

Design and Implementation of Modeling Virtual Campus

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Abstract—In this paper, it took Suzhou University of Science and Technology as an example, designed a real-time virtual campus roaming system. It discussed the three-dimensional modeling of buildings, gates, roads, bridges, surrounding lawns, trees and other objects on campus, and implemented the data change between 3ds max and VRMLPad. At the same time, it used a model with kinds of texture maps, multi-resolution hierarchy, and achieved the scene using DEF/USE ways of VRML language. This paper focuses on some questions, such as a variety of scene building, scene model and mapping methods, code conversion, optimization techniques, interactive programming based on the triggers, cruise, controlling viewpoints, communication between JAVA and scene etc.

Index Terms—Virtual reality technology, virtual campus, 3ds max modeling

I. INTRODUCTION

The virtual campus roaming technology is a digital and virtual projection on three-dimension all and scope of the real campus and the teaching environment, and it is a three-dimensional virtual environment based on the real campus. It will play an important role in the digitization of the real campus, the campus environmental plan and management, and remote education.

Before modeling the virtual campus, we need to learn about the architectural style and characteristics of the college. The architectural style of Suzhou University of Science and Technology is rich in typical garden characteristics, with pink wall and black tile, tiny bridge and flowing river, which shows considerable charm of Suzhou. In this paper, we use 3ds max, VRML and Google maps to model the virtual campus three-dimensionally, and then achieve the scene using DEF/USE ways of VRML language[1]. Finally, we research and implement the automatic roaming and real-time interactive roaming according to a certain path by using VRML and JavaScript programming interaction.

II. SCENARIO MODELING

The first step making up a virtual campus is three-dimensional modeling [2]-[6], which is the most time-consuming and tedious; step in virtual campus walk-through system. Whether it is a good three-dimensional modeling is directly related to the performance of the system design and the running efficiency. It is necessary to get three-dimensional geographic data of the campus to make the three-dimensional scenes more realistic. The data includes the shape, size, scale, location or other parameters of the

model. Consulting the real scenario is also needed in building model. Here is some specific modeling process.

A. Ground Modeling

Since the ground in reality is basically flat, it is designed as a large, thin rectangle in the three-dimensional scene. The size of the ground should be a little larger than the scenario. The unit should be ignored in the conversion of 3ds Max to the language of VRML, with only value recorded. The default height of the embodiment of the viewer in VRML is 1.7, with the unit as "meter (m)". In this paper, the satellite image "/maps/map.jpg" of the college cut out of Google Satellite Map is used, which makes it convenient to locate objects in modeling. It is shown in Fig. 1.

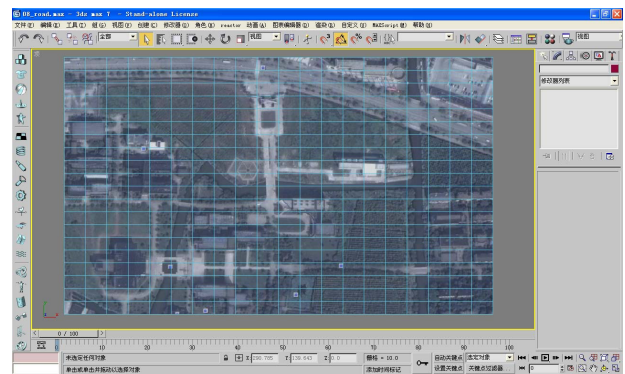


Fig. 1. Satellite image of college out of google map

B. Architecture Modeling

Most buildings in Suzhou University of Science and Technology are complicated, with many floors, large shape. Some of them are joint style, which is difficult to see its overall shape from the perspective of the ground. So it is necessary to use field measurement data and statistics of photographs and satellite maps in modeling.

1) North gate modeling

The north gate is a little complex architecture, which consists of several shapes mainly split into two side doors and a main entrance. First model the gate, post, base and other elements using 3ds Max modeling tool. After rotation, bending and other operations, we can get half of the north gate model. The other half can be automatically completed by using the "symmetry" tool. Then add some backbones according to the photos, also using the "symmetry" tool. Finally name the north gate model.

2) Teaching buildings modeling

There are some buildings between the north gate and the center, including Department of Architecture Hall, amphitheater building, first teaching building and second teaching building, etc, which need to model respectively.

a) Department of architecture hall

Department of Architecture Hall mainly consists of main building and an Auxiliary building. In order to model and paste pictures conveniently, the hall is split into six parts, which are modeled respectively. In the modeling process,

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we use Boolean tools to model the Department of Architecture Hall. Finally model other details according to the photos, including roof, trims and others. As is shown in Fig. 2.

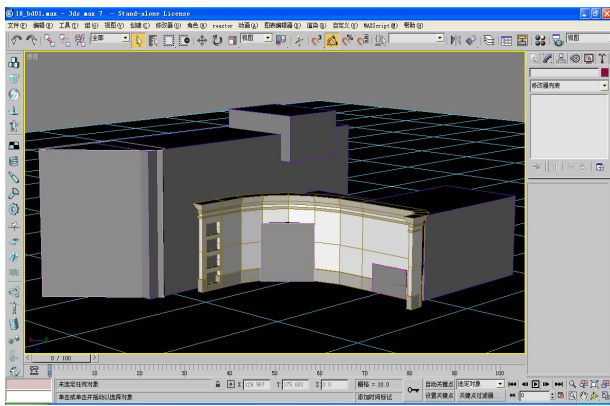


Fig. 2. Basic model of department of architecture hall

b) *First teaching building*

The body part of the first teaching building consists of three components. Each of them is a cuboid of different size, and setting position according to the map. We wish to make a realistic model to reflect details. Since there are many projections on the side of the body part, we implement it by using cuboids, and adjusting the height of the projections according to the photos. If it is higher than the body part, stretch it, otherwise sink the bottom part into the ground and add the roof. Finally name the model.

It is similar to model other three-dimensional buildings, so it is unnecessary to go into details.

C. *Roads and Lawns Modeling*

1) *Roads*

There are mainly two programs on modeling roads. One is to create several thin cuboids close to the ground as roads. The other is to cover all the related roads with a few large cuboids. Then cover part of the road side with lawn, forming the outline of the road. We take the second one.

2) *Lawns*

Modeling lawns is similar with modeling roads. Create some flat cuboids to cover the lawns according to the map. However, the sections should be a little more, because the lawn area is irregular, and needs to be adjusted. The lawns can be slightly higher than the road. The model is shown as Fig. 3, named “grass01”.

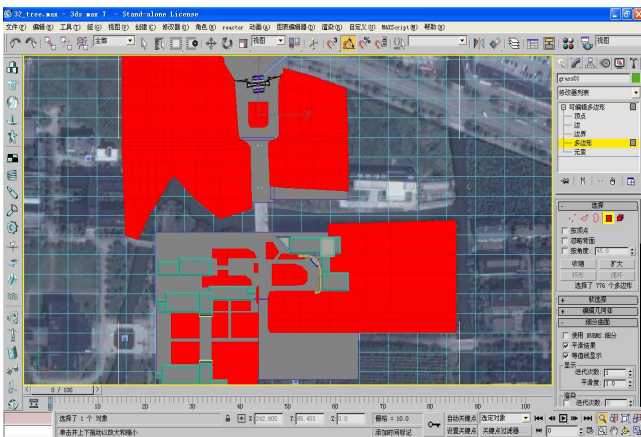


Fig. 3. Lawns modeling picture

D. *Bridge Modeling*

There are only three bridges in the scenario. In this paper, the main bridge road to the north gate is taken for instance, to illustrate the process of modeling bridges. First, according to the map, create appropriate cuboids, divided into five parts in length, three in width, three in height. The surface is regarded as the bridge deck, curved by adjusting some fixed points. Then adjust the width of the segments of the bridge as sidewalks, and squeeze them to be sidewalks. Finally, shape the side as the bridge opening, remove the bridge opening part, and seal it. The main part of the bridge is then complete.

The bridge railings on both sides are also formed by some cuboids. We can get a pair of railings by duplicating a completed one. Then put them on both sides of the sidewalk on the bridge deck after adjust their height. The bridge model is shown in Fig. 4, named “bridge01”.

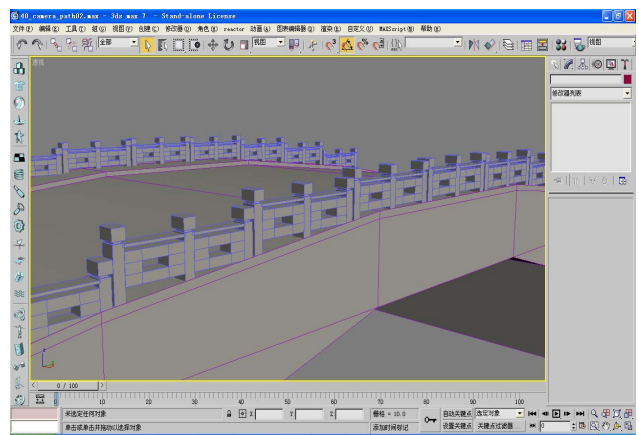


Fig. 4. Railing part of the bridge

E. *Landscape Modeling*

Landscape is not only used to beautify the campus, but also a very important part in increasing the simulation.

1) *Tree modeling*

There are many ways to model trees. We can model tree in full accordance with the shape. Also, we can use “direction board” in VRML or the cross patch. However, under the first circumstance, the number of polygons would increase significantly, with the size of files expanding, and operating efficiency reducing. As to the second method, with the number of polygons decreasing, the simulation is down a lot. So we choose a compromise way that is the third method.

First, create cuboids with appropriate width, and same height as the third floor of the building. However, the thickness of the cuboids is 0. That is to say, the side of the cuboids is invisible. Then, copy and rotate the patch, so that the two patches cross vertically. Finally, paste the picture, and complete the tree model. There are three kinds of trees designed in the scenario. They are grouped into three parts in order to distinguish. The names are “tree01”, “tree02”, “tree03” for each.

2) *Bush modeling*

Bush is shrubbery around the lawn. Since it is too much to model like trees, we choose trapezoids with small bottom instead. According to the real ground, the lawn is surrounded by these objects. The model is named “bush01”, shown in Fig. 5.

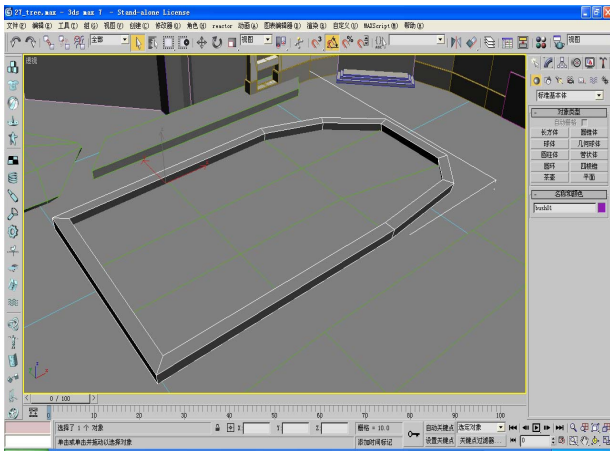


Fig. 5. Basic model of bush

3) Lamps modeling

There are two kinds of lamps in the scenario, both of which are near the north gate. One is the metal lamp composed of some cylinders. The other is the plastic lamp with many blades.

Modeling the first kind of lamp is to create some cylinders, and then adjust the height and location based on the picture. The upper half can be shaped as a circle, with slightly small diameter. Then remove the lower half. The head part of the lamp is composed of two hemispheroids of different radius. As is shown in Fig. 6.

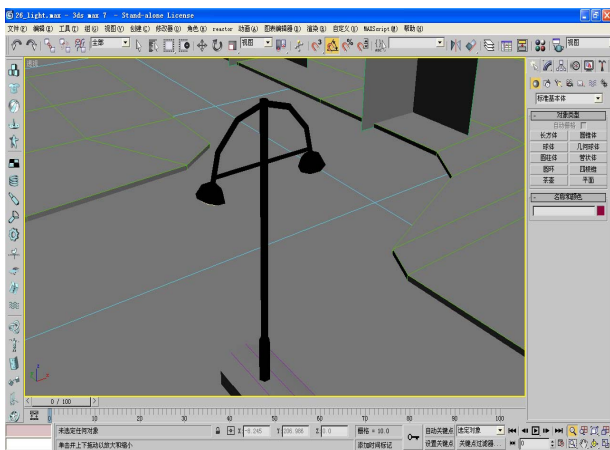


Fig. 6. Model of lamp 1

The main body of the second kind of lamp is cuboids. The blade is achieved by the curved thin cuboids. Then copy some to the round of the lamp according to the picture. The model is shown in Fig. 7, named "light01", "light02", etc.

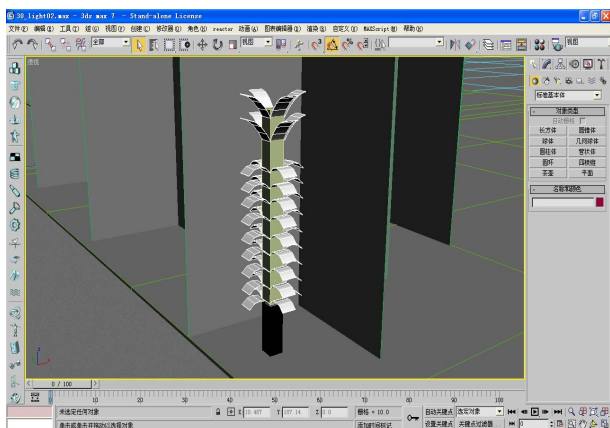


Fig. 7. Model of lamp 2

4) Riverway modeling

According to the map, draw a shape of riverway on the ground model using cutting tool in the vertex editing interface. In the polygon editing interface, pick the polygons covering the riverway, input an appropriate negative value, and use extrusion tool to pit these polygons as riverways. Then hold the "shift" key and move up these polygons, so that the patches of the riverways can be created as the water surface. The model is shown in Fig. 8, named "water".

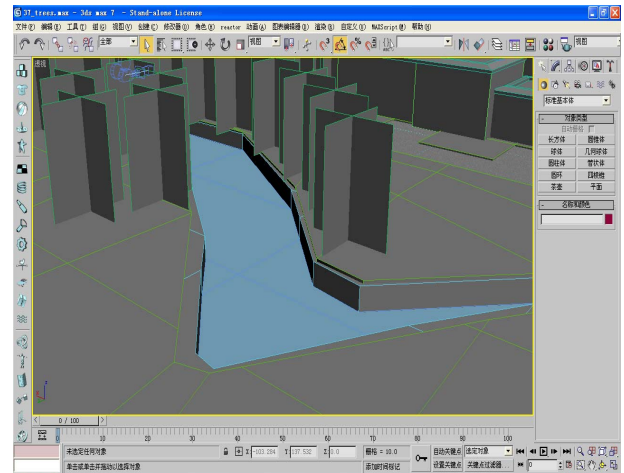


Fig. 8. Basic model of riverway

F. Light Modeling

Without light, the objects in the virtual scenario are hard to see due to the darkness. In order to simulate sunlight, four parallel beams, from different angles including north, south, east, west, is designed in this virtual scenario. The intensity of these beams is 1. All of their direction is towards the center part, so that all the corners of the scenario can be lighted more brightly and comfortably. The light source in VRML only has effects instead of physical reality. The model is named "FDirect" series.

III. SCENARIO MODELING

G. Textures in Model

After all the objects are created in the scenario, the models are smooth without any patterns or textures, which make it less realistic. So pasting some texture maps to models makes it more practical.

1) Making texture maps

Some texture maps are materials downloaded directly from the network such as trees and the ground. Some others are made by us such as the windows in the buildings and gates.

Here is a brief introduction on the methods. First, take photos of the objects, while the angle of the photos is nearly opposite to the objects. Then cut part of the photos needed using image editing software and save as an independent picture. So that the photos become as materials. The storage location of the maps is the folder "maps".

2) Road maps and lawn maps

The road maps is achieved by applying the picture "road01.jpg" under the folder "maps" to the model "road01". It is implemented by the material editor in 3ds Max. The

process of making lawn maps is similar. As is shown in Fig. 9.

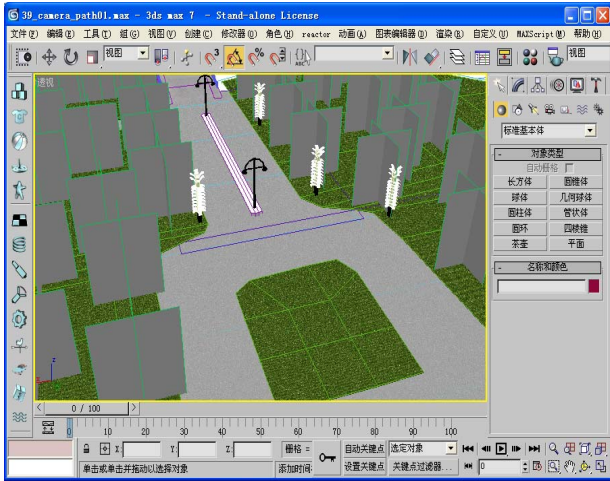


Fig. 9. Maps of road and lawn

3) Building maps

The method of the building maps is basically same as the ground. However, there are many kinds of the windows in the buildings, which mean many kinds of maps are needed. The series of maps named “bd_window” and “bd_gate” are mainly used in windows. According to the maps, different maps are labeled on different buildings, and the UV value is changed respectively. Two kinds of maps called white wall and stone wall are labeled on the two parts of the north gate. As to the college name on the main gate, we create new cuboids, adjust it, move onto the gate, and then label the college name map “UVname01.jpg” on the gate. It is shown as Fig. 10 and Fig. 11.

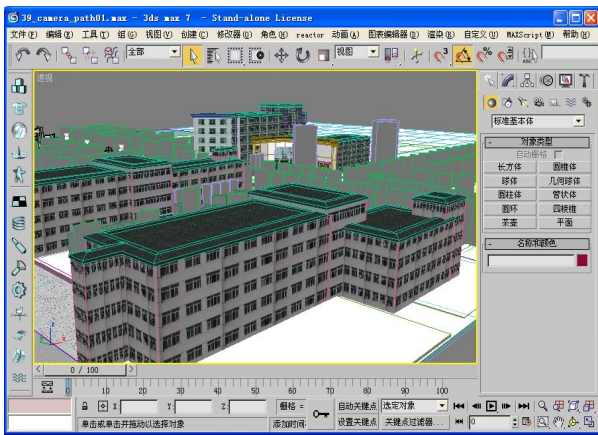


Fig. 10. Teaching building map

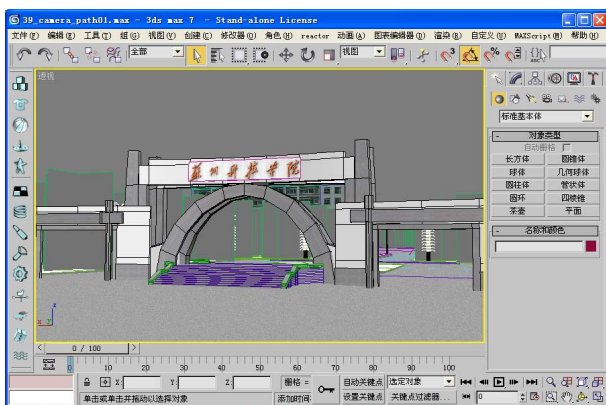


Fig. 11. North gate map

4) Landscape map

Because the pictures of trees are cut from other pictures with irregular margins, the backgrounds should be transparent. However, the transparent background cannot be saved as jpg format, while the gif format can. So the tree maps should be saved as gif format. Transparent effect cannot be displayed in 3ds Max, but it works after it is converted to the VRML. As is shown in Fig. 12.



Fig. 12. Running effect with tree maps

The maps of other objects are similar to the previous roads and buildings, so it will not be repeated again.

IV. PROGRAM TRANSFORMATION AND OPTIMIZATION

In 3ds max, only the designed virtual model can be run after it is converted into the VRML language format. The method is shown below. First, export the virtual model in 3ds max as a file of “VRML97 (*.wrl)” type. Then open it using NotePad or VrmlPad and we can get the converted model of VRML language format. The converted wrl model file needs to optimize, that is, classify the nodes with same kind, and all the Transform nodes are placed in one node, which is named as “Scene”.

Finally, add some sound and background node elements in the scenes, in order to enhance the presence while roaming.

V. CONCLUSION

Compared to the traditional two-dimensional maps, building three-dimensional virtual campus can contain a richer amount of information, and it can also provide users with more ways and interactive tools to learn about the school. With the development of virtual reality technology, virtual campus is bound to contain more content, with more broad prospects for development.

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