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Construction of the Three-dimensional Virtual Campus Scenes' Problems and Solutions

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Abstract: With the progress of technology, virtual reality technology plays a key role in many domains and has great potential and applied prospects. Virtual campus is the reappearance of a real campus's scene by applying virtual reality technology. This technology is aimed to the construction and propaganda of campus. But in the course of construction of the three-dimensional virtual campus scene, owing to numerous things and different kinds of shapes of the real campus, the achievement of virtual campus's system is made difficult. So there are many problems, and if we cannot deal with them properly, they might seriously influence the issue, the application and the use of this system. Combined with examples, the paper analyzes possible problems in the process of building three-dimensional virtual campus scenes, and puts forward some feasible solutions, so as to provide reference for 3D modeling of large scenes.

Keywords: Modeling, virtual campus, virtual reality.

1. INTRODUCTION

Virtual reality technology is a comprehensive technology, which uses computer graphics, human-computer interaction technology, sensor technology, artificial intelligence and other technical means. It enables users to interact with the virtual world naturally by means of the necessary devices and the computer to generate realistic 3D visual, auditory, tactile and other feelings [1].

Based on a real campus environment, virtual campus offers a digital campus created by using virtual reality technology. The user can use the necessary input devices, such as a mouse and a keyboard, through the network to achieve the campus browsing or roaming, immersive understanding of the campus environment.

2. THE PROCESS OF CONSTRUCTION OF THE 3D VIRTUAL CAMPUS

2.1. The Preparation

Virtual campus scene is designed to reflect the real campus scene. In order to comply with the actual situation, we need to obtain the real size of the buildings before setting up the scene by looking at their historical data and field measurements. In order to reflect the scenes models of surface texture, color, *etc*., we need to use a high-definition camera to take pictures of the buildings surfaces, including exterior wall, ground, street lamps, plants, *etc*. Then Photoshop software is used to deal with the collected pictures to get models surface texture.

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2.2. Drawing of the CAD Plan

The plan includes: drawing the planimetric maps using AutoCAD, determining the specific location of each building, making arrangement of roads and green belts at the same time, completing the overall positioning of the campus scenes, and preparing for the integration of the models in the later stages.

2.3. Modeling

After drawing the planimetric maps, the rich modeling technology of 3D Max can be used to establish the indoor and outdoor building models. 3D Max is simple and easy to learn, its function is perfect, it has many kinds of modeling methods, and its powerful polygon modeling function is very suitable for the modeling of building models. After drawing a good plan, the rich modeling technology in 3D Max can be used for indoor and outdoor architectural modeling. Because of the complex campus scene, different modeling methods can be used, such as polygon modeling, Boolean operation, lofting, two-dimensional rotating 3D modeling, texture modeling, *etc*.

2.4. Add Texture

Using 3D Max included with the plug-in-VRay renderer implementation model for the production of surface material, real performance, surface texture, color, other physical properties, and finally lifelike model effects are acquired [2].

2.5. Map Baking

The light effect on campus can be simulated by using the map baking technology or the lighting technology. For using lighting technology, the CPU will require a large amount of calculation, which the rendering speed is slow. So in the actual production, map baking technology can be used to real-

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ize the simulation of light. Map baking technology can bring the light information into mapping, and then put the mapping again to the scene to simulate the light [3]. Such processing can reduce the calculation time of CPU to a great extent, and speed up the running speed of the system.

2.6. Integrating and Importing of the Model

After using 3D Max designed models, according to the previous drawing's reproduction using AutoCAD, put each model in its corresponding position, and then export all of the scene files to a virtual interaction platform in a compatible file format. If Unity3D is used as virtual interactive platform, the scene file needs to be exported into FBX format.

2.7. Designing of Interactive Roaming

Import all scene files into the virtual interactive platform to start the interactive design of virtual scenes. Ultimately enable the system to achieve: users through the necessary input device to control the scene, users roam in the scene and generate immersive experience. It does not only offer ease of use but also provide different scenarios with audio commentary and descriptive text.

2.8. System Testing and Release

After the completion of the system, the system will be tested and according to the test results the system is optimized. To ensure good performance of the system, testing can be carried out after its release.

3.SCENE BUILDING POSSIBLE PROBLEMS AND SOLUTIONS IN THE PROCESS

3.1. Unit Settings

In the modeling process of large scenes, the task is usually divided into several modules, which are modeled separately and then integrated together. If the unit is not consistent in the design process of each module, it will bring difficulties in the model integration. So before modeling, ensure that the modeling is according to the actual needs, for which the model unit is set up so that "system unit" and "display unit" are consistent. In this way, the model unit displayed in 3D Max is the actual unit of the model.

3.2.The Face Number Problem of Models

A few more model faces can make the surface quite smooth. However, due to the too many virtual campus scene models, the number of faces, if not handled properly, may cause the model points to further increase the number of faces, due to which the scene file becomes large. This will not only make models in 3D Max uneditable, but also will lead to import of the virtual interactive platform that will render the platform unresponsive or freezing. So in the production of models, choosing the appropriate modeling method is very important. We further discussed in the next sections that how the use of appropriate modeling methods helps reduce the number of sides of models.

3.2.1.Model Simplification

In a virtual campus, high-rise buildings are more appropriate for a number of high-rise windows. In the process of modeling of the window, because the window itself is raised and there are large number of windows, therefore the more number of points would lead to the more number of faces. The problems of the number of points and surfaces, which are caused by the convex of the window itself, can be used in the establishment of the model to ignore the details, and the window frame is made simplified using a rectangular method to solve the problem. Because of the large number of windows, the whole row or the whole column can be designed as a whole. With three horizontal and three vertical windows, for example, if each of the windows is used to establish a model, they are synthesized as a whole, and then the number of points for the entire model is 575, the number of surfaces is 864. The window scene effect established by this method is shown in Fig. (**1**).

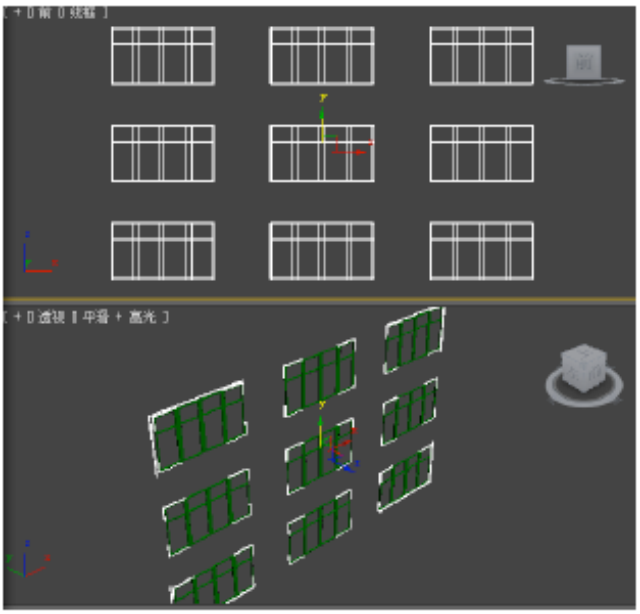

Fig. (1). The effect diagram of a single window modeling.

After improving the method of modeling, windows on the same level or in the same column are modeled as a whole, and windows frames at the same level or vertical position are regarded as a whole; modeling of the scene is shown in Fig. (**2**). At this time the number of points of the entire model is 192, and the number of surfaces is 288. After the model is built in this way, the window is embedded in the wall, and the non-window frame part will not be revealed. This modeling approach not only reduces the number of points and the number of windows facing the model, but also eliminates the need for late model production alignment of the windows operating. Similarly, in the modeling of the glass, the establishment of a large plane is embedded into the wall inside, and without the need for glass, each window is modeled, which can reduce the number of unnecessary surfaces.

3.2.2.Mapping Modeling

In large scenes, mapping modeling is mainly used for the modeling of vegetation and other objects which use 3D modeling to produce a lot of surfaces. Its advantage is that it can greatly reduce the number of surfaces of models. Take plant modeling as an example.

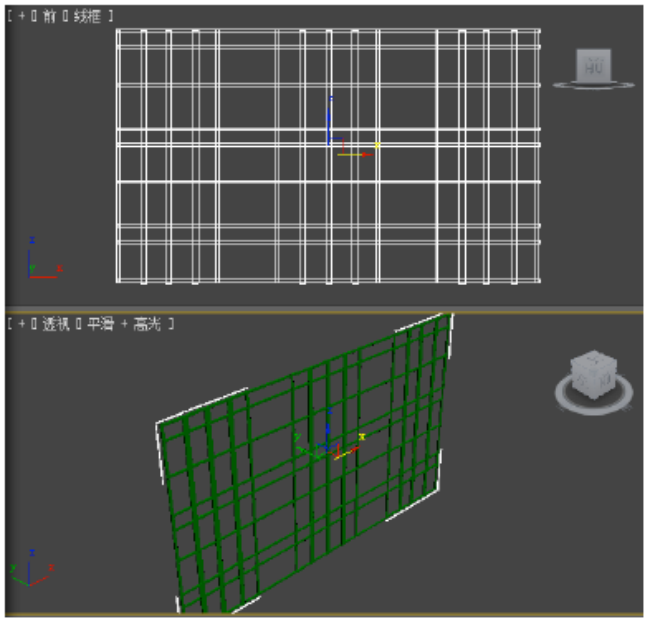

Fig. (2). The effect diagram of the whole window modeling.

In 3D Max of "AEC" expansion options, there provided three-dimensional trees models. 3D Max users use these trees models directly. But since these models are built out of a number of faces and more points, they occupy more memory, plus they cover high school general vegetation. So, if this method is used, 3D Max software will lead to slow down or even crash. Therefore, When modeling a plant, the method of "Mapping modeling" is usually used, that is, a picture of a plant is attached on the two vertical cross planes. Using this kind of imitation of 3D modeling technology, effect is not only better than the direct 3D tree provided by the system, but also it can greatly reduce the number of surfaces of models.

For example, when there is common lilac on campus modeling, first of all in the front view, using a standard geometry "flat" model, draw a plane named Plane 01 which size is "1 m" multiplied by "1 m". Pay attention to the length, and width of segment is set to 1; and establish a plane model named Plane02 of the same size in the left view. Then set the scene of Plane02 and Plane01 in X and Y directions respectively aligned with the center position. After setting, the effect is shown in Fig. (**3**).

Re-use Photoshop processing lilac photo shoot. The processed image gives lilac shaders in 3D Max, and single-channel output from the "RGB intensity" is set to "Alpha". Then map Plan01 and Plan02, to get a clove model; the effect is shown in Fig. (**4**).

As described above, for all vegetation modeling, all the trees of the model are available on campus.

3.3. Naming Problems

The Chinese version of 3D Max allows Chinese nomenclature for the model. However, considering that the model needs to be imported into virtual reality interactive platform to complete the interaction, and many virtual reality interactive platform have the English interface, such as Unity 3D, which does not support Chinese [4]. Models with Chinese naming show messy codes after importing and are difficult to distinguish from each other by names. To avoid such problems, models could be named with English or Chinese spelling during the modeling. Besides, semantic names should be used as much as possible for easy finding and distinguishing.

3.4.Material Issues

1.In the process of making the material, simple materials should be done on priority. For example, while making metal, it is enough to establish only the monochrome metal

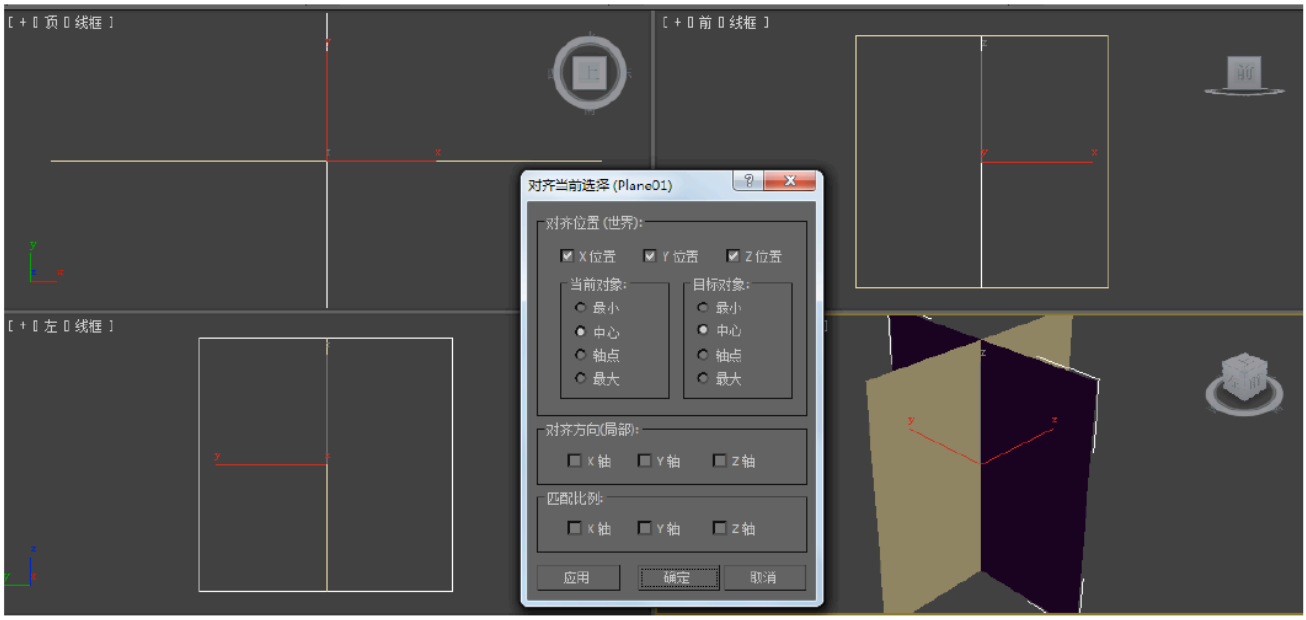

Fig. (3). The Plan01 and the Plan02 after alignment scene graph.

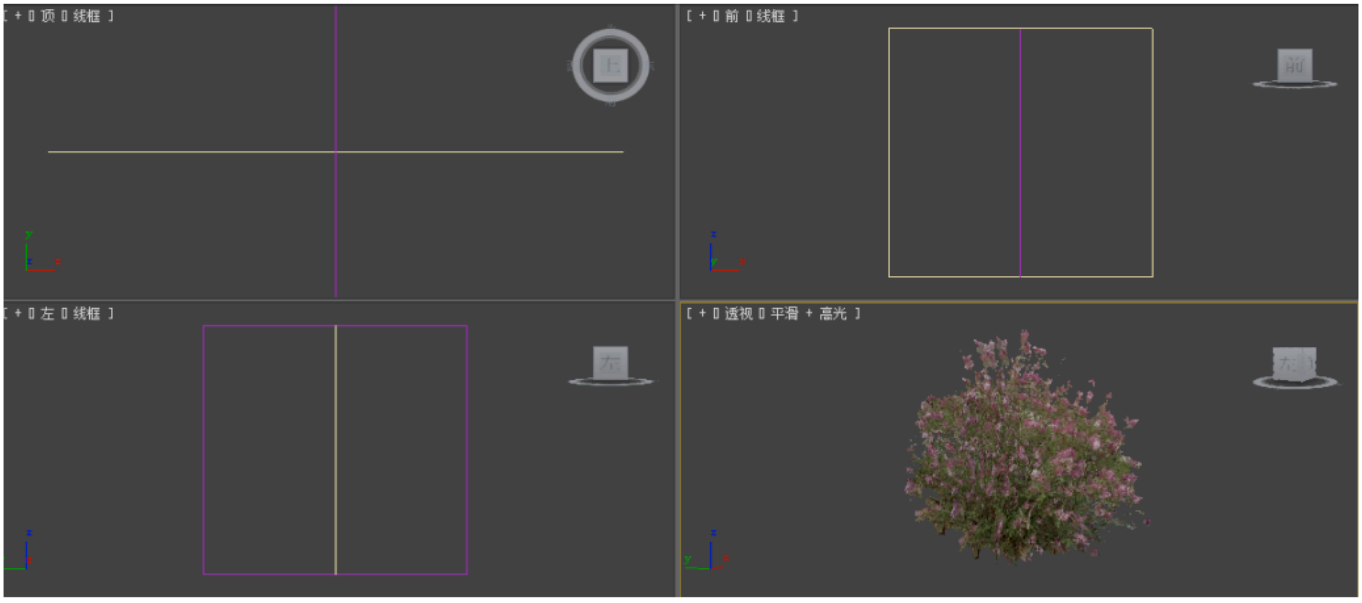

Fig. (4). The clove model.

material, in order to save the base material to a material library. And when such a metal material is required, we just need to do simple edit so that the desired material can be obtained quickly. For example, when it requires to establish metal material full of rust, as soon as the modifications to the basic metal and detail of rust are added, the desired effect of the material can be obtained quickly. This not only greatly facilitates the production of the material, but also can reduce the amount of time and unnecessary trouble.

2.We should develop a habit of side edge forming material production, *i.e.* after building a unit member we should give it corresponding material (such as: campus dining table, chairs, *etc*. When a set of table is finished, the corresponding material to the unit should be provided, and then the generated model is copied to the entire restaurant scene). As for complex scenarios, such as restaurants, if the corresponding material is not given until all units are built, many objects will not be easy to select, which often leads to omissions.

3.In the scenes of indoor and outdoor of campus building, the number of materials used are generally up to dozens of species. Therefore, each material should be named in time so that the process of the realization of materials will be no confusion. And because the materials would be imported into the virtual reality interactive platform, it is best to use Pinyin or English to name the materials in order to avoid unnecessary trouble later.

4. The model used by the sub-scene and the map to the model should be put in the same folder by the use of "archive" method, so even when the scene file is saved in another computer, the texture is retained, otherwise there will be trouble of maps losing [5].

5. In the process of pasting maps in the campus's indoor and outdoor models, in order to reduce the space of map in resource system, textures such as bitmap, tiled textures without using bump maps, displacement maps, dents mapping, reflection and refraction map and so on, should be used.

CONCLUSION

The construction of a virtual 3D campus scene is a relatively large project. Model making requires a long period of time and always needs many people to work in cooperation with a due division of labor. As a result, model standard shows great significance. Lots of factors will influence models integration in later stages, such as models naming, match of models units, texture's naming and filing, synchronization problem between texture making and models making, *etc*. 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 it contains the least number of surfaces.

CONFLICT OF INTEREST

The author confirms that this article content has no conflict of interest.

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REFERENCES

[1] Y.F. Ma,Y.T. Xue and H.S. Nan.*Virtual Reality Technology and its Application[M]*. Beijing: China Railway Press, 2011: 2-2.

[2] Information on http://wenku.baidu.com.

[3] Information on http://baike.baidu.com.

[4] X.Y. Huang, M. Du, F.F. Dong and M.H. Guo. *3ds Max 2011 standard tutorial*. Beijing: Tsinghua University Press. 2011.

[5] Y. Fan, M. Yang and W.C. Sun. *3ds Max three dimensional animation production base and operating instructions*. Beijing: Tsinghua University Press. 2010.

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