Study on the structure and virtual model of “xiezhi” gown in Ming dynasty

Shuran Yang 1,3,a, Li Yue 1,3,b*, Xiaogang Wang 2,3,c

1 Wuhan Textile University School of Fashion, Wuhan, Hubei, China
2 Wuhan Textile University School Of computer science and artificial intelligence, Wuhan, Hubei, China
3 Research center of Wuhan textile and garment digital engeering and technology
aemail: 2001008@wtu.edu.cn, bemail: 3074543407@qq.com
*Corresponding author’s cemail: 2001008@wtu.edu.cn

Abstract: By now, there is still relatively blank area for studying the Chinese historical costume, which basically the traditional sample replicating method is used. It takes long time, and many clothing patterns and techniques can not be fully resembled. Since the development of CLO3D virtual simulation technology, the visual model of clothing can be set up on the virtual human body, and the model can simulate the fabric texture and physical properties. In this paper, by studying the color, fabric and structure of the Ming Dynasty “xiezhi” “side ear” round-neck gown, the structure is reproduced and simulated and reproduced through the CLO3D system. The use of digital technology to simulate and restore the Ming Dynasty “xiezhi” round-neck gowns is a new method of inheriting Chinese traditional clothing culture, and it is also the basis for establishing a visual clothing database.

1. Introduction
With the continuous advancement of CLO3D virtual simulation technology, the research on clothing virtual trying-on has gradually become a hot spot in clothing research. The virtual trying-on of clothing can help people observe the effect of clothing more accurately and intuitively, and the research of Chinese historical clothing can also be simulated and reproduced through virtual trying-on models, which is a new way of inheritance. This article takes the Ming Dynasty round neck gown as the research object, carries on the virtual trying-on modeling and verification, in order to achieve a better restoration of the Ming Dynasty gown. In this paper, the “xiezhi” gown is taken as the research object, the virtual sample model is set up and the method and pattern are verified. The Chinese traditional costume is duplicated by modern science and digital technology.

2. Variety of Men’s Clothing in Ming Dynasty

2.1 The influence of Ming Dynasty economy, politics and culture on clothing
In the early days of the Ming Dynasty, its political economy was severely damaged. Therefore, the founding emperor of the Ming Dynasty, Zhu Yuanzhang, in order to rehabilitate and rejuvenate, politically strengthened the centralization of the rule, implemented the economically to encourage land reclamation, and build water conservancy projects. The ideology was promoted by science. In this
In economic, political and cultural context, the rulers of the Ming Dynasty paid much attention to the distinction between etiquette systems and ranks in terms of dress. The concept of "distinguishing high and low, wise and prestigious" has been formed. Officials of different levels can only wear clothing of the same level [5].

In order to restore the traditional costumes of the Han nationality, Zhu Yuanzhang, the ancestor of the Ming Dynasty, eliminated the Yuan Dynasty costume characteristics. "From the Zhou Han to the Tang and Song Dynasties", the Ming Dynasty Hanfu was formulated. Among men's clothing in the Ming Dynasty, official clothing was roughly divided into sacrificial clothing, court clothing, public clothing, and ordinary clothing. Common men prefer gowns [4].

2.2 The color, fabric and patch filling of “xiezhi” round neck gowns
The colors of traditional Chinese clothing are usually influenced by the theory of the five elements of "yin and yang". The five elements of "yin and yang" means that the world is composed of five substances: metal, wood, water, fire, and earth, and operates under the impetus of the two elements of "yin and yang". In the Ming Dynasty, although the emperor of Ming Dynasty restored the old system of the Tang and Song Dynasties, because Confucius once said that "the evil purple is the one to win the vermilion," the purple was removed and the vermilion color was adopted as the orthodox color. Therefore, the costumes of the Ming Dynasty were prevalent in red. Due to the age of “xiezhi” round-neck robes, it is impossible to distinguish its own color. However, the “xiezhi” round-neck gown was worn by Fengxian officials, In modern times, it is same as the prosecutor. According to the strict official uniform system of the Ming Dynasty, “the first to fourth grade, the scarlet robe; the fifth to seventh grade, the green robe; the eighth rank, the nine rank, the green robe. And the highest in the Ming Dynasty Fengxian officials is the second-grade positive and the lowest is the seventh-grade positive, so the wearer of the “xiezhi” round-neck gown should be between the second and seventh grades, and the color should be red robe (that is, red robe) or green robe.

In the Ming Dynasty, the clothing materials worn by officials were silk or leno silk, while ordinary civilians wore coarse clothing made of cotton and linen. Even if the gauze was fine, the blue and black color was only allowed to use. According to data collection, the fabric of “xiezhi’s” round-neck gown is silk satin with dark floral moire pattern. And it is a dark satin material. The chest and back are woven with patterns of auspicious clouds. And a small amount of twisted gold can be found in the chest and back patterns. It can be seen that the round-necked robe is made of twist gold on the chest and back when weaving.

“Buzi” first appeared in the Wu Zetian period of the Tang Dynasty, but it was not until the Ming Dynasty that it was clearly used to distinguish official ranks. In the Ming Dynasty, “Buzi” was mostly symmetrical 40 cm square embroidery with patterns of birds and beasts. Among them, the tonic of the civil official is a bird, the tonic of the military officer is a beast, and the tonic of the Fengxian official is usually “xiezhi.” The tonic on the duplicate robe is "(xiè zhì)", a kind of beast in Chinese myths and legends. According to the legend, “(xiè zhì)” can distinguish right from wrong. In the face of treacherous officials, it is knocked down with a horn. Swallowing, in ancient times, was a symbol of fairness, justice, and discrimination between right and wrong.

3. Structural analysis of “xiezhi” round neck gown and side ears
3.1 xiezhi round neck robe structure
The shape of the round-neck gown had already begun to take shape in the early years of the Han Dynasty. But before the Eastern Han Dynasty, it could only be used as a lining (underwear), until after the Six Dynasties began to wear outside and can be worn as a formal wear. The structure of the round-neck gown in the Ming Dynasty is the "cross plane structure" of the traditional Chinese dress structure. The front and back of the cross plane structure are bounded by the middle seam of the sleeve. The front and back parts are basically symmetrical, and the left and right sides of the body are also basically. The center line is the axis of symmetry, and it is cross-shaped [6]. The main parts of the
The round neck of this gown with specific structure can also be called a tuan collar, which is different from the traditional stand-up collar. It must have a hard lining inside to make it stand up, and then fasten it with buttons. And the placket of the Ming Dynasty gown extended from the collar to the armpit into an arc or straight line, and then tied it with a belt. The sleeves in Ming gowns are mostly “pipa” sleeves. “Pipa” sleeves are usually small cuff and large sleeves. The tightening of the cuffs is also called "qu". Because the underarms are narrow, the overall shape of the sleeves looks like a “pipa.” So it is called “Pipa” sleeve. The overall shape of the “pipa” sleeve is arc, which can facilitate enough movement of the arm in the sleeve. At the same time, the tightening of the cuff is also more conducive to people doing things in daily life.

### 3.2 Structural analysis of “side ear”

At the same time, the round-neck gowns also combined the costumes of the Yuan and Mongolian ethnic minorities to form a "side ear". “side ear” is a unique structure in the round-neck gown, which appeared in the Ming Dynasty. This is because at that time, although Ming Taizu Zhu Yuanzhang in order to eliminate the customs and costumes of the Yuan Dynasty, Emperor Zhu Yuanzhang of the Ming Dynasty. In the "Records of Ming Taizu", it was also recorded that "their braided hair, vertebral hair, Hu clothing, Hu language, and Hu surname are all forbidden."Hu is the general term for ethnic minorities in ancient China. But even in this general environment, cultural exchanges between various ethnic groups are an unstoppable trend, which has not completely eliminated Yuan and Mongolian costumes.

From the perspective of costumes, “side ear” is a representative of the combination of Han traditional costumes and ethnic minority costumes, and is a manifestation of the multicultural clothing of my country. In terms of function, one can increase the looseness of clothes and increase the range of people's activities. Second, in ancient times, revealing the inner clothing does not conform to the etiquette, and inserting ears into the clothing can play a role in covering the inner clothing. The same jacket can also play a role in supporting the side ears, and the two complement each other. And based on the collection of relevant data [2], after drawing specific data and drawing the plate shape, the author conducts experiments with white fabric and continuously adjusts it. After stitching the actual object, it is obtained that the side ear is 80cm long and 31cm wide. The dot lines are the fold lines. A is the front, and b should be turned inward as shown in figure 1. Then the side ear helps to connect the front and back. The overall renderings are drawn by the author as shown in figure 2.

3.3 Analysis of the structural panel of gowns and garments, style diagrams and data analysis

After the gown is drawn by CAD, except the sleeves and collar, and the body part is divided into three pieces (as shown in figure 3), namely the left front piece, the right front piece and the large flap. Since in ancient times, the traditional Han clothing system was all right closure, this is because the costumes of most ethnic minorities were basically left closure. The ancient Hans used to distinguish the clothing styles from ethnic minorities. At the same time, right closure were also an important part of Han
Therefore, the costume "right closure" is a traditional costume etiquette system. Therefore, when sewing round-neck gowns, it is necessary to sew the large flap with the left front piece first, and finally the right front piece, and the right front piece must be covered by the left front piece and the large flap. The shape of such clothing is the right closing. Then the collar, sleeves and side ears are sewing to the body. Through data analysis, specific data is shown in figure 1, and the shape of clothing is shown in figure 3 [1]. Figure 4 shows the pattern and figure 5 shows the style of the gown. Through data analysis, the specific data is shown in Table 1, and the clothing shape is shown in Table 2.

4. Virtual trying-on and reproduction of “xiezhi” round neck gowns

4.1 3D virtual sewing of “xiezhi” round-neck gowns
First of all, CLO3D virtual trying-on is building a 3D human body model, because it is an official gown, a male body model is selected. And because the sleeves of the gown are too large, only by spreading the arms flat can the shape of the sleeves be better restored.

It is the choice to unfold the arms. After importing the plates and stitching them, Virtualization them to observe the effect of the re-engraving of the round neck gown. Secondly, in order to facilitate the virtual stitching in CLO3D, the sleeve and the body are divided into two pieces. Originally, the gown had to be fastened with buttons on the neckline, and the underarms were lace-up styles. In CLO3D, there were no buttons and belts that met the requirements, thus the large flap of the gown is sewn directly to the right front piece. At the same time, in the software, in order to reflect the folding effect, the side ear is cut into two pieces along the folding line for stitching. When stitching, the side ears cannot be kept upright because the fabric is soft, so the inward side ear pieces are selected for hardening, which supports the side ears and ensures the shape of the side ears. And at the beginning of the virtual operation, the pleats were not sewn to directly connect the side ears, and then were deformed after stitching. First, pleats were stitched. Including the tonic on the clothing, due to the age of the unearthed gowns, the color of the tonic pattern has also faded to ocher. Therefore, when stitching the modern duplicate “Xiezhi,” it needs the inner seam to the front and back before sewing the patch on the gown.

Then the garment pieces are arranged on the model according to the arrangement points of the human body in CLO3D (as shown in figure 7). At the same time, when arranging the 3D garment pieces, in order to avoid the garment pieces cutting the human body, the 2D garment should be constantly adjusted (as shown in figure 6). Whether the 2D garment pieces are in the right position, the combination of the two pieces can make the 3D garment pieces arranged on the mannequin. First the big placket and the left front part are sewn, and it is covered on the right front part, and then sleeves and side ears are stitched. After stitching, the front, side, and back sides are compared and adjusted continuously according to the final costume effect.

for the virtual fabric, the large red embroidered yun he round-neck gown is chosen as the example in Shandong Museum's, and the patch is a modern duplicate “xiezhi” patch. The virtual effect is as follows (as shown in figure 8).

\[ \text{Figure 8 positive, side, back} \]

4.2 Experimental replication verification of round-neck gown samples

In order to verify the correctness of the pattern and method obtained by the research, the sample garment experiment is adopted, and the experimental sample garment is completed according to the CAD pattern (figure 4), Complete the experiment sample (as shown in figure 10). The results of the experiment shows that the modeling characteristics and clothing size of the round neck gown, as well as the structure of the side ears, are highly consistent with the unearthed cultural relics, indicating that the structural model and research method of this study are correct. On this basis, the established three-dimensional virtual model restores historical facts in terms of clothing fabrics, colors, complements and structures. It shows that the model established by this research reproduces the costume form and cultural characteristics of the historical period at that time.
5. Conclusion

The research is based on the cultural background, structure, fabric and color of the “xiezhi” round-neck gown in the Ming Dynasty, combined with CLO3D virtual trying-on technology and physical production. Better to reproduce the original appearance of the gown, and the following conclusions are:

1. The main parts of the “xiezhi” round neck gown in the Ming Dynasty include left body, right body, left sleeve, right sleeve, four side ears, large placket, collar, etc. ”side ear” is a product of cultural exchanges between ethnic minority and Han ethnic groups in the Yuan Dynasty. The fabric is silk satin with dark floral moire pattern, and the technique of gold weaving and traditional Chinese pattern moire are applied on it. The color may be scarlet or cyan, and the complement is “xiezhi.” The clothing structure is still based on the traditional Chinese cross structure. The front middle and back middle of the body must be slit, and the sleeves are wider than the wrist line.

2. After structural research, using CLO3D virtual trying-on software to restore the colors, fabrics and styles of gowns, you can more intuitively observe the shape characteristics and clothing effects of ancient gowns, and modern technology is used to replicate the ancient costumes help people not only understand the ancient costumes, but also inherit the traditional culture. Three-dimensional simulation technology is a breakthrough in the replication of ancient clothing. At the same time, it also provides a new method for the inheritance of Chinese traditional culture, which has important significance for the establishment of virtual apparel databases for different historical ages.

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