

# Research on the key technology of urban planning virtual emulation system base on openGL

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## Abstract

3dmax software is a tool of three dimension model. VC is a platform of development. OpenGL is interface of graphics. Urban planning three virtual emulation system is developed. The key technology is researched: 3dmax texture render, three dimension model reading and demonstrator, DirectSound sound effect control, LOD, sun shadow analysis. The system is a successful application of urban planning virtual emulation.

*Keywords:* virtual reality; OpenGL; 3dmax; LOD; sun shadow analysis

## 1 Introduction

In the past ten years, the way of CAD-based graphic design has played an important role in the field of urban planning design. However, the way of CAD graphic design is lack of the effect of three-dimensional and intuitive, making it difficult to assess. The general practice is to use of expert knowledge and experience to determine or to demonstrate achievement of the final plan though the three-dimensional animation. But it is only a passive display by the three-dimensional animation, can not be human-computer interaction. The introduction of virtual reality technology has changed this state. It can simulate current and future city vividly though the three-dimensional modeling, analyze the data, program verification and optimization, data query and spatial analysis, through detailed data and related information can conduct program evaluation, audit and management of the daily work intuitively and truly, and can provide an effective platform for multi-sectoral and collaborative work. Since the virtual reality technology the most mature and the most extensive area is the entertainment industry, especially the game, the key is the online game in the moment, its growth rate is very rapid. Therefore, this paper will draw a three-dimensional game engine development methodology proposed design goals of urban planning virtual reality simulation system. using OpenGL to read the 3dmax Three-dimensional scene, as a development platform VC come to realize the three-dimensional planning virtual scene animation, interactive walkthrough, commentary, navigation, program switching, three-dimensional model import and movement functions, the key technology is researched: 3dmax texture render, three dimension model reading and demonstrator, DirectSound sound effect control, LOD, sun shadow analysis.

## 2 Technology roadmap

Urban planning virtual reality system is based on the

construction of detailed planning content. According to provide spaces layout of the buildings, roads and green and landscape planning and design of the overall plan, import the floor plan to 3dmax to establish roads, landscaping, construction, pipelines, and other municipal facilities 3D scene, reads the three-dimensional model using OpenGL, add animation and walking camera, analysis the planning scheme though sunshine, to realize the Animation walk to walking along the path and freedom to roam by use of the keyboard as well as the switching functions of between different options. The overall urban planning of virtual simulation system structure shown in Figure 1.

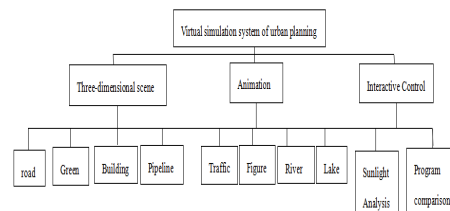


FIGURE 1 General Structure of Urban Planning Virtual Reality Emulation System

## 3 Key technologies

### 3.1 TECHNOLOGY OF RENDER TO TEXTURE

The so-called render to texture, is defined according to the construction of detailed planning program by offered to make the three-dimensional model in 3dmax, after rendering of lighting effects being brought to the material, then use OpenGL to read the after render material re-mapping, to make the three-dimensional scenes with realistic effects. This method is also commonly used to make the three-dimensional scenes of game. Complete map and lightmap texture can be used when rendering, after rendering the former have large map, image clarity, but poor lighting effects, the latter occupy less space, lighting effects

is good , but the image is not clear,among the practical application of the two can be used in conjunction with the display requirements.Related parameter setting method shown in Figure 2.



FIGURE 2 Virtual simulation system of urban planning

3.2 THREE-DIMENSIONAL MODELS' READS AND STEREOSCOPIC DISPLAY

To load the model after it was rendered into 3dmax,OpenGL is an open graphical development library,the same time interactive control can be achieved on the model,we can use VC as a software development tool, calling OpenGL function libraries for reading and three-dimensional display the models. OpenGL working mechanism as shown in Figure 3.

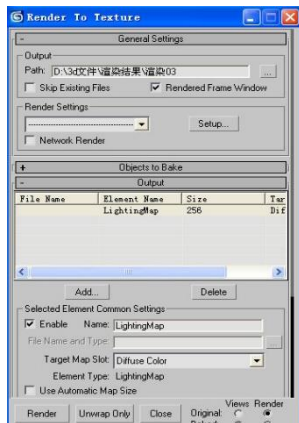


FIGURE 3 Render texture parameter design

3.3 DIRECTSOUND SOUND CONTROL

It is need to add a variety of the sound effect when making the three-dimensional landscape Virtual Tour, such as water, transportation, and other sound of plant machinery roar, to assess the noise impact on the environment. There are a variety of methods to simulate the natural sound, one method is based on the reflection principle of hearing, the methods of procedures to trigger sound object ans respond is based on the distance of viewpoint objects near or far. The basic principle is: when the officers entered the object to a certain distance, the sound objects trigger a response, for example, we are able to hear the sound in 5 meters. The sound objects trigger message response will closed when the object is away from 5 meters. People can not hear the sound.3D sound API functions are DirectSound, A3D and OpenAL. DirectSound, DirectX is designed to handle the part of audio, music and capture and the input sound.Based

on the basic principle, we use API functions of DirectSound provided to complete the sound trigger message response.

3.4 LOD IN REAL-TIME DYNAMIC

The calculate storage requirements of cities virtual reality simulation scenarios to far exceed the processing power of computer graphics hardware,in order to reflect the hree-dimensional landscape more realistic,use a levels of LOD detail to model landscape simulation. The basic idea: Generate multiple versions with different levels of detail on the same model,in the graphics rendering according to viewpoint to select the appropriate level of detail to draw.If a model under the condition of far viewpoint, select a coarser LOD to draw, if the model close to the viewpoint, then choose a higher-resolution LOD draw.

Currently the polygon mesh is used to describe the physical model in three-dimensional scene.There are two types to structure LOD models, the Discrete resolution LOD model and the continuous resolution LOD model. Study on analysis and comparison of the two models, and practical application in highway route system, using the scheme of combination the two models together effectively, can control the complexity of the scene effectively, and also conducive to conserve computer memory and the time overhead.

3.5 SUNLIGHT ANALYSIS

Sunshine analysis is an important part of the construction of the planning and design to homes, hospitals, schools and nurseries and other buildings,the basic principles of dynamic simulation sunlight on a buildings on the computer are: assuming an arbitrary vertical height H of the rod on the ground at the point O, on the situation of known solar elevation angle and azimuth at the moment. Sun shines the rod on top of a floor projection is a ', the rod shadow length Oa 'L is obtained by the following equation  $L=Hctghs$ , and azimuth of stick shadow  $A'sA's=As+180$ , above is the basic relationship between the rod and the shadow shown in Figure 4. Because there are different building height, according to the above-mentioned rod and shadow relationship, when ctghs constant, L and H is change in proportional. If the graph H of object height and length of the shadow as a unit height in Figure 4, you can find units long shadow L. If the bar high from H to 2H, 3H, ..., then the shadow length to 2L, 3L, ... shown in Figure 4.

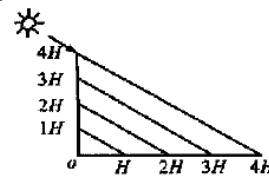


FIGURE 4 The Relation of height and shadow

4 Conclusion

Virtual reality technology is an extremely realistic simulation people's vision, hearing, moving and other acts in the natural environment of human-computer interaction technology.Wide range of applications,including aviation,

aerospace, shipbuilding, railway, construction, civil engineering, scientific visualization, medical, military, education, entertainment, arts and sports. In this paper, virtual reality technology is introduced into the field of urban planning, learn from the three-dimensional game engine development methodology, the 3dmax as a modeling tool, VC as a development platform, OpenGL as interface of the three-dimensional image developed the virtual reality simulation system of urban planning, the system display the relationships of different architectural scheme and the neighboring building community. A true representation of the space relationship between planning architecture and architectural status quo, and to modify the height, direction, volume, color, etc timely, so that the planning reviewers and decision-makers can observe from multiple angles visual contrast multiple planning and design programs to help the plan policy makers more clearly visually confirm reasonable solution to improve the planning and management levels, reduce decision-making errors and blindness, improve the quality of planning review and enhance the scientific nature

of assessment decisions, virtual reality technology is a successful application in the field of urban planning.

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