freely, change the observation angle anytime and anywhere, and really browse without blind spots. This also requires that the scene model must be completely correct and not have Any errors, this puts forward high
requirements for model making. The current landscape design model is mainly produced by importing CAD drawings into 3DSMax or Sketch Up.

4. The process of virtual reality technology in urban landscape design and three-dimensional model construction

4.1. The process of virtual reality technology in urban landscape design

The design of the overall framework of the system is a crucial issue in the development of the virtual garden landscape system. The overall system framework is related to the following three aspects:

- What types of information need to be included in the virtual garden landscape system, and how many digital materials are there.
- In what structural form will the various information of the virtual landscape architecture system be organized and displayed.
- When users access and use the virtual garden landscape system, what kind of interactive interface and interactive functions will the system provide.

Figure 3 shows the overall process of constructing urban garden landscape through virtual reality technology.

![Figure 3. The flow chart of virtual reality technology to construct landscape design](image)

4.2. Three-dimensional model construction of virtual reality technology in urban landscape design

The digital architectural 3D model is the main content of the 3D virtual system of landscape architecture, and it is also one of the contents with the largest workload.

The 3D model building for the Quest3D platform mainly uses 3DSMax as a modeling tool, and AutoCAD can also be used as a modeling tool for more regular models.

The visual reality of the 3D building model in the virtual interactive platform is mainly realized by texture mapping. Making the texture mapping of the 3D model is also a task that requires a lot of time and energy. The texture map mainly adds the visual reality of surface materials to the 3D building model, and the baked light and shadow map adds real lighting effects to the 3D model. The purpose of this link is to make the virtual interactive system run more smoothly. Necessary model optimization and integration are required. The main tasks include the following:

- Simplify the number of faces of the 3D model and delete invisible model surfaces.
- Adjust the topological structure of part of the polygon model to have a better display effect in the virtual interaction engine.
On the basis of ensuring the display effect of the model, reduce the pixels of the texture file and save it in a file format with higher compression efficiency such as dds and png.

Place the adjusted model on the terrain 3D model according to the layout of the plan, and integrate it into a complete 3D model form.

Taking 3DSMax as an example, the process of model construction, optimization and conversion is shown in Figure 4:

![Figure 4. Quest3D composition structure](image)

5. Conclusion

With the continuous improvement and progress of virtual reality technology, more and more people use the technology to explore and research in various professional fields. Due to the multi-perceptual, interactive and immersive characteristics of this technology, it also provides creative space and platform for creators in various fields, and brings people various types of interactive experience. The unique virtual experience and technical advantages of virtual reality technology play an important role in the protection and renewal of historical buildings and the landscape design of specific geographic environments. Architectural and landscape design's demand for multiple types of experience and multidimensional experience outside of vision will further promote the in-depth application of virtual reality technology in architecture and landscape design, and will also elevate design technology and methodology to a new level.

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