Research on the Modeling Method of Virtual Tourism System Based on Virtual Reality Technology

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Abstract: The development of computer technology has brought people a new way of browsing the landscape. Using a computer, you can enjoy views from all over the world. After the popularization of virtual reality technology, people can visit tourist attractions in the virtual world through virtual reality technology, and the virtual world can bring realistic experiences to users. The use of virtual reality technology to build a virtual tourism system requires steps such as data collection, data preprocessing, establishment of three-dimensional virtual terrain, modeling of ordinary buildings, modeling of special terrain and objects, and system integration. In this paper, the steps of constructing a three-dimensional virtual tourism system using virtual reality technology are described in detail, and the current collision detection algorithm is improved and verified.

Keywords: Virtual reality technology; virtual tourism system; 3D modeling; collision detection algorithm

1 Introduction

Virtual reality technology is a comprehensive science and technology, which includes computer foundation, image processing technology, sensor technology, network technology and so on. Virtual reality technology can construct a complete virtual space. Users can feel the virtual space through sight, hearing and touch, and experience a feeling that is highly similar to the real world. The three-dimensional image display, surround sound and interactive operation in virtual reality technology jointly create a virtual space. Virtual tourism is a kind of tourism method developed with the development of virtual reality technology. Virtual tourism creates a virtual space based on real tourist attractions. Users can enjoy the scenery of tourist attractions from any angle through the operation of the smart terminal, and can interact with the virtual space to obtain a pleasant travel experience. Users can enjoy tourist attractions at any place and at any time at a very low cost. The great advantages of virtual tourism make virtual tourism a very popular way of tourism. This paper analyzes and discusses the three aspects of creating a 3D scene, setting the texture of the 3D scene, and performing collision detection on the 3D scene, and improves the collision detection algorithm.

ICIDC 2022, June 17-19, Qingdao, People's Republic of China

DOI 10.4108/eai.17-6-2022.2322833

2 3D scene modeling requirements

The modeling of 3D scene is a very important part of virtual reality. In order to make the scenery displayed by the virtual tourism system to the user more realistic, it relies on the modeling technology of the scenery. There are some differences between 3D scene modeling and other aspects of modeling. A 3D scene can be a very wide range of objects, often requiring the construction of a large number of objects of entirely different types. In 3D scene modeling, the scene can have its own behavior. In other graphics modeling, it is often necessary to construct static objects, and even if there is motion, it is only a simple translation or rotation. In scene modeling, in order to build a more realistic scene, it is necessary to make the scene in the system move, such as the shaking of leaves, the movement of animals in the scene, and so on.

The simulation of natural scenes has always been a research focus in the field of computer graphics and seems to be difficult. Using computers to simulate complex natural scenes has always been a hot topic in computer graphics. Simulating natural scenes is different from regular geometry, whose surfaces often contain rich details or have randomly changing shapes. This feature of natural scenes makes it difficult to describe the simulation of scenic spots with traditional analytical surfaces. In 3D modeling, the models of buildings, trees, and terrain should be modeled in detail according to the physical laws of objects.

In the 3D scene, some scenes can interact with the user. When the user interacts with an object in the scene, the object can react in an appropriate way. This interactive experience can bring real feelings to users.

3 Create a 3d scene of the virtual tourism system

The scene in the virtual tourism system is constructed according to the real scene, so it is necessary to have a comprehensive understanding of the terrain characteristics in the real scene, and build a three-dimensional scene according to the terrain characteristics. In order to fully grasp the terrain data in the scenic spot, the virtual tourism system needs to grasp the panoramic terrain scene data, the aerial image of the scenic spot and the related vector data. The acquisition of scene data can use photogrammetry data or 3D laser scanning measurement data [1].

This study uses the Terra Builder module in the Skyline series software to build a 3D terrain database for scenic spots. In the database, terrain data can be superimposed with satellite images, aerial pictures, DEM and other data. The format of the urban 3D terrain database file generated by the Terra Builder module is the MPT format file, and this file will become the basis for the next architectural modeling.

In most scenic spots, architecture is the highlight of the scenic spot. When constructing the virtual tourism system, we should pay more attention to the production of the architectural model. In order to improve the authenticity of the 3D model, during the modeling process, the geometry modeling tool that comes with the Terra Explorer Pro module is used, and the scene in the photo is restored with a scale of 1:500 [2]. The 3DSMAX modeling software was also used to assist in the establishment of the 3D model. After the modeling is completed, the established model is imported into the Terra Explorer Pro module for integration and processing [3].

4 Building a 3d scene texture

After constructing the terrain and architectural frame of the 3D scene, it is necessary to add texture data to the architectural frame. In order to reproduce the pattern texture in the real scene, the texture of the three-dimensional scene in this system is pasted through the real texture image. The authenticity of the pictures taken should take into account the level of detail in the building [4]. If you want the surface color of the buildings in the virtual scene to be more in line with the actual effect, you can use the diffuse map when mapping. Diffuse mapping can represent the reflection and surface color of the surface of the object in the virtual scene. Diffuse maps can show in detail the color and color intensity of objects when they are illuminated by sunlight. This map allows users to see more details of buildings. There are many ancient buildings that change color after thousands of years. The color on the surface of the building will deepen, and under the sun, the original color rendering of the building will be revealed. Diffuse stickers can restore this texture to the user.

In order to reduce the complexity of the scene model, bump stickers can be used to add a three-dimensional effect to the scene. Among the buildings of scenic spots, there will be many raised or recessed patterns on the buildings, which can reflect Chinese culture. The bump map can achieve the effect of highlighting the three-dimensional effect of architectural patterns by affecting the shadow on the surface of the model [5]. There are two different types of bump mapping methods in Virtual 3D Yangtze River, Normal maps and High maps. Normal maps can change the inclination of the surface of a 3D object in the user's view. Normal maps record parameters (X, Y, Z) in spatial coordinates in bitmap image pixels (R, G, B). The figure below shows a simple example [6]. This is the use of bump maps in a simple and smooth virtual model, resulting in a three-dimensional effect. High maps are a 2D array that can represent the three-dimensional effect of the terrain. A terrain is actually a series of grids of varying heights. The index value of each element in the array can be used to locate a different grid (x, y), and the stored value is the height (Z) of the grid. High maps are black and white images. High maps define the height of the model surface in pixels. The brighter the place in the model, the higher the height, the whiter the place the higher the height. This way of definition can simulate different terrain effects [7]. As shown in Figure 1.

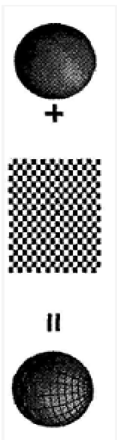

Figure 1: The effect of the bump map

5 Collision detection in 3d virtual scene

5.1 Classical Collision Detection Algorithms

Collision detection is to detect whether objects collide with each other in the virtual space. In simple terms, collision detection is the intersection test of two polyhedra. In two-dimensional space, objects are all in the same plane space, and two-dimensional objects can be represented by polygons, so the collision detection for two-dimensional objects is relatively simple, and the calculation is relatively simple. But the composition of objects in three-dimensional space is more complicated. Three-dimensional objects are also composed of polygons, but the geometric complexity is relatively high, so the collision detection of three-dimensional objects is a very complicated problem.

At present, there are mainly two kinds of collision detection algorithms, one is to transform the problem of judging the intersection of lines and surfaces, and the other is an algorithm based on the bounding box and continuously improved. The basic principles of these two algorithms are as follows: One is converted into a judgment line and surface, which takes the viewpoint as the starting point, and advances the length as the length to form a line segment. This line segment is intersected with all the visible surfaces in the scene. If there is an intersection (intersection), it means that a collision has occurred [8].

The collision detection in the virtual tourism system does not require high accuracy. Compared with the accuracy, the scene modeling pays more attention to real-time and fastness. The virtual scene in the virtual tourism system only needs to perform approximate simulation collision check. As shown in Figure 2.

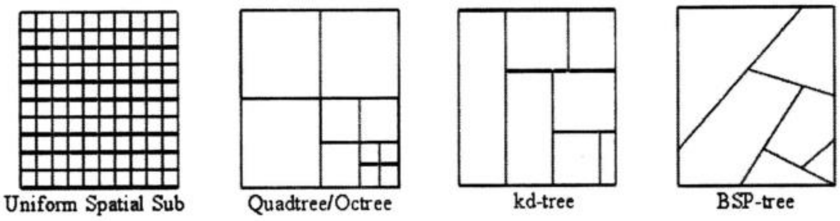

Figure 2: Schematic diagram of collision detection algorithm based on space division method

In the second bounding box algorithm, if it is the collision detection between the object and the scene, a ray will be made along the forward direction, and the ray will first detect whether it intersects with the bounding box, and then do the variability intersection detection; if it is between three-dimensional entities [9]. Collision detection: Create a bounding box for a three-dimensional object, and calculate the intersection of the bounding box in the three-dimensional space. The specific method is to use the bounding box (ball) to perform pairwise collision detection. If the bounding sphere is collided, use the polygonal collision detection method to calculate, but if there are many scene entities, the execution efficiency of this method is relatively low, which affects the computer processing performance. Although it can be realized, it is not the optimal algorithm. As shown in Figure 3 and Figure 4.

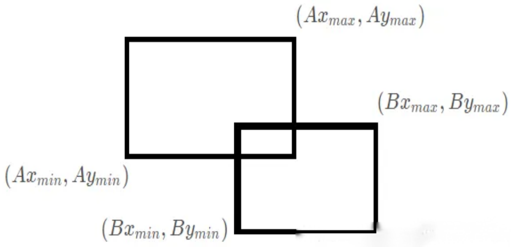

Figure 3: Determine whether the bounding boxes intersect

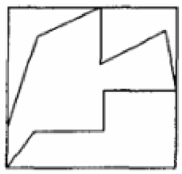

Figure 4: AABB bounding box

Nowadays, some scholars abroad have improved some new algorithms on the basis of these two algorithms. Moore has proposed two effective collision detection algorithms, one of which is used to deal with the triangulated object surface, because any one the problem surface can be represented as a series of triangular patches, so the collision detection algorithm is universal [10]. The disadvantage of this algorithm is that when the scene is a complex sculpture surface, the triangulation may generate a large number of triangular patches, which will greatly affect the algorithm. Another algorithm is used to deal with the collision detection of polyhedron environment: Moore and Wilhelems proposed a convex polyhedron collision detection algorithm based on the Cyrus-Beck clipping algorithm, that is, by detecting whether the vertices of polyhedrons contain each other to determine whether they collide [11].

In China, some algorithms have also been proposed recently, that is, using hierarchical directed bounding boxes, that is, using a number of geometric bounding volumes with slightly larger volumes and simple and regular shapes to replace geometric objects of complex shapes for collision detection; The collision detection algorithm for separating bounding boxes, this algorithm effectively improves the efficiency of collision detection. The algorithm studied in this paper is a further improvement on the basis of this algorithm, which makes the execution efficiency of the algorithm higher, and also merges event handling capabilities.

5.2 Improved collision detection algorithm

Bounding box algorithm is the most popular and tried collision detection algorithm. This study improves the construction of bounding box trees.

The selection of Sphere and AABB segmentation layers is the key to determine the efficiency of collision detection. The segmentation layer can be adjusted up and down for different scenes. Female II If the objects are denser, and the collision probability is high, the segmentation layer of Sphere and AABB can be appropriately increased to quickly enter the stage of accurate collision detection; if the objects are relatively sparse, the running trajectory is more complicated. Lower the split layer of Sphere and AABB. To improve the efficiency of collision detection. details as follows [12].

Establish an AABB bounding box for each basic geometric element, and combine them in pairs according to the strategy of minimizing the sum of the bounding boxes, and build a bounding box tree from the bottom up. In the merging process of AABB bounding boxes, a new AABB bounding box can be constructed by selecting the maximum and minimum values of the projection of the bounding boxes to be merged in the direction of the coordinate axis.

In the segmentation layer of Sphere and AABB bounding box, a circumscribed bounding sphere can be directly constructed for the underlying AABB bounding box, and its center is the center of the AABB bounding box. The formula for calculating the radius is as follows:

$$r = \frac{\sqrt{(x_2 - x_1)^2 + (y_2 - y_1)^2 + (z_2 - z_1)^2}}{2} \tag{1}$$

In the upper layer of the segmentation layer, the upper bounding sphere is constructed by merging the bounding sphere. The formula for calculating its radius is as follows:

$$r = \frac{(d + r_0 + r_1)}{2} \tag{2}$$

The formula for calculating the center of the sphere is as follows:

$$c = \frac{c_0 + (r - r_0)(c_1 - c_0)}{|c_1 - c_0|} \tag{3}$$

Among them, C0 and C1 are the centers of the two surrounding spheres to be merged; r0 and r1 are the radii of the two surrounding spheres to be merged; d is the distance between the centers of the spheres. As shown in Figure 5.

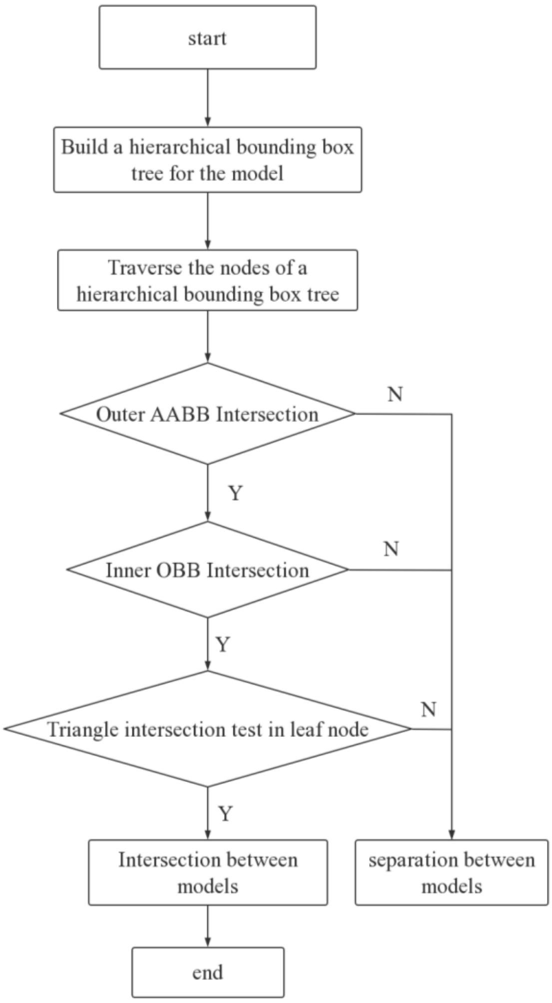

Figure 5: Bounding box algorithm flow

6 Conclusion

This research uses the Skyline virtual reality modeling software to construct the process and key technology of virtual tourism system. Collision detection is a critical step in modeling landscapes using virtual reality technology. In practical applications, the bounding box algorithm is the preferred algorithm for developers. However, the collision detection efficiency of the virtual world using the bounding box algorithm is slow, and the pressure on the server is large. In order to improve the bounding box algorithm and make collision detection easier, this study made some improvements to the bounding box algorithm. In this paper, the collision detection algorithm is analyzed in detail, and the efficiency of collision detection is improved by reducing the segmentation layer between Sphere and AABB. After the virtual space is constructed, the algorithm can be used to perform collision detection on the virtual environment to improve the simulation degree of the virtual world.

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