Application of Computer 3D Animation Technology in Construction Industry

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Abstract. Nowadays, 3D technology can be used to simulate and create a simulated virtual scene and present objects in the real world to people in an all-around manner. This technology can play a significant role in various fields. It is still quite challenging to create a virtual environment similar to reality, and one of the challenges is represented the virtual construction industry system. In this paper, the 3Dmax modeling software is used to establish a 3D model of the campus library and add some roaming animation for an all-around demonstration. Animation production mainly includes the modeling of teaching buildings, the production of materials, lights, animation paths, the use of cameras, the final animation rendering output, and the postproduction processing of animations with the video editing software premiere cs6.

Keywords: Virtual Campus, 3D Technology, Construction Industry, 3DMAX

1. Introduction

With the popularity of the “Big Hero 6” film in the world, three-dimensional (3D) animation production has once again become the focus of attention. Compared with traditional 2D animation, 3D animation is more systematic and convenient to produce, and it has a more realistic expression [1]. Generally speaking, the production of 3D animation is to first create a realistic virtual world in the computer-based on the objects in reality or imagine from scratch and then set up certain motion rules in this virtual world [2]. In fact, the movement and changes of many things are often irreversible, but in the virtual world of computers, much software can solve this problem very quickly. Hence, 3D animation has excellent fault tolerance and remodeling during the production process. The basis for making 3D animation is to create suitable 3D models and scenes [3]. With the rapid development of computer technology, people can now use 3D modeling software to perfectly create almost all objects in reality or imagination, which makes its application almost everywhere. Many domestic universities have used this technology to make a relatively sophisticated virtual campus system. The emergence of the virtual campus system allows users to understand all the landscapes and structures on the campus without leaving home. This high-tech has gradually entered every college in China [4].

3D animation is a high-tech dynamic video product combining computer graphics technology, photography technology, space technology, and visualization technology. It has developed rapidly in recent years and has been extensively applied in architecture, medicine, military, science, education, and other fields. The 3D animation system can be divided into three systems: an electronic display system, a virtual simulation system, and a database system [5]. Among them, the electronic display
system is a comprehensive display of products or design schemes in multiple ways, through the integrated application of multiple technologies such as images, animation, commentary, music, and scripts to deliver as much information as possible to the public. The virtual simulation system is for the simulation analysis of city planning, real estate sales, and industrial products. The established scenes are used to implement autonomous control in the products. Among them, the change of light and shadow, the simulation of traffic flow, the replacement of color and building materials, the variation of volume and displacement, and even the combination of industrial products can be simulated realistically to provide a genuinely scientific judgment and analysis basis for users in an interactive manner. The system can show the existing or future product styles to various households vividly from multiple perspectives [6]. The data system is a set of archive and classification operating system. It combines the database established by the electronic display system and the simulation system, which can implement the statistics, query, and classification screening of the vital information in the above system, which can be further transferred to the Internet platform to maximize the spread of information flow. The data system can be used to maximize the savings in human, material, and financial resources and establish a clear and complete database.

This paper mainly uses 3D max 3D modeling tools to model and render the animation of a school library. To ensure the feasibility of the relevant design, we first establish the library model in the 3Dmax software carefully. Subsequently, we use V-ray rendering tools to color the model and assign material textures. Finally, we apply the Premiere and After Effects to render the animation clips and perform splicing and beautification. 3D max has a powerful 3D modeling function. After the architectural materials and collection layout are obtained, a 3D model that can be viewed from any angle is established in the software. To ensure the overall beauty of the scene, we can add relevant background and iconic textures after modeling.

V-ray can add materials and textures similar to the real world on the completed 3D model, which is more convenient and beautiful than the 3D max rendering in the exquisite processing of the model. Because the animation segments rendered by 3D max have very complicated problems in connection and display, using Premiere and After Effects can totally solve these problems.

2. About to 3D roaming animation

2.1. About 3D modeling

Creating a 3D model is the basic premise for establishing a VR (VR) environment and making 3D animation. To create a virtual environment that can make users feel immersive, we need to build a highly simulated model and attach a suitable scene. However, where the models and scenes are excessively elaborate, the amount of data to be processed will be extremely redundant, which will make it very difficult for the VR system to be used normally. Modeling in the virtual scene should reduce the calculation of the amount of data as much as possible on the premise of ensuring the exquisite and realistic model, to ensure that the virtual scene can obtain perfect operating results and efficiency.

This paper selects the 3Ds max modeling tool. 3Dsmax is a computer 3D graphics software based on the Windows operating system developed by Autodesk. It is regarded as a popular software in the field of 3D production. 3Ds max has a wide range of applications in the digital film and television and computer game industry due to its outstanding advantages such as high-cost performance, low configuration requirements, and stackable modeling steps. Many movies, such as Mission Impossible, Age of Empires, and Tomb Li, as well as the beloved computer games, such as Shadow, have enjoyed its powerful support.

In the 3D max tool, there are many different modeling methods, the types used in this paper include patch modeling, polygon modeling, composite modeling, and stacking modeling.

1) Patch modeling. Patch modeling is to use splines to outline the shape or contour of an object, and then use the surface modifier to edit to build the model. This modeling method is often used in the construction of building walls and nonlinear regular objects. For example, when constructing a wall of
a building, you can use splines to draw a plan outline of the building wall, set the appropriate spline thickness, and then use the “Extrude” tool.

One-sided modeling is extensively used, and there are very editing applications for modeling objects with some irregular surfaces. Different thousand polygon editors and patch modifiers convert the constituent points of objects into Bezier corner points and adjust the surface by the method of curve adjustment. One-sided subdivision modeling has a vast range of uses when modeling organic objects, such as characters.

2) Polygon modeling. Polygon modeling is one of the most commonly used methods for 3D modeling. The models created using this method are all composed of straight lines and are often used for modeling linear structures. Firstly, an editable polygon modifier is added to an existing basic model. Subsequently, the most basic sub-objects of the model are edited. There are five sub-objects in the model to which the multi-edit polygon modifier has been added: Vertex, Edge, Border, Polygon, Element. In computer configuration logs, any object can be regarded as composed of countless points connected, so changing the state of these points can achieve any modeling effect you want. Therefore, multi-deformation modeling can totally solve any needs of linear modeling. Modeling using polygons often requires mutual adjustment in the front, left, and top three views. When making a linear model, it is often superior to other modeling methods.

3) Compound modeling. Compound modeling is often used to deal with the details of irregular models. For example, Wanfeng winding road, uneven surface. Commonly used conforming modeling tools include deformation, dispersion, water drop network, Boolean, and Proboolean. Boolean operations are commonly used in the creation of building window holes and door holes, which is similar to a rule of addition and subtraction between 3D models. First construct a whole object, and then use this whole object to subtract the unwanted parts, you can get a suitable model. Lofting tools in compound objects are also a very common modeling method. Lofting tools usually use a two-dimensional figure as a cross-section and copy and extend along a predetermined path to obtain a 3D figure.

4) Stacking modeling. Stacking modeling is more like a post-processing method for the model. With the zoom and move tools, it can perfectly stitch different objects together.

Stacking modeling is just like building a house in the construction industry, combining individual bricks and tiles into a whole. It is an indispensable method for building modeling, i.e., completing the overview of each floor first, followed by splicing appropriately to complete the whole production. For example, when we establish a common commercial house model, the main building body, including the staircase, roof, balcony, and other components, are completed first. Subsequently, a suitable location is selected to splice them into a unit building.

2.2. About materials and textures
In the commonly used 3D modeling software, since the initial modeling objects generally use solid color materials, they basically cannot achieve the visual effect of the model that people need, so it is generally necessary to complete the basic modeling. The model is finely processed-given materials and textures. The material is more like a beautification tool to make the model more realistic. Because people observing objects in the real world are often affected by various factors such as light reflection and refraction, so to make the 3D model display more realistic, it needs constant refinement. Adjust the material of the model. The material is affected by many factors, such as commercial light color, gloss, refraction, and transparency. When adjusting, the material should be as close as possible to reality.

The texture can be understood as a special material. The user can use the picture taken in reality to attach it to the appropriate model position to obtain a wholly simulated visual effect.

2.3. Introduction to 3D animation
In 3D max, add certain trajectories and changes to the 3D objects that have been modeled and assigned materials on the appropriate time axis to generate animations automatically. 3D max uses keyframe
animation technology. The so-called keyframe refers to setting keyframes at two points in time, and then the software will compare the difference between the two keyframes to generate other frames between the keyframes automatically. Specifically, in 30max, the keyframe is described as the state of the selected object then, this state contains the position, size, material, shape and other information of the selected object. Subsequently, the differences between the time points are compared to calculate the animation.

There are many deficiencies due to the animations rendered only by 3D max. For example, the display animations inside and outside the model cannot be seamlessly linked. Hence, under normal circumstances, first use 3D max to render each animation segment that needs to be displayed, and then use the Premiere professional video editing software for stitching and beautification. Premiere can add various conversion special effects in each animation segment, thereby making the display animation more humanized and beautiful. Moreover, Premiere can also add appropriate background music to the completed cartoon segment, which will also make the animation get better viewing and promotion effects.

### 3. Examples

Through the flexible use of various modeling tools in the 3Dmax tool, we can complete the 3D model of the school library easily. Then adjust the realistic materials and assign appropriate textures to make the model more realistic in its performance. The specific process is shown in Figure 1.

![Diagram](image.png)

**Figure 1.** 3D modeling steps

For a compound high-rise building such as a school library, planned sub-modeling is very necessary. We have tried the modeling in an unorganized manner previously and found that some indoor or embedded objects could not be modeled at all. This method is also not suitable for later inspection and intensive work. After developing a detailed division plan, the overall design is relatively smooth.

Given the coordinates of two points \(zd(x_1, y_1, z_1)\) and \((x_2, y_2, z_2)\), then the spatial distance between the two points is shown in equation (1):

\[d = \sqrt{(x_2 - x_1)^2 + (y_2 - y_1)^2 + (z_2 - z_1)^2}\]
\[ D = \sqrt{\left( x_2 - x_1 \right)^2 + \left( y_2 - y_1 \right)^2 + \left( z_2 - z_1 \right)^2} \] (1)

The calculation equation of the ellipse corner is shown as equation (2):

\[ r(\phi) = \left[ \frac{1}{a} \cos\left( m\phi / 4 \right) \right]^2 + \left[ \frac{1}{b} \sin\left( m\phi / 4 \right) \right]^3 \] (2)

Where \( a, b \) represent the long and short axis distance, and \( m \) represents the calculation angle.

Similar to the stitching of a part, any part can be modified and redone in time if it shows a bug or is out of proportion. This makes the overall modeling of the library—smooth and clean. Of course, due to limited professional knowledge and design time, there are still many problems to be solved and further improved. The professional knowledge shall be gradually accumulated in future studies and work so that the final product can be more beautiful and real. The Library modeling results is shown in Figure 2.

![Figure 2. Library modeling results](image)

After modeling, we can set the appropriate back and ground, and then use the camera to configure the track for animation. There are two types of cameras, free camera and target camera. Compared with a thousand-target camera, a free camera has more diversified shooting techniques and is more convenient to adjust. The running track of the camera is drawn in the top view, and then the “path constraint” tool in the “animation” drop-down bar is used to constrain the camera to the running track, set the camera state to “follow” at the “motion level”, and then adjust the camera lens aperture and shooting angle appropriately to make the entire model Can be shrouded in the camera's perspective. If a camera with path constraints is used, a key frame animation of the camera motion perspective is added to the scene by default. You can use the shortcut key “C” to switch the camera perspective to see that to make the environment more harmonious, you can set up the outside of the library model—The cylinder is enveloped, and then use the “normal edit” modifier to flip its normal, and then give a light blue gradient map, which can create a blue sky effect in the camera perspective.

To make the rendering more expressive, there is no fine modeling of some extremely fine places (such as the internal stairs of the library), and for some iconic buildings, more exaggerated materials and textures (such as The windows and sky corridors of the Senate Library). Through this approach, the memory footprint of the 3D max software can be saved to some extent. and the pressure of the computer graphics card can be alleviated. The author personally feels that in 3D modeling, not all
objects are more detailed performance, the better, extend to 3D max It means that the more points or line segments that make up the object, the more expressive the object. 3D modeling is not only an application of professional knowledge but also a test of the ability to streamline work.

After completing the animation output of several clips, to make the entire animation video more comprehensive and coordinated, we can use Premiere software for post-processing. The use of Premiere this time is mainly for splicing videos, converting special effects, and adding background music. After completion, it is similar to the 3D max. Premiere also needs to render the final product. The default settings and mp4 format can be used to complete all the production of this design.

4. Conclusion
3D animation is a high-tech dynamic video product that combines computer graphics technology, photography technology, space technology, and visualization technology. In this paper, the 3Dmax modeling software is used to establish a 3D model of the campus library and add some roaming animation for an all-around demonstration. Animation production mainly includes the modeling of teaching buildings, the production of materials, lights, animation paths, the use of cameras, the final animation rendering output, and the postproduction processing of animations with the video editing software premiere cs6.

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