Research on 3D Restoration and Display of Tunisian Ancient Post Station

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Abstract: Tunisia is one of the few countries with a concentration of beaches, deserts, forests and ancient civilizations. It is located in the middle of the Mediterranean region. Tunisia has more than 200 ancient cities and ancient building ruins. Among the Islamic cities in North Africa, the old Tunisian city is one of the examples of urban building codes and has a high cultural research value. In order to reflect the cultural significance of ancient buildings, this article restores and reproduces a Tunisian post station. The main contents are as follows: We constructed the entire post station scene by site survey and consulting related historical data. We used 3ds Max and other 3D modeling software to model the houses, characters, animals, etc. in the scene, and we used Zbrush to sculpt and refine the models in the scene. Finally, the model was imported into Unity 3d to complete the entire scene and achieve interaction and display functions.

Keywords: 3ds Max; Unity 3d; 3D modeling; post station; relic restoration

1. Introduction

The ruins of ancient buildings are a symbol of human civilization, which contains a profound historical and cultural heritage, and they have extraordinary significance for the country and the nation. Nowadays, the protection of cultural heritage is facing unprecedented impact. The natural decline of historical heritage and the development of modern cities have increased the difficulty of cultural heritage protection. In addition, these ruins which fail to fully display the cultural significance are usually dilapidated. With the development of 3D modeling technology, 3D display has great potential in heritage conservation and restoration [1]. The technology can be used to reproduce the surrounding environment and human activities, and it is better to recover cultural heritage. In addition, it also plays a prominent role in preserving historical significance and improving positive learning experiences.

Foreign studies on heritage restoration have been very mature. Japan invested huge sums of money to build a digital "Tangzhaoti Temple", and it not only reproduced a real-time interactive 3D temple model, but also it gave visitors a sense of experience in the temple [2]. The 3D virtual ancient Roman city launched by Google in 2008 made the glorious scene of the ancient Roman city reappear, and users can also stroll through in the virtual Ro-

man city [3]. In recent years, researchers in China have also made some substantial progress in the field of heritage restoration. The Qin Terracotta Museum, Dunhuang Mogao Grottoes, etc. used virtual 3D digital modeling projects to restore the life scenes of ancient people at the time [4]. Beijing Normal University realized 3D modeling and virtual display of broken terracotta warriors and Beijing hutongs [5].

Based on the existing conditions of the ruins, we collected relevant image texture data and historical information, and we used 3D modeling and virtual simulation technology to model the buildings, surrounding terrain, and plants in the scene to achieve scene roaming, flying, animation and audio commentary.

2. Outline Design

We combined with the picture of the field photography (Figure 1) and relevant historical data to determine the outline of the scene. Besides this, we obtained the initial data of constructing the terrain by recording the physical features of the real terrain, the size of the plants, and the placement of the stones [6].

Figure 1. Reference picture of terrain

The building models in this study are the main part of the entire scene. We collected the picture information through the network and combined with the characteristics of local dwellings, and we initially established the initial outline of the house model as a low-rise building complex. We surveyed and recorded the length, size, and shape of the real houses to obtain preliminary data on the house construction. In addition, we checked the historical data and learned that the roof of the local people is curved in order to prevent sand and dust, so we designed the curved roof [7]. And according to the historical data, we learnt that the locals were mostly Arabs. Due to their

clothes were mostly black-and-white robes, so we collected relevant photos to prepare the costume design. The pictures of collected data are shown in Figure 2.

Figure 2. Ruins of houses

3. Restoration and Display of Ruins

3.1. Model Making

This research adopts the polygon modeling technology. This technology has a small amount of calculation and fast rendering speed, and it is usually suitable for large scenes. When you make a model, you must first pay attention to the fact that coplanar phenomena such as superposition and crossover are not allowed between the patches of the 3D model, and the case of missing faces or face flips in a single model is not allowed [8].

A good texture image can not only enhance the reality of the entire scene, but also it can effectively reduce the burden of the roaming system and improve the operating speed [9]. The collected texture images need to be processed because the texture images may have different resolutions. Firstly, the texture images were classified as the overall images and the detail images. Secondly, we processed the texture images by Photoshop. Finally, in order to improve the fluency of system, we tried to choose low resolution texture images without affecting the whole effect [10].

Taking the making of a house model as an example, first we determined the shape of the house based on the collected data, then we used 3ds Max to draw a two-dimensional outline, and we used the extrusion command to extrude a certain thickness to determine the basic shape. After that, we drew the outline on the front of the model and extruded a certain thickness in the direction of inside of the model to complete the making of the entire model. Finally, we exported the manufactured house model as an obj file, and then we imported it into Zbrush for detailed sculpting. After importing the model into Zbrush, we need to add subdivision levels to the model and use a brush to sculpt details such as scratches on the surface of the house to enhance the realism of the house. After we finish sculpting, we need to import the created textures and brush the textures on the corresponding parts of the house to make the overall transition of the house. The normal map of the house is shown in Figure 3.
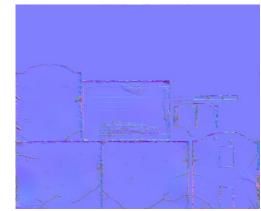

Figure 3. Normal map

The function of the normal map is to express the effect of bump. This way can not only represent the real effect of the model, but also it can save the memory of the system. The final house model is shown in Figure 4.

Figure 4. The house model

The steps for making a character model are as follows. We designed the appearance of the characters by recording information of facial features and dress, and we used 3ds Max to create various parts of the characters, finally we stitched them together and spread clothes on the character model. In addition, after we created the character model, we added bones to the character and skinned it, finally we added a script to achieve the animation effect.

The part of the model that cannot be seen during the 3D scene roaming process is not necessary to make it. For example, the polygons that are not visible at the bottom of the 3D building can be deleted directly. This can reduce the number of faces of the model to improve the rendering speed of the scene. Besides, it is necessary to consider the fineness of the production of model. The models that are far away from the field of view, such as sand dunes, we can make quick rough models. And we need to make more delicate models such as houses, characters, and so on. However, the number of faces of a single object should not be too much (Generally, it is suitable to control the number of faces of a single object below 7000).

3.2. Construction of the Scene

The entire 3D scene was constructed with reference to Fig. 1. The layout design based on the historical literature information and combined with the characteristics of houses, people, etc.

The first is the terrain design of the 3D scene. For the edge of the terrain, we adjusted the angle around the terrain to make a hilly effect. For the middle part of the terrain, different bump levels were made by the built-in tools to express the fluctuations of the ground. Finally, we added a river stream to make the entire scene terrain more natural. The initial terrain is shown in Figure 5.

Figure 5. Initial terrain

The second is the import of the scene model. After we exported the produced model from the 3D modeling software in FBX file format, we imported it into Unity 3d, and the texture map file will automatically generate the standard of corresponding shader. But you need to select the shader corresponding to the special material to display the material effect correctly. Because the default unit of the scene in Unity 3d is meter, the model will be reduced to one percent when we import the model. So the scaling of models needs to be adjusted to one to one. After consulting historical data, we learned that the layout of houses in the town is U-shaped to protect against wind and sand. Therefore, we designed the house to be placed on three sides and left empty in the middle. Since we built a post station in a Tunisian town, we also added markets and rest areas to the scene.

The lighting effect of the entire scene plays an important role in the rendering of the scene and the user experience. In order to make the scene light more natural, we need to add a directional light source as the sunlight of the scene. And some models are added to enrich the details of scene such as trees, jars, etc. The scene of relic restoration is shown in Figure 6.
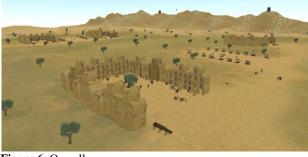

Figure 6. Overall scene

4. Module of Roaming and Interaction

We used NGUI plugin of Unity 3d to design the interface of system. After importing NGUI plugin, we created a UIbutton object and a C # script, and then we added the script to the canvas to achieve the login function of the system.

In Unity 3d, we added a first-person character controller to the scene and used iTween plugin to implement the flight function. In addition, we added function buttons to the scene and binded the corresponding c # script to make users choose functions such as flying, roaming, and animation. In order to make users experience better the cultural background of site, we had also added audio explanations to the system. The interactive interface is shown in Figure 7.

Figure 7. Animation interface

5. Conclusion

This article first determines the outline design of the scene, and it analyzes the collected data to implement the relevant functions. Besides, it is combined with material object to propose a feasible method with restoration of ruins. The simulation modeling base on this method can reduce the loss of system resources and completely display the ruins of ancient buildings, and it can also provide physical data for the study of historical culture.

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