

# 3D Digital Display of Chinese Traditional Costume

Shuyuan Shang\*, Zengmin Geng, Xiaohong Gu  
\*shang@bift.edu.cn, jsjgzm@bift.edu.cn, 1660192320@qq.com

Information Center, Beijing Institute of Fashion Technology, Beijing100029, China

**Abstract.** This paper first studies the digital display technology and methods of domestic costume and costume museums. By constructing the virtual display system of costume and costume museums based on three-dimensional geometric models and the virtual display system of costume and costume museums based on images, the advantages and disadvantages of the two construction methods are summarized, and the key path of digital display of Chinese traditional costume is obtained.

**Keywords:** digital display, costume, virtual museum, virtual reality

## 1 Introduction

China is known as the "Agricultural Crown Kingdom". Countless exquisite costumes are the precious wealth created by all Chinese nations and play a very important role in the history of world costumes.

The VR technology is used for digital display of cultural relics, so that visitors can understand the historical background of cultural relics more intuitively, comprehensively, anytime and anywhere, and have zero distance contact with cultural relics, appreciate the details of cultural relics from different angles, greatly improving the visitors' experience. Therefore, building a 3D virtual display system has great significance for inheriting and developing Chinese traditional costume culture.

## 2 Digital display of Costume and Costume Museum in China

Jiang integrates somatosensory interaction technology and augmented reality technology to design and implement a 3D costume culture display system based on Kinect somatosensory equipment <sup>[1]</sup>. The 3D model construction scheme reduces the number of patches of the model, which is of positive significance to the display speed of the model. However, the reduction of the number of model patches will lead to the reduction of the display accuracy of exhibits in the 3D display system.

Duanmen digital museum <sup>[2]</sup> uses virtual reality and artificial intelligence technology to fully and vividly convey the historical features contained in the cultural heritage of the Forbidden City to the audience. Through the matching of costume and the selection of accessories, the audience can understand the matching of court costume in the Qing Dynasty. With Kinect, you can also "put on" a whole set of court costume. The exhibition of Duanmen Digital Museum is shown in Figure 1.



**Fig. 1.** Duanmen Digital Museum – costume <sup>[2]</sup>

Tian used 3ds Max to create Manchu costume collections and exhibition hall models, and used clo 3D to generate dynamic display effects of costume; Use LOD technology to optimize the scene of the system; Based on the database, the dynamic call of the basic information of costume in the system is realized; With the help of HTC vive equipment, VR scene roaming and interaction between users and virtual costume collections can be realized <sup>[3]</sup>.

Tang uses 3D scanning equipment to obtain the scanning model of costume exhibits, and optimizes the scanned costume model. Taking the Han nationality costume Hall of the Ethnic Costume Museum of Beijing Institute of Fashion Technology (BIFT) as the object, the three-dimensional scene model is constructed, and the design and implementation of the virtual interactive display system of scanned costumes are completed. The virtual scene is roamed freely, and the interaction between users and costumes exhibits is realized. <sup>[4]</sup>

The drape, wrinkle and reflection of ambient light of different costume fabrics are very different. Different model building methods have a great impact on the display effect of costume and the interaction between costume and people.

Liang discussed the establishment methods of three-dimensional mannequins and three-dimensional costume models, pointing out that the virtual three-dimensional costume display technology is becoming more and more mature, and has developed from the initial static display of simple costume to the current dynamic display of complex costume, but it is still difficult to simulate the virtual deformation of costume and the drape of costume <sup>[5]</sup>.

Anhui museum uses VR panoramic technology to digitally display the boutique exhibitions in the museum through the Internet and mobile Internet platforms, so that visitors can roam the exhibition halls of Anhui museum without leaving home <sup>[6]</sup>.

The advantages of panoramic image in analyzing environmental visual information are as follows: 1) it can record the environmental visual information within a 360° spatial range with the viewpoint as the center, and restore the visual experience of people in the real environment; 2) It can accurately record the spatial geometric relationship of "viewpoint environment" and provide a data basis for quantifying the visual information of the environment <sup>[7]</sup>.

Liu Xin applied panoramic technology to restore the 3D real scene of the celebrity calligraphy and painting exhibition in the collection, adding functions such as hot spots, panoramic roaming and rapid navigation, and built a three-dimensional, digital, real scene integration and dynamic landscape model real scene panoramic Museum <sup>[8]</sup>.

Chen uses panoramic mosaic technology and unity3d to build virtual scenes, realizing the construction scheme of the virtual campus of Harbin University of Science and Technology [9]. The system has a certain degree of interaction function, and users can roam any scene on the campus through computers or other mobile devices.

### 3 Virtual exhibition based on 3D geometric model

#### 3.1 Scene model construction

##### 3.1.1 Construction of three-dimensional costume collection model

Creation of three-dimensional costume collection model: first, establish a costume outline reference map, build a basic model of costume, and then create a white model and add a texture map in 3ds Max software. The construction process of the three-dimensional costume model is shown in Fig. 2.

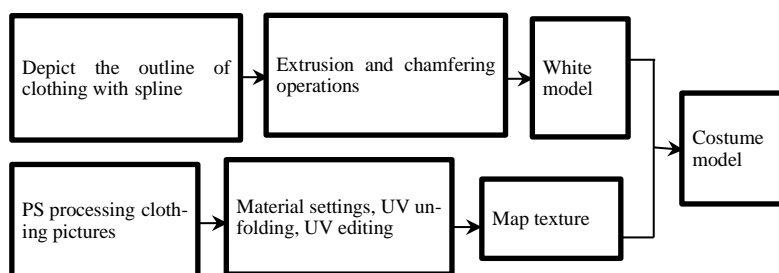


Fig. 2. Flow chart of apparel collection model establishment (owner-draw)

##### 3.1.2 Construction of 3D exhibition hall model

First, design the overall style of the exhibition hall, and determine the objects and positions in the exhibition hall; Secondly, design the space size of the exhibition hall, the size of the display cabinet, the position and size of the booth, the position and brightness of the light; Collect map textures in the exhibition hall, including ceiling style and texture, floor texture, plaque map, etc. Build a scene in 3ds max, set up lights, and render the scene. The scenario model construction process is shown in the fig3.

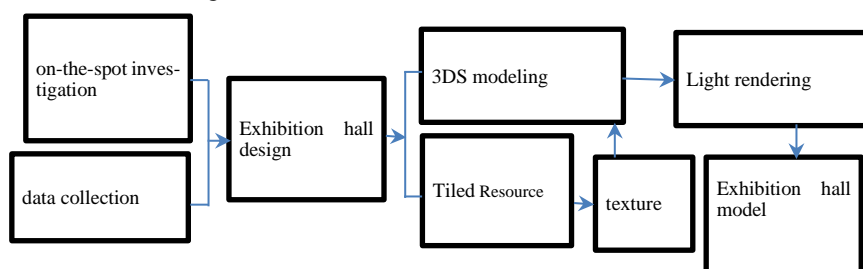


Fig. 3. Scene model making flow chart (owner-draw)

### 3.1.3 Construction of dynamic display model of costume

Costume display has the characteristics that other exhibits do not have, that is, the drape and natural wrinkles of costume. The software that has better simulation effect on the dynamic display of costume generally has clo 3D, Vidya, Style3D, and etc. Clo 3D can be used to build a model of dynamic display of costume and record a walk video of 3D virtual human. The clo 3D modeling process is shown in Figure 4.

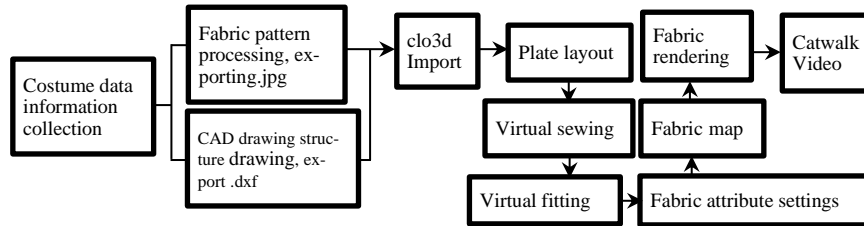


Fig. 4. Clo 3D modeling process (owner-draw)

### 3.1.4 LOD algorithm based on texture simplification

This method is based on the distance between the viewpoint and the model. When the distance between the viewpoint and the model reaches the boundary value of a certain level of LOD, the original texture will be replaced with a finer texture or a compressed texture. Through this method, a better balance between the system running speed and the fineness of the exhibits will be achieved.

## 3.2 Roaming path of virtual exhibition hall

To realize roaming in the costume virtual museum, first, it is necessary to build each exhibition hall of the museum and the positional relationship between the exhibition halls according to the situation of the real museum or the vision of the virtual museum, so that the system loads the next scene and the position and perspective of the scene according to the direction of the tourists at the entrance and exit of the scene. Through the on-site investigation of the Ethnic Costume Museum of BIFT, the positional relationship between the exhibition halls is shown in the fig5.

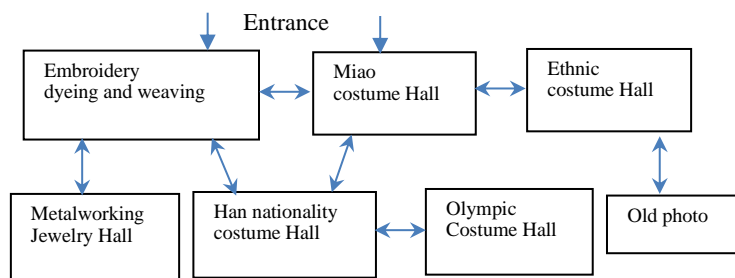


Fig. 5. Logical relationship of exhibition hall path (owner-draw)

### 3.3 Construction of virtual display system

In the virtual costume Museum, visitors can freely choose their walking route, move freely through the mouse and keyboard, and click on hot spots to enjoy 360<sup>0</sup> costume exhibits in all directions. The overall flow chart of costume virtual display system software is shown in the fig6.

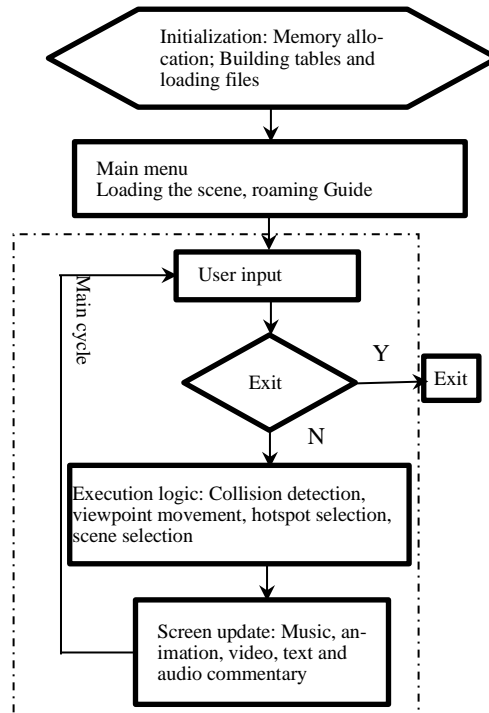


Fig. 6. Overall flow of system (owner-draw)

## 4 Virtual exhibition based on Panoramic image

### 4.1 Production of real panorama

Panorama is composed of projection images of six planes in space. There are three common methods for making Panorama:

- (1) Generate maps seamlessly spliced on the six faces of the cube by using relevant software.
- (2) Using special photographing devices and methods, 6 material photos for making panorama are obtained, and processed and spliced.
- (3) The fish eye lens is used for shooting, and the 180<sup>0</sup> lens is selected to take two hemispherical photos. After relevant processing, these two photos become rectangular photos with a length to width ratio of 2:1. After further processing, they are converted into spherical panorama.

This article uses insta360 one X2, which can easily collect consumer panoramic pictures with 6080 x 3040 pixels, as shown in the figure 7a.

#### 4.2 Construction of real panoramic scene map

Use unity software system to build panoramic scene. First, create the unity 3D project; Panoramic image of import resource; Panoramic image mapping mode setting; Create material; Load the panorama on the material; Setting a first-person camera; Set the camera bearing plane; Set collision attributes of each object; Write a hotspot click response program. The constructed scenario is shown in the figure 7b.



a. A panoramic in Ethnic Costume Hall

b. A scene based on panoramic

**Fig. 7.** Virtual display system based on Panorama (owner-draw)

The fundamental difference between the virtual exhibition of costume and costume museum based on three-dimensional geometric model and the virtual exhibition of costume and costume museum based on image lies in the different construction methods of Museum exhibition hall model and costume exhibit model, which leads to the different consumption of computing resources such as scene loading, shadow calculation, collision detection and so on in the process of virtual exhibition. The control logic of the virtual display system is basically the same.

### 5 Comparison of virtual display based on two modeling

According to the above research, the digital display system based on three-dimensional geometric model and the digital solid system based on panoramic image have similar construction processes, and each has its own advantages. The advantages of the virtual display system based on 3D panorama technology are as follows:

- (1) Strong realism, because it is made based on the pictures taken on the spot, which is more realistic than the objects generated by 3D geometric modeling;
- (2) Wide viewing angle, convenient control and good interactivity. Users can control the scene to look around, down and up with the mouse, and can obtain more image information;
- (3) The production steps are simple, the production cycle is short, and the production cost is low;
- (4) The generated 3D panoramic virtual scene file has a small capacity and is easy to spread, browse and watch on the Internet;

(5) It has good compatibility, can be browsed and viewed without taking out equipment, and can be perfectly combined with traditional two-dimensional websites;

Correspondingly, building a virtual display system based on 3D panorama technology also has corresponding defects, mainly including:

- (1) The 3D panoramic image may be distorted;
- (2) You can only browse according to the time axis of panoramic picture shooting, and you can't change the light source and shadow of the scene, but for the indoor place with fixed light source such as the museum, this shortcoming is avoided;
- (3) The virtual scene built based on the three-dimensional geometric model can change the exhibits as needed, while the exhibits of the image-based virtual museum are immutable;
- (4) The garment model built based on three-dimensional geometry is convenient for building a virtual fitting based on body shape, and is conducive to the interaction between visitors and exhibits. This is incomparable to the image-based system.

## **6 Conclusion**

The digital display of costume and costume museum makes the audience feel the external beauty and internal charm of Chinese ethnic costume, so as to better inherit and develop the ethnic costume culture. Taking the Ethnic Costume Museum of Beijing Institute of Fashion Technology as the object, this paper describes the construction process of a 3D virtual display system based on 3D geometric models and panoramic images, and analyzes the characteristics of the two systems. The 3D virtual display system based on 3D geometric model has a large amount of modeling work, but it can replace the exhibits at any time as required, and is convenient for the dynamic display of costume. The 3D virtual display system based on panoramic image is fast in construction and operation. The virtual display screen is completely consistent with the real scene, which is undoubtedly a good choice for one-time display.

## **Acknowledge**

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