Virtual Digital Campus Roaming System Based on User Behavior Analysis

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Abstract: Design of virtual campus system has an important positive influence on digital management of school. Firstly, I designed the scheme and process of virtual campus system development by using 3DS MAX modeling software and VR-Platform platform editor, which is feasible, and the tools are easy to learn and the process operation is easy; then I analyzed and compared the geometric modeling method and image modeling method, and adopted joint modeling method based on it, and carried out analysis and comparison on various objects of campus models, and selected a suitable method for modeling, which can reduce the data volume and ensure the reality of object model; finally, I summarized a mature modeling process in entity modeling, and orderly completed the modeling work of Anhui Polytechnic School by region, module and step from data collection, entity modeling, material and chartlet design and integration of baking and scene, and I also carried out key design for model optimization, including replacing non-standard shape model by standard geometry, elimination of redundant surfaces and so on, and they have effectively reduced the capacity of model.

Keywords: Virtual reality; Virtual campus; Entity modeling; OpenGL; VR-Platform; 3DS Max

1. Introduction

As a part of the virtual technology, virtual campus realize the screen display of computer graphics, image processing technology and 3D visualization language, and it also realize the functions of roaming, human-computer interaction and so on. This paper takes the Yangquan College campus of Taiyuan University of Technology as the virtual space, mainly to realize the terrain and building modeling, and omni-directional observation, and realize the roaming function in the virtual space, so that the observer can have an immersive feeling when he/she does not need to arrive on the spot [1]. These advantages make virtual campus system enable students and parents have an immersive feeling of the beautiful campus scenery, excellent teaching environment by interactively simulating and they can choose the visit route and specially select the visit area at their wills. It can deepen their perception and understanding of campus, and provides better platform for the campus’ development plan, and it also has important guiding significance for teaching resource management, school development and other aspects[2-6]. At present, many colleges and universities have designed a virtual campus system, and virtual campus roaming system is the inevitable trend and fashion for digitization and informatization of campus management.

2. Virtual Campus Design and Entity Modeling

2.1. Design of Virtual Campus Roaming System

System design requirements: (1) complete the terrain and building data collection of virtual campus; (2) complete the establishment of main building model in virtual campus; (3) treat the texture and chartlet; (4) complete the design of system interface and implementation of tree; (5) realized the roaming in the overall campus.

Basic functions of graphic operation: it mainly realized the scanning function of maps and scenic pictures, and provides the basic operations of maps, such as panorama, amplification and mitigation’ manual roaming[7-13], in order to be convenient for campus management planning, many interactive functions are provided are designed and developed in virtual campus system, and interaction of users and system can be realized by mouse and keyboard. It can be moved to up, down, left and right though w, a, s and d key and the mouse controls the direction of advance. Users can effectively locate the latest campus information for users to access.

2.2. Modeling Process

Scene modeling is the key step in moving the actual display object into the virtual system, and it is also the most complicated and time-consuming process in all workflows. The project is modeled with 3DS MAX. Modeling of campus objects can be divided into overall modeling and partitioned object modeling. Data volume of overall modeling is very large, which greatly affects the running speed of the system. And it may also cause inconvenience for updating and expanding of virtual campus system in the further campus reconstruction. So it is necessary to divide the campus into several smaller sub-modules, such as school gate, teaching building, office building, dormitory, green belt, lawn, playground, etc., before modeling, and then take detail design and modeling for these smaller sub-modules. Sub-scene shall be created and finally combine all sub-modules in 3DS MAX and generate the whole virtue campus. It can ensure that the computer resources have been rationally uses and operating efficiency of the system is improved. Modeling process is shown in Fig. 1.
3. Implementation of Virtual Campus

3.1. Construction of Virtual Campus Entity Model

In the virtual campus system, for the aesthetic needs, I will not display the storefronts at the right side of school gate, and use joint modeling method for school gate modeling. Architectural structure of school gate adopts geometric modeling method to carry out polygon graphical modeling, while electrically retractable doors use image modeling. And fully expansion method is used in effect to highlight the solemnity effect. The modeling process is: we set the size parameters and shape information in 3DS MAX according to the size information of school gate and image data of electrically retractable door collected in early stage and based on the modeling principle of “from coarse to fine and from easy to difficult”; we assemble the cuboids and other basic geometrical shapes and corner cuboids and other extended primitives to form the outlines of school gate. And then we shall carry out further detail adjustment for visual information, remove the line, surface, angle which cannot be seen on the surface, adjust the 3D coordinates of each sub-module, and then add the image modeling of expanding electrically retractable door into the geometric modeling results. And the modeling process is shown in Fig. 2.

3.2. Modeling Method

In OpenGL, we can draw points, lines and polygons, and we can almost construct all 3D models by applying these basic forms. Considering the rendering speed, triangle is mainly used for modeling in the paper. In OpenGL, we can create triangle by editing codes, but we shall specify three vertices of triangle and so we need to write many codes and it may cause a lot of redundant codes in the whole modeling process. In order to solve this problem, I adopt the method of reading text in the Paper to reduce the redundancy of codes. In the process of modeling, we define the step function DrawStair (), side function DrawWall (), horizontal function DrawFloor () to complete establishment of various models.

3.3. Construction for Final Model of Virtual Campus

Construction for final model of virtual campus is completed in function DrawGLScene (). The function is cyclically used in main function WinMain () until the program exits. Its drawing effects are shown in Fig. 3.
4. Development Process of Virtual Campus Roaming System

Then I will describe the development of 3D visualization system by using visual program language VC++ 6.0 and OpenGL and development process of campus 3D visualization system in the following content.

In the process of creating a virtual campus, data collection on the building is very critical. As all buildings are different in appearance in virtual campus system, their chartlets are not the same. So it is really a difficulty in design. As we shall collect the front view, so when we take pictures with a digital camera, we shall keep it in a horizontal line with the picture.

We processed the collected digital photos by photoshop, such as after we processed the step chartlet, step color has become light in the bottom and dark in the top, resulting in a sense of hierarchy, as shown in Fig. 4. We processed all building pillar chartlets and make it looks 3D, as shown in Fig. 5. If it is of the same color, it will look as if there is no edge and it will lose realism. In addition, chartlets adopted in the paper are all square. Some chartlets also need re-pasting. Such as the narrow brick road at the grassland of college, it realizes up and down, left and right symmetry. It looks coordinate when they coincide together. Effect of chartlets after treatment is shown in Fig. 6.

Implementation of the tree is achieved by defining a similar Tree. Because shapes of trees are not as regular as the building, its construction is quite complex. In this paper, the modeling process is as follows:

At present, tree modeling method which is used often is cross method. It has simple operation, high efficiency, significant 3D effect, good practical and less impact to the operation speed and real-time of the system. So this method is used in the project, and the model can be directly replaced by captured images. Firstly, we shall establish simple facets, and paste the collected tree chartlet on the simple facets after
certain treatment, and set transparent chartlets which is not at the trees and hide then. Then we copy the facets and realize 90 degree rotation and tree modeling can be completed when two pictures have been crossed combination, as shown in Fig. 7. Trees modeled by cross method can make corresponding changes according to the change of visual angle when the user is roaming. It shall always face the direction of visual angle and make the line of sight face the front of trees.

However, cross-model trees also have some shortcomings, mainly in: (1) it has some impact on the roaming of system, such as some smaller width paths, as setting of two cross faces may result in the larger bounding boxes of tree models, these tree models may be inspected into the sight during roaming, make the sight have unnecessary shelters and affect the observation effect of roaming; (2)in processing of tree shadows, shadow area under the tree may increase due to manual sheltering of two surfaces. When light exposure is increased, the light will appear uneven display and it will affect the visual experience. Therefore, in this project, trees at far visual point shall adopt cross method and trees at near visual point shall carry out modeling by bulletin board method.

Implementation principle of bulletin board method is that we shall pre-set a or more polygon faces, and paste tree texture mapping on the faces, and the polygon can rotate around the axis center. When the user watch it through roaming, and the specified face can also face the direction of sight, and its main implementation process is: (1) set coordinate of center point of polygon faces and length and width parameters of each faces, so as to ensure the position and size of trees; (2) determine three vectors V1, V2 and V3 according to line of sight and polygon, calculate the location of vertices of the polygon surface and its diagram is shown in Fig. 8.

When the tree is modeled by bulletin board method, the polygon position will change correspondingly when the line of sight changes. So coordinates of the four points need to be calculated again. Therefore, number of tree modeling by bulletin board method shall not be too much. Otherwise it will seriously affect the efficiency of system operation. In the system, only trees close to the road and main buildings can carry out modeling. And we shall carry out chartlet settlement for trunks after modeling. The main chartlets are shown in Fig. 9.

After chartlet and optimization treatment, trees in the virtual campus system are shown in Fig.10.
Construction of interface can be divided into three layers. The first layer: main interface background, it is mainly made up of a quadrangle and background texture chartlet. The second layer: option menu and description layer, in this layer, we can choose different texture chartlet by position of mouse and click event to make people feel it has changed. The layer is also the main layer in the interface. The third layer: mouse layer, mouse is made up of a quadrangle and background texture chartlet. But the texture chartlet method is realized by transparent and background color. Drawing effect of the interface is shown in Fig. 11.

5. Virtual Simulation

Roaming is an important means of achieving interoperability. The solution is as follows: (1) rotate and change the lens position according to user’s instructions; (2) rotate the world around the origin, in the opposite rotational direction of lens. (Make people have the illusion of lens rotation); (3) shift the world in the opposite rotational direction of lens (Make people have the illusion of lens shift). Rotation of lens can be realized through click event. Three overall variables and one constant are used, heading is used to record the angle of left and right rotation, and rot is used to transfer the value to render function. Lookup down is used to record the up and down rotation angle. Shift of lens is realized through click event. Shift of lens can be divided into left shift, right shift, go ahead and back up, corresponding to the A, D, W and S keys on the keyboard. Collision detection detects whether the observer has encountered an obstruction during the travel. The main implementation method is set different height values based on different terrain or building (namely Y value), and then detect the change of Y value during travel. If change of Y value at some point has exceeded a certain range, they we shall restrict the change of X or Z values.

6. Conclusion

In this paper, implementation of virtual campus is used as the research object. I drew the 3D model of virtual campus by virtual reality technology, and realized the roaming of virtual campus. But there are some problems, such as I only completed outdoor modeling during modeling and no indoor modeling is carried out. Of which, the collision detection algorithm is not too accurate and it resulted in a waste of resource. The innovations of the author were: realized the simulation and display of virtual campus by Visual C++6.0 and OpenGL technology, selected suitable entity modeling method, carried out necessary texture setting and chartlets, made the simulation results in line with the actual situation and well solved the problem of 3D roaming in virtual campus.

References


