Study on the Virtual Reality Based on ComGIS and OpenGL

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Abstract: With the perfect of 2D GIS technology, the current research has been focusing on 3D GIS technology gradually. But there are some choke points in the 3D GIS studying at present, for example: how to create the terrain model and object model and how to achieve the real-time display in deed. Aiming to these problems and introducing the predominance of 2D ComGIS technology and OpenGL technology, then the author put forward a method which was integrating the ComGIS technology and the OpenGL technology in virtual reality studying. At the same time, the author discussed the key technology in simulating the terrain and the object, texture mapping and roam in 3D scene. Taking this method can not only hold the technology predominance of ComGIS in development, but also achieve high realistic virtual reality by using OpenGL software. As a result the system will be with a good man-machine interface, simple operation and intuitionistic display. This preliminary exploration will provide a new way in studying the virtual reality technology.

Keywords: ComGIS; OpenGL; 3D GIS; VR

1 Introduction

Virtual Reality (VR) technology is an advanced technology of the human-computer interaction, it could create the realistic artificial environment by applying many technologies synthetically, and simulate human's vision, hearing, touch and other perceived effectively in the natural environment[1]. It is a synthesis technology, which consists of computer technology, sensing and measurement technology and simulation technology and so on. Willian Gibson American scientist put forward it in 1984, but a lot of scholars thought that another American scientist named Jaron Lanier truly endowed the scientific meaning to "virtual reality" [2,3] , he proposed that everyone used the "Virtual Reality" to describe this new human-computer interaction technique uniformly. VR technology is considered to be one of the most important technologies that have a significant impact on people's lives in 21st century[4~6], it provides a platform for a lot of professionals to study, communicate and work.

VR has three prominent features, namely the "3I" features[6]: illusion of immersion, the virtual world generated by computer gives people an immersive sense; interactivity, you can communicate or interoperate with the objects which is in the virtual world by a natural way; imagination, people can immerse themselves in the virtual environment to learn and improve the recognition level of the emotional and rational, which allows users to understand the concept deep and generate some new ideas. At present, the research and application fields related to VR mainly contains[7~12]: military, medicine, psychology, education, scientific research, commerce, film and television, entertainment, manufacturing, engineer training and so on, Moreover, with the development of VR technology, it will demonstrate more extensive prospect in application.

2 Summarization of OpenGL

Open Graphics Library (OpenGL) is a 3D graphics function library, it is also an excellent application programming interface (API) and independent of hardware [13~15]. OpenGL is an open graphics industry standard, it is a high-performance developing package for protracting high realistic 3D graphics and achieving interactive scene simulation and VR. Because Microsoft Windows NT provides a dynamic link library for OpenGL, the corporations at home and abroad have launched the 3D

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graphics accelerating card for hardware-accelerated aiming to OpenGL，so you can achieve the real-time 3D display by configuring a graphics accelerating card, which is completed only in the workstation of SGI in the past, that will provide a broad prospect for OpenGL in application. It is the only truly open and cross-platform graphics standard with the characteristics of high reliability, good scalability, good scalability and easy to operate[16], and OpenGL is a low-level graphics API interface, it can keep up with the needs of the latest development in hardware and computer graphics. As an efficient graphics developing package, OpenGL consists of more than 100 graphics functions which are divided into four groups[17]. It can achieve the functions of 2D and 3D modeling, projection transform, processing the light and color, texture mapping, animation and real-time interoperation smoothly. And it provides a direction for further achieving the operations of 3D GIS in rotation, zooming, roaming, search spatial and attribute data interactive, calculation distance of the terrain and search in wide range.

3 Summarization of ComGIS [18~21]

3.1 Definition

Component GIS(ComGIS)is a branch of GIS, which adopts the object-oriented technology and the component idea, among the GIS components or the GIS components and non-GIS components, you can create the applications and basic platforms of GIS through the method of integration the visual developing tools of the software. At present, most of the GIS software companies regard developing ComGIS as an important direction. MapX is the component production of the company named MapInfo, its characteristics are fast, easy to operation and powerful, and it has most of the MapInfo Professional's functions. MapX can realize plenty of the GIS functions such as data visualization, thematic analysis, search geographic information and geocodes by setting the properties or the corresponding method of transfer events in the visual environment of the VC + +, Delphi or VB.

The interface is the key between the components software, you must use the same interface standard so that the components can communicate each other easily.COM not only provides the standard of the interface, but also introduces the idea of the object-oriented. Component modules provide the space for the activities of the COM objects, COM objects provide service by the interface approach, which is known as COM interfaces（figure 1）.

3.2 Advantage in technology

(1)Convenient developing for GIS

The basic idea of ComGIS is to divide the major functions of GIS into several controls and each one completes the different functions. Controls like a pile of varied building blocks, they can achieve different functions (including GIS functions and non GIS functions), according to the needs, you can constitute applications by building the "building blocks" which have various functions.

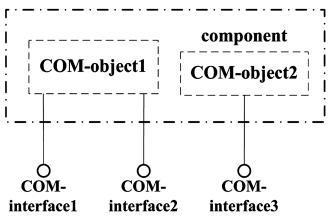

Figure 1. The relation of COM, COM-object and COM-interface

(2) Powerful GIS functions

At present, components of ComGIS are all based on 32-bit system platforms, they take the form of calling directly in process, so both the ability of data management and the processing speed are not worse than the traditional centralized GIS software. ComGIS also can complete the spatial processing capabilities such as stitching, cutting, congruence and buffer zone, plenty of spatial search and analysis capabilities by making full use of the excellences of all kinds of developing languages.

4 Key technologies for creating VR

Because VR technology is extremely complex and still in the development stage, it must be real-time, have the inherent maintainability and scalability, the key technology is the object-oriented. So the component

technology of the object-oriented combining with OpenGL has its unique advantages. VR system mainly consists of the VR generator subsystem and I/O subsystem of tools processing (figure2).

4.1 platform and tools of developing

We adopted Windows2000 as the operating system, MapX the component of MapInfo as the developing platform, because MapX encapsulates a large number of functional modules, such as zoom in, zoom out, roaming, they were all achieved by the simple code or setting controls' properties, and the interface was friendly; in 3D graphics library aspect, we took OpenGL which is popular at present as the base and VC++ as the developing tool. So the objects not only had the properties of the appearance, texture and so on, but also possessed the effect of 3D display and the powerful GIS features.

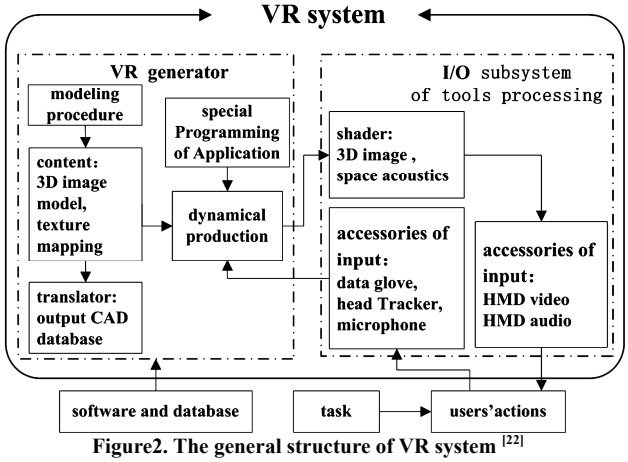

Figure2. The general structure of VR system [22]

4.2 simulating the object

It is complicated to simulate the object due to the features of the relative discrete and the different forms, therefore, in order to achieve good visual effect, we can use the 3DMAX software to build 3D models and then deal with them with the OpenGL software, for example, for the object with the complicated structures, we can use the technology of levels of detail(LOD) for multi-level processing and expression. Under the promise conditions of insuring the picture-visual effect, we can reduce the geometric complexity of the scene by simplifying the surface details of the scene successively, thereby the efficiency of rendering algorithms is enhanced. There are a lot of algorithms, by comparing with other algorithms, we found that the vertex clustering brought forward by Rossignac and his partners could simulate the complicated object perfectly, and the steps of the algorithm are as follows[23]:

(1) According to the changing degree of the object features, you must empower the value for each vertex, the greater weights are given to the points with the bigger changes in features

(2)According to the complicated degree and the relative size of the object, you must divide the space held by object into many cube elements.

(3)Calculating the representative points located in the cube elements.

(4)Taking the representative points to replace the same points in the same cube elements and remove the degradation polygon away.

4.3 simulating the terrain [24~26]

Terrain is one of the most complex nature scenes, you must use the real coordinate data to create 3D realistic terrain, then many researchers would like to use the Digital Elevation Model (DEM) to achieve terrain simulating, which has the real, intuitionistic and high-precision characteristics, the general making steps are as follows: at first, you must obtain the high-precision sampling points in study area, and then interpolate the sampling points, according to the foregone points, you can create the triangulated irregular network to simulate the terrain, finally, you ought to import the DEM into OpenGL software to enhance the visual effect by texture mapping, so that you can access the high precision simulation of the terrain.

4.4 texture mapping

Texture mapping is the process of taking the texture pixel in the texture space mapping to the pixel of the screen space. It is an important part in rendering highly realistic image, you can create the realistic graphics easily by texture mapping technology, without having to

spend too much time to consider the object's surface texture. However, the process of loading the texture may affect the running speed, which is particularly evident, if the format of texture image is great. How to manage the texture properly and reduce the unnecessary spending, these are the problems must be considered when you optimize the system. OpenGL provides a technology named management texture object to solve the above problems. It is very complex in the process of texture mapping and mainly contains two parts: texture definition and filtering control [25].

4.5 roam in 3D scene

The main work of Virtual scene roaming focuses on the 3D modeling, good or bad of the 3D modeling will affect the quality of the VR system directly. As the relationship between the fidelity of the 3D scene roaming and the modeling is closely, in order to get realistic drawing, you need to elaborate on the models, that will waste a lot of time, and the model created is also very complex. The real-time effects are not achieved easily, due to the constraint of the machine performance during the rendering, so you have to get a compromise between the precision extent of the models and the rendering speed. That you must not only guarantee the quality of the drawing, but also ensure the rendering speed is abided by most researchers.

5 Conclusion

VR is still a new discipline, which will have far-reaching impact for the promotion of the scientific and technological advances. In recent years, with the development of the computer's software, hardware and the related disciplines, VR technology has being applied to more areas, but there are also some choke points for the development of the VR technology, due to the limitations of the current technologies. The method of combination ComGIS and OpenGL and implement to VR proposed by the author has its own unique features, it will provide a new idea for the researchers and software developers.

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