Research on dynamic simulation of landscape design based on Quest3D technology

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Abstract

Virtual reality technology in the field of application in the garden is becoming increasingly broadly, the impact of landscape design is also growing. Virtual reality technology can be widely used in all aspects of virtual garden, and bring real benefits. Quest3D is one of the important software that virtual reality technology can realize. In this paper, a garden courtyard design is taken as an example, and a garden roaming display system is developed with Quest3D technology. The application of Quest3D technology in landscape design is expounded from the aspects of Quest3D technology selection, hardware and software selection and basic process. In this paper, the optimization and construction of the virtual reality system based on Quest3D are put forward in order to obtain better performance.

Keywords: Virtual Reality System, Landscape Design, Quest3D, Optimization.

1. INTRODUCTION

Landscape design refers to the use of garden aesthetics, art and engineering techniques, through the transformation of terrain, the allocation of plants, the construction of buildings and the construction of garden roads and other means to create a public environment for the public and visit the rest area process. To a certain extent, reflects the development of human civilization at that time and the value orientation and the designer's personal aesthetic concept (Liu et al., 2016). In the conceptual design of the project case, the use of virtual reality technology simulation environment, to create a “immersive” feeling, so that the public can directly face the design object, the formation of interactive communication. Therefore, the application of virtual reality technology in landscape design plays an important role in presenting the designer's ideas and intentions (Wang, 2013).

China's garden design industry is in a period of vigorous development, but also flourishing period. With the development of computer hardware and software technology, three-dimensional renderings, garden animation and other methods have been widely used in the display of garden design results, people can enjoy the project before the completion of the preview of the landscape effect, the virtual reality technology to join the garden Landscape design reached a higher level. Virtual reality let the designers in the interactive three-dimensional scene to examine, discuss and modify the design. This is what cannot be achieved by any traditional means of the past (Okutsu et al., 2013). In this paper, Quest3D is used as a tool to study the application and realization of Quest3D technology in landscape design by establishing a garden roaming display system. To help landscape designers to improve the level of business, better to achieve human-computer communication, to create a better landscape design works.

2. VIRTUAL REALITY TECHNOLOGY

2.1 Introduction to Virtual Reality Technology

Virtual Reality (VR) technology is one of the important science and technology in the 1990s. It is developed on the basis of scientific research such as computer graphics, computer simulation, artificial intelligence, computer network and human behavior. A cross - cutting science and technology. Virtual reality technology to computer technology, the use of computers and other equipment to create an audio-visual experience realistic three-dimensional virtual environment in a virtual environment, people can directly control the virtual object, and the system can also be real-time feedback to the user information, which also Which embodies the three
characteristics of virtual reality technology: immersion, interaction and conception. With the continuous
development of computer technology and virtual reality technology, it also promotes the application of virtual
reality technology in construction and civil engineering (Ma, 2014).

2.2 VR technology features

Virtual reality technology has four basic characteristics such as immersion, interactivity and imagination. A
typical VR system mainly composed of professional graphics processing software, hardware systems (including
VR and VR software, database), input and output devices and other components. Interactivity refers to the user
through the input and output devices, the scope of the object in the virtual environment is operational and the
degree of feedback with the natural environment, its user and virtual environment close to the virtual
environment in the interactive way is naturally desirable. The Immersive participation, also known as the most
important feature of virtual reality technology (Dörner et al., 2014). Users use interactive devices and their own
perception system, access to the virtual reality environment in the real level.

The use of VR technology in landscape design has had a tremendous impact, and virtual reality technology is
changing many aspects of traditional planning and design methods. On the one hand, it provides a new means of
artistic expression for the creation of landscape virtual reality technology: on the other hand, it makes the
landscape planning and design methods and ideas change. Computer network technology and virtual reality
technology aim to achieve network virtualization, so that more people through the network can see and hear
the designer's work, understand the design intent, participate in landscape planning and design.

2.3 VR technology in landscape design

There are many software tools to support graphics modeling. Because 3DSMAX has better support for VRML,
3DSMAX is suitable modeling software for landscape designers. It not only supports the output of the VRML
program, but also in the VRML program by selecting the camera in the three-dimensional scene in the
navigation settings, in the scene specified in the active controls and sensors, rich real-time browsing content. So,
for familiar 3DSMAX garden designers, VRML is a good choice (Dörner et al., 2015).

Landscape design in the visual modeling is the basis of virtual reality, but also the key to garden design, to make
the participants have a sense of immersion, we must create a real virtual world. The establishment of the
landscape is mainly composed of AutoCAD and 3DSMAX, the scene plan in AutoCAD after the introduction of
3DSMAX, the construction of the garden model, and then these elements are integrated, integrated after the
terrain model, such as the addition of buildings, Plants and so enrich the virtual environment, and finally get the
designer of the ideal landscape.

Dimensional graphics generation technology is more mature, the key is how to achieve real-time generation of
virtual scenes in the design of the larger amount of data, it is difficult to achieve real-time technical
requirements (Marghi et al., 2014). To this end, the need to configure high-performance computers, in order to
achieve real-time purpose, at least to ensure the quality of graphics and complexity under the premise of
increasing the refresh rate, which is the bottleneck of the development of the technology.

Designers in the garden design program release process, the need for a powerful interactive technology as a
support to facilitate real-time replacement of mobile scenarios in the element model, in order to review and
compare the rationality of the design (Yanet al., 2011); VR technology is interactive, system integration,
management Model identification and synthesis technology and other comprehensive use of technology, how to
use these technologies rationally, to maximize the design of the functional design concept is the landscape
design and application of VR technology key.

3. TECHNICAL REQUIREMENTS

3.1 Advantages of Quest3D technology

Quest3D is a powerful industrial or gaming real-time graphics rendering engine developed by the Dutch Act-3D
company. Its biggest feature is the inclusion of a number of standard functions as "channels", so that design and
development staff can really use the "building blocks" programming method to focus on their own virtual reality
system development. The entire engine is divided into three chunks: the editor, the browser and the SDK development kit.

Quest3D can be more easily create a tree, grass, flowers and other natural scenery, rendering time can maintain a surprising speed, distant objects slowly fade out, so that people do not feel their disappearance, can create a “thinking” Interactive objects and people, so that the object of walking, talking and so become a reality, but also provides a path search function, and Javascript can communicate(Xiang et al., 2010).

3.2 Quest3D technology on the hardware and software requirements

Based on the Intel core series or AMD APU series of CPU, 4096M or more memory, with more than 1024M graphics memory is now widely used by the computer configuration of the computer to meet the needs of Quest3D run; draw the scene using AutoCAD, modeling software using 3DSMAX, Map processing using Photoshop.

4. BASIC PROCESS

4.1 Development of the program

Select the classical courtyard for the garden display scene, the main area of the scene area of 3500m2, the number of scenes is expected to more than 100,000 the texture does not exceed 100M, are "mini" reality project small scenes. This program is relatively flat terrain. The scene includes several sets of classical buildings and a dozen garden plants.

4.2 Create 3D scenes in 3DSMAX

First in accordance with the design program to produce the scene of the elements of the model, and assigned to the corresponding material map, and then can illuminate the entire scene of the light, and finally according to set the field of view and visual high to determine the free camera (Freecamera) Lens type and position. Thus, the establishment of virtual reality environment and the production of computer graphics rendering process is basically the same, but the focus is different. The former is more concerned about real-time browsing fluency and sense of space, while the latter need is the static image rendering effect.

Therefore, in the creation of virtual reality scenes should do the following:

(1) To meet the visual requirements of the premise, to minimize the number of faces of the model. After the model is created, optimize it with Optimize in 3DSMAX to minimize the number of faces.

(2) Use instance copy (Instances Copy). Instance is the instance copy of the object, and when you change any instance replicas, all other replicas are changed.

(3) For some non-main objects, do not be too demanding, as far as possible the use of "simulated" geometry, such as the surrounding buildings can be directly used "geometry + map (box + map) way."

(4) The scene used in the map does not need very fine, it is best to use jpg format compression, and reduce the size. This can save a lot of download time.

(5) In Quest3D cannot use such as global light, reflected light, refracted light, shadow and other light effects, can only be used to make up the light lighting techniques. In addition, make sure that any corner of the scene can be illuminated by the light (since any corner of the virtual reality scene is likely to be browsed).

(6) Create a free camera in 3DSMAX to determine the field of view and visual high, contribute to the establishment of the model and the final rendering of the performance. But the Quest3D scene is through the camera to carry out, in the 3DSMAX scene in the establishment of different cameras, Quest3D cannot be used, so the introduction of Quest3D before the scene can delete the total camera.

Quest3D technology operation has five steps, the process shown in Figure 1.
4.3 Virtual scene

4.3.1 Construction of roads and lawns

Buildings, roads, sketches, and lawns are used in the same way, with language node modeling, or by using auxiliary modeling, with the editing, modification, and optimization of available software. The preparation of the language of the node to determine the shape of the material, through the image texture node, pixel texture node, texture coordinate node, texture coordinate transformation node to determine the texture and color.

4.3.2 Plant modeling

The method of plant modeling, the second chapter has been discussed, in the plant after the completion of modeling into the virtual reality scene is the main application. Here mainly use two mapping method First, first use the graphics processing software will be processed into a tree background without background format, and then directly as a map to give a plane. Second, the application of the line to describe the outline of the trees in the picture, and then apply the extrusion modifier extrusion height to close it to form a plane, apply the map assigned to the plane, the final application of the modified modifier to modify.
In order to solve a map in the scene cannot do multi-angle observation of the problem, the main application of two methods one cross. That is, copy the instance of the way to copy a copy, and then cross each other. This method is always very unpleasant when it comes to browsing, because it always sees the blurry of the other tree, and the effect is not very good. The method can be implemented through a node, or through an integrated standard. In the specific method for the first to create a check box, and then build a tree, and then the center of the two alignments and link, you can make the tree always aim at the camera. But in the output file will automatically in the Riga, so that the object can be any rotation, rather than around a specific axis rotation, so that when the user close will appear "tree was knocked down" phenomenon. You can use the "copy" function in the text editing software, replace "with", and make the statement a comment, and the browser will use the default value-the rotation of the axis, there will be no "tree down" phenomenon. However, it should be noted that, in the icon and tree alignment, we should pay attention to the direction of the axis, the application of the smallest point alignment, so in the scene roaming process, there will not be trees rising from the ground.

![Figure 3. Plant model](image)

4.3.3 Particle effect

The basic idea of the particle system is to treat irregular fuzzy objects as a number of particles of particles, and each particle has a common property, such as color, shape, size, survival, initial speed and so on. The particle changes its state in the process of changing with time, and the particle motion can be simulated by a controlled stochastic process.

In the actual work, a large number of natural phenomena can be constructed using the particle system, a particle system is composed of objects with different properties and some of their behavior consistent with the norms, the particle creation, disappearance and movement trajectory by the shape of the characteristics of the object control, thus forming a dynamic changes in the scene.

Each particle at any time to some of the properties and other particles to distinguish, commonly used in the location, shape, size, color, transparency, movement direction and movement speed, and over time changes in the occurrence of attributes. Particles in the system have to go through the "initialization", "update" and "death" stage, at a time all the active particles of the collection of particles constitute the model (Wanget al., 2016).

4.3.4 Modeling of pond effects

The texture coordinate transformation method is suitable for simulating slow translations of water and clouds, but is not suitable for generating pond water with occasional slight ups and downs. So in the system will use the average value of the average algorithm to generate pond water surface fluctuations.

The height of the pond water surface is stored in a two-dimensional array in which the initial values of each element of the two-dimensional array are initially set. When the system is running, each time a timer is started, and it changes the value of an element in a two-dimensional array and sets its value to a predetermined value. This value will affect the severity of the pond's surface fluctuation. The coordinates of the changed element are controlled by a random function, and then the two-dimensional array is traversed, and the value of each element is changed to the average of the values of the three elements around it. In accordance with this method repeated several times, they will continue to fluctuate, and there are ups and downs of the pond water surface height value of the array. Finally, the subscript of the two-dimensional array is taken as the value of the space point, the value of the array element, the coordinates of the space point, and then the drawing command is used to generate the pond surface.
4.3.5 Dynamic cloud and sky effect

The slow moving effect of clouds and streams is mainly achieved by texture mapping and texture coordinate transformation on the sky and river bed background. In the system set the corresponding static variables used to store the texture coordinates of the transformation value, each time the timer starts when the variable update, again drawing the updated using the new texture coordinates, you can better simulate the Clouds and water flow effects. Although it is very simple to realize the movement code of clouds and water by changing the texture coordinates, but also has a good simulation effect in the three-dimensional scene.

4.4 Output Quest3D files

Quest3D’s output plug-in a DirectX Exporter can be 3DSMAX model into Quest3D can import. X format files. .X file contains an object all the surface, texture mapping configuration and animation information, etc., can be directly into the Quest3D.

4.5 Create interactive effects for the scene

Quest3D technology is the most exciting is the scene of the interaction, the introduction of 3DSMAX model scenarios Quest3D provided in a variety of "channel" to achieve a logical link, each Channel has its specific function and logical order. According to the choice of different channels, the logical order of the arrangement and parameter settings, you can create a variety of interactive effects, of course, can also achieve a variety of effects and animation, such as the camera, halo effect, garden plants, background music Establish and control.

5. ADJUSTMENT OF THE VIRTUAL REALITY SYSTEM IN QUEST3D

5.1 Light treatment

Appropriate lighting is necessary to create a perfect scene. Light and shadow can give the user a visual impact. If there is no dark contrast, it is difficult to build depth effect in the scene. There are three types of lighting in Quest3D: point light, transmitted light, and directional light. The light source emits light in any direction. The transmitted light is defined by the outer and inner angles to form a gradual effect. Directional light only emits light in one direction. The rays of all directions are parallel to each other.

The color of the light in Quest3D can be set by its 'Diffuse'. The 'Ambient' vector is like a global 'Emissive' vector, and all objects in the scene are affected by it. You can control the lighting effects of a scene by connecting a Light channel to a Render. Only objects connected to the same Render will be affected by the light source. Each Render channel can connect up to eight light sources. This number is affected by hardware. The brightness of an object can be changed by its Diffuse and Emissive. You can set these options in the 'Object' tab of the Object Section. Larger Emissive means a certain degree of self-luminous or ambient light. Especially in the outdoors, adding Emissive (launch) will produce very good results. As mentioned above, the 'Ambient' vector of the light source is like a global 'Emissive' vector that affects all objects.

5.2 The use of halo

In the virtual reality scene, you can use the sun halo to contrast the atmosphere of the scene. In the Quest3D in the sun halo is composed of a number of pictures, these pictures can be used to produce Photoshop.

In 3Dmax to do a few planes to represent the sun and halo, to do a good job of the sun halo pictures were given to these planes, pay attention to these pictures should be with the alpha channel, in order to facilitate the display in the Quest3D transparent effect. After passing these scenes into Quest3D, enter the Object Section and set the transparent property to Add under the Surface property panel. And in turn adjust the self-luminous objects of these flat objects, so that the halo show different colors, the darker the darker the darker the color, the lighter the more light the more light halo.

In Quest3D, the halo on the scene and the different call module, a separate rendering. The intensity of sunlight changes with a program. In the call module set up a light intensity of the module flare intensity and a program control module Set Vector, through the Set Vector under the input value module and the output value module of
the two sub-modules for the control of the intensity of sunlight. The value of the input sub-module is represented by the position value of the sun on the display. When the mouse is moved or routed in the scene, the position of the sun on the display changes, passing this value to the output value, where the intensity of the sunlight. The value range is 0 ~ 1, the maximum intensity is 1, the minimum is 0.

Figure 4. Halo module settings

5.3 Use the routing module to give life to the virtual implementation

By adding a walking character or moving a car, the virtual world can be given life. These may be pre-defined, but sometimes more flexible solutions are needed. The role may have to stop at the traffic lights, the broken bridge or the front of each other, Path finding allows the dynamic line to be selected. AA routing depends on the segmentation point or 'nodes' set in the virtual environment. Objects can be sent directly to these nodes or path structures. Particularly complex environment, it is very important to set up a suitable path structure. In Quest3D, routing is handled by two channels. The first is a three-dimensional graph, which stores all the nodes and path structures. In Quest3D, routing is handled by two channels. The first is a three-dimensional graph, which stores all the nodes and path structure information. The other is the Motion Planning channel, which calculates the shortest path from the current location to the destination through the path.

The collision object can be connected to the first sub-connection of 3DGraphchannel. Another branch of T3DGraph also requires a Collision Object channel. The object is used to determine the line of sight during the path calculation. The two collision objects can be the same. Suggest in any case, keep them as much as possible 'lowpoly'. That is, we can create a simplified three-dimensional model, and through it to achieve the collision.

5.4 HLSL applications

HLSL is the abbreviation of the High Level Shader Language, which is a program that can be manipulated against a 3D object and executed by the CPU. Through these procedures, programmers will be able to get most of the desired 3D graphics effects. In a 3D scene, it typically contains multiple shades. Some of these Shades are responsible for processing the 3D object surface, and some are responsible for processing the texture of the 3D object. HLSL’s main role is to deal with complex images, quickly and efficiently on the graphics card to complete, compared with the combined or Low Level Shader Language, can reduce the preparation of complex special effects when programming errors occur.

In Quest3D, HLSL is used to make some surface effects, such as surface reflection, simulated wave fluctuations, hair effects, film effects, cartoon effects and so on.

5.5 Sound effects settings
From a simple click menu sound to complete environment music, can be added to the scene. Like brilliant graphics and lifelike animations, the sound helps create the atmosphere of the scene, increasing the realism of the scene. Quest3D supports sound formats that are `.wav` and `.mp3` files.

![Diagram of sound module settings](image.png)

**Figure 5.** Background music module settings

When roaming in the scene, press the P key, trigger the trigger, pass the input value to Play Sound, and then activate the following sub channel Sound Command to play the music file in the Sound File. Press the Backspace key, trigger the second trigger, pass the input value to Stop Sound, Stop Sound and then activate the following sub channel Sound Command, thus stopping the sound file in Sound File.

The value of the sound dot field specifies the intensity of the sound emitted by the sound transmitter, that is, the volume. The field value changes in the range. Indicates that the volume is the largest, which is mute. The value of the field specifies a three-dimensional coordinate in the current local coordinate system that represents the position of the sound transmitter. The value of the field is used to specify the priority of the sound. The value of the field provides a sound source for the sound played in the scene. The field value is the node or node used to create the sound source. Specify whether to achieve the sound three-dimensional, that is, after the sound through the digital processing, so that the viewer can hear the sound at the same time can feel the sound transmitter in the three-dimensional space of the specific location, so as to achieve three-dimensional effect. The value of the field specifies the straight line distance in the current coordinate system from the direction in which the sound transmitter is located along the direction specified by the area, and the sound is not heard beyond this distance. The value of the field is set to be greater than its default value.

6. CONCLUSION

The modeling of the scene is done in 3DSMAX, and then the model file is converted to Quest3D file. In the course of the study, the garden model is classified and studied separately, and the interactive effect is created for the scene. Through the browsing of the virtual reality, the application of Quest3D technology in the garden design is realized.

The 3D model created by the computer is composed of the face, the more complex the model, the more faces it will use, and the higher the computing speed of the computer. Landscape elements commonly used in landscape design, such as plants, changing terrain, water, etc. are irregular shapes, with the computer model that will be very complex, such as a tree itself has thousands of leaves, made model After the use of the surface can reach millions of orders of magnitude, these complex landscape modeling model into the Quest3D will affect the software running speed, resulting in cannot achieve the desired results or cannot achieve virtual roaming, so to achieve landscape modeling in Quest3D In the simulation or artistic effect, but also need to further study the simplified modeling method.

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