Design and Realization of Scenes of 3D Virtual Digital Library

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Abstract. 3D virtual digital library is a virtual library environment realized by using virtual reality and other technologies. It can realize the library scene and information resource three-dimensional display. It provides a more direct and convenient way for the inquiry and reading of book resources. In the construction of 3D virtual digital library, the establishment of virtual scene is the key. Taking the three-dimensional virtual digital library of Shanxi Datong University as an example, this paper discusses the design method of 3D virtual digital library, the process of virtual scene design, and the realization technology and method of virtual scene, providing reference for the construction of virtual digital library.

1. Introduction
As a public place for people to obtain information materials and knowledge, library plays an important role in the development of education industry. However, the traditional library navigation system is mostly introduced through pictures or words. After new readers enter the library, they often need to spend a lot of time and energy to understand the library's internal environment, the location of various books or the use of electronic equipment.

Three-dimensional digital library is established by using virtual reality technology, computer network technology, database technology and so on. It can let readers stay at home, through the network to learn the internal structure of the library, and through the keyboard and mouse for related operations, "roaming" in any corner of the library, to achieve the immersive feeling; at the same time, you can also preview three-dimensional books and achieve the book lending. However, in the process of building 3D virtual digital library, the establishment of 3D virtual scene is the key.

2. Design method of 3d virtual digital library
At present, three-dimensional virtual libraries in China can be divided into two types according to different modeling methods: image-based virtual libraries and geometric-based virtual libraries. The generation of scene of the first type virtual library depends on the 360 degree panoramic technology of the image. When this technology is applied to generate scenes, professional cameras should be used first to capture the image information of the whole scene, and then the images should be pieced together to form a panoramic image with a horizontal perspective of 360 degrees and a vertical perspective of 180 degrees [1]. The generation of the second kind of virtual library scenes needs to use 3D modeling software (such as 3D Studio Max) to actually construct the 3D scenes and generate the corresponding 3D models.

Each of these technologies has advantages and disadvantages. The first method has the advantages of fast development speed, good simulation effect and less computing resource consumption. The
disadvantage is that the system lacks interactivity and the model lacks stereoscopic sense [2]. This kind of technology is more suitable for virtual systems with large scenes (such as virtual cities) and need real-time imaging [3]. The advantage of the second method is that the model is realistic and three-dimensional, and the system is interactive. The disadvantage is that the system requires more workload, takes longer development cycle, takes up more computing resources, and the final effect is restricted by models quality [4]. Such technologies are more suitable for establishing virtual museum system, virtual museum system, virtual campus system and landscape design system [5].

This article takes the library of Shanxi Datong University as an example, uses the method of geometric modeling, uses “SketchUp” and “3D Studio Max” software to model the scene of the library of Datong University, establishes the external structure and internal space layout of the three-dimensional virtual library, so that users can understand the internal structure and environment of the library through the computer. Create a sense of being on the scene.

3. The design process of the scene of 3d virtual digital library

The construction of library virtual scene should be based on real library. Before the construction, we need to collect relevant data, that is, we need to obtain the actual size of the library building and take relevant pictures of the building to prepare for the later modeling and mapping. When making virtual scenes, first of all, the floor plan of the library should be drawn with “AutoCAD” according to the actual size and layout of the library building, so as to make clear the area division of the library and the plane layout and position of each building. Secondly, building walls are modeled using “SketchUp” software. Then, the library's internal facilities are modeled with the abundant modeling technology in 3D Studio Max. Finally, the models made with “SketchUp” are imported into “3D Studio Max” and all the models are merged. After the model of 3D virtual library is made, material should be given to the model to accurately express the physical properties of color, texture, reflection and refraction of light. In order to be able to simulate real library scenes, we need to add lighting effects to the scenes to highlight the layers of the scenes and make the scenes more real and natural. To reduce CPU computation time, we can use texture roasting technology to transform light information into texture form. [6]

4. Realization of 3d virtual digital library scene

4.1. Make the floor plan

Use tools of “AutoCAD” such as "lines" and "arcs" to draw the outline first. Then the "offset" command is used to shift all the edges out of the wall thickness, thus forming the outer outline of the whole library. The library plan is shown in figure 1.

![Figure 1. Library plan](image)

4.2. Wall modelling

Import the floor plan made in “AutoCAD” into “SketchUp”, and use “SketchUp” to build the wall model of the library. The detailed process is as follows:
After importing the plan into “SketchUp”, we use the "line" tool to make the curve. When the curve is closed, the system will automatically generate the plane.

Using the “push and pull” tool to build the wall. We calculate the height of each floor and pull out the wall according to the height of the library collected. On this basis, the top and bottom of the building are respectively added with a thickness for the roof and foundation.

Dividing the layout of the library. We use the "line" tools to divide the layout of each classroom, corridor and so on, and then use the "push and pull" tools to push out the wall, which serves as the partition between each classroom.

Make doors and Windows. We need to first determine the width, height and position of the door frame and window frame, then draw with the “line” tool, delete the excess surface and seal the unsealed surface, and finally export the model to the format of 3ds. The effect of the model after completion is shown in figure 2.

Figure 2. Overall effect of library wall

4.3. Modeling of objects in the library

4.3.1. Selection of modeling methods. The scenes in the library are relatively complex and there are many modeling methods used. There are different modeling methods for different objects, and there may be multiple modeling methods for the same object. How to choose the appropriate modeling method plays a key role in the performance of virtual library system. Combined with experience, how to choose the modeling method is summarized as follows [7]:

Direct modeling of basic three-dimensional forms. For objects that can be modeled through the standard geometry and extended geometry provided in 3D Studio Max and their mutual combinations, modeling can be carried out directly, such as regular tables, chairs, bookshelves in the library.

Polygon modeling. For objects that need to take a standard geometry or an extension set as the initial shape, the initial shape shall be converted into "editable polygon" or "editable grid", and the points and surfaces shall be selected in the editing panel for modification to achieve the ideal modeling effect, such as the computer monitors in the library.

Two-dimensional figure modeling. For some objects with complex shapes, which cannot use standard geometry or extended geometry, we can try to use 2d graphics to shape them, and then transform them into 3D solid models by adding corresponding modifiers, such as floor vases in the library.

Compound object modeling. Compound object modeling. Composite object modeling is often used for modeling where two or more objects need to be combined to form an object in a particular way, such as the doors and Windows of the library.

Map modeling. If using conventional modeling methods will result in too large number of points and faces, you can use methods such as map modeling. Map modeling is used to model plants and objects that are less demanding and far away from the model, Such as the library of potted, computer keyboard.
In the process of modeling, if multiple modeling methods can be used to complete the same model, the method that produces the least number of model faces should be selected. When modeling the distant object, due to the low visual requirements, the "segmentation" can be appropriately reduced to reduce the number of faces of the model.

4.3.2. Implementation of modeling. Let's take the bookshelf model making in the reading room as an example to illustrate the concrete realization process of modeling.

- The model making of the bookshelf: First, we create a new cuboid, and set its length, width and height according to the actual scale. Its rounded Angle is set to 5mm. Then we use the "rotate", "move", "etc scale" tools to build the bookshelf.
- Model making of books: First, we need to create a rectangular wireframe and convert it to editable spline. In the modify panel, select the line segment hierarchy and use the optimization tool to add a point to the middle of one of the edges. Then, we select the added point at the "point" level, change the type of the point to "Bezier Angle point", change the type of the left and right points to "Angle point", and adjust the curve of the line. We then add an "extrude" modifier to the completed spline, set its height and convert it to an "editable polygon." We select the edges to edit and select the connect command to add two edges. We then add the extruder for the three sides. Finally, we put the books on the bookshelf one by one, and adjust the size and direction of the book respectively with the zoom tool and the rotation tool, so as to achieve a casual and natural effect, and then assign the material collected from the Internet to the model. The final shelf rendering is shown in figure 3.

![Figure 3. Rendering of the model of the bookshelf](image)

5. Material making
The virtual library mainly involves glass and texture materials. The glass material needs to be adjusted for "highlights" and "opacity" and "ray tracing" added to the reflection and refraction channels. Texture material needs to adjust corresponding texture parameters.

6. Model integration
After each scene is finished, it is necessary to put each model in the corresponding position according to the CAD floor map drawn earlier, and integrate each scene into a complete virtual library. The effect after model integration is shown in figure 4 and 5.
7. Conclusions
The selection and application of the modeling method is very important for the construction of large scale scenes. The most critical problem in modeling is the problem of the number of surfaces of models, which is related to the computer system's rendering and running speed; the design should not only meet the needs of the user's vision, but also ensure that the model contains the least number of surfaces. The appropriate modeling method will make model planes appropriate, facilitate follow-up material and other processes carried out smoothly. [8]

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