Traditional Clothing Digitalization Technology: A Case Study of Three-dimensional Digital Restoration of the Leather Coat in Northern Wei Dynasty

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Abstract. With the development of artificial intelligence, big data and other information technologies, digital technologies have been widely applied. China has seen further enhanced ethnic cohesiveness and core social competitiveness recently, as well as gradually deepened cultural interactions and communications with other countries. Digitalizing traditional clothing and accessories benefits the protection and inheritance of traditional ethnic culture, consolidation of their status, reshaping of national image and enhancement of ethnic and cultural identification. On this basis, this paper presents a case study of leather coat of the Northern Wei dynasty, a collection of the Xilin Gol League Museum, Inner Mongolia, where three-dimensional digital software was used to complete processes like clothing piece drawing, cutting, pattern development and grain effect production. After that, the Style 3D software was applied to fulfill a virtual try-on presentation, further enhancing the inheritance and protection of traditional clothing and accessories.

Keywords: traditional clothing; leather coat of the Northern Wei dynasty; Three dimensional digitization; the Style 3D

1   Introduction

National costumes are an important part of Chinese traditional culture. China boasts a vast territory and numerous nationalities, and each nationality has its distinctive traditional costumes because of their different living backgrounds and customs. With modern economic growth, some of the national ethnical costumes are gradually replaced by modern clothes. Influenced by multiple factors, the culture of traditional national costumes of China faces a battery of obstacles and dilemmas in the process of inheritance and development, to the detriment of the development of national costume culture. Therefore, China should vigorously explore a path to develop the culture of traditional national costumes and inherit and promote it with the help of digital technology.

2 The plight of the inheritance and development of national costume culture

2.1 The development of national costume culture is neglected resulting from the Western ideological and cultural surge

As global economic and cultural integration speed up, some young people generate different ideas from the collision between Chinese and Western cultures and are impacted by different western cultures, thereby overlooking the traditional national costume culture of China to some extent [1]. Furthermore, those who have studied or worked in Western countries for a long time are deeply influenced by Western dress culture, and their national cultural ideology and cultural awareness are insufficient. As a consequence, these people break conventional perceptions, change the style and characteristics of traditional national culture, oppose traditional costume culture and develop unhealthy cognition [2]. On the other side, there are many ethnic minorities in China, but their total population is small, and the long-standing shackles of foreign culture and ideology hinder the inheritance and promotion of Chinese national cultural costumes and makes them underrated, which may lead to the extinction of traditional national culture.

2.2 The influence of domestic economic growth and ideology

With economic growth and technological advancement in China, people's mindset, aesthetics, cognition, and dressing habits have gradually changed, and the inheritance and development of traditional costume culture of many nationalities are impacted by the influence, assimilation, and invasion of modern mainstream ideology [3]. As a result, their unique customs and national and regional cultures and thoughts have faded out and the concepts about the protection and inheritance of traditional costume culture have changed. However, in the process of protecting traditional costume culture, the means are obsolete, the forms are monotonous, and a favorable environment for promoting, protecting, and inheriting cultural costumes has not been created. Finally, the inadequate protection of traditional national costume culture leads to a cultural drain, and the room for inheritance is limited.

2.3 The inheritance of national costume culture tends to be commercialized

With economic growth and social progress, people require a higher quality of life, so tourism has become one of the popular pastimes now. As regards the inheritance and promotion of traditional national costume culture, wearing national costumes when advertising and promoting tourist attractions, tourism industry, and tourism products has become a common practice as deeply influenced by commercialization. As a consequence, national costume culture has lost its unique national significance and characteristics and has become a publicity tool for the tourism industry. If things continue this way, it will impede the building of national image and the protection and development of traditional national costume culture.

3 Application methods of digital technology in traditional national costume culture

3.1 Raise awareness of protection and base on fundamental digital protection

In the process of protecting, inheriting, and developing traditional national costume culture, China should at first change the ideology of its people, weaken the impact of Western ideology and culture, strengthen its national ethos, take fundamental digital protection as the foundation to support and guide the endangered traditional national costume culture by preserving it through records, films, images or videos, and enhance policy-based protection, thus intensifying the development of traditional national costume culture. [4] Besides, we should innovate and develop traditional culture, keep abreast of the times, creatively develop traditional costume culture, arouse the interest of more people, and make costumes more appealing, in order to better protect, inherit, and promote traditional national costume culture.

3.2 Expand the development room for traditional costume culture with the support of digital technology

The combination of traditional national costume culture and digital technology can expand the room for cultural inheritance, step up efforts for cultural inheritance, and make cultural inheritance and development more innovative, thus contributing to the improvement of national cohesion to some extent and consolidating the competitiveness of traditional culture. For traditional national costumes, it is necessary to make the most of digital technology to achieve the inheritance and innovation of traditional national culture in diverse ways, in order to increase the value of traditional national culture, build up national cultural confidence and weaken the impact of Western culture on the traditional culture, thus better developing national cultural ideology and national costume culture. Furthermore, the advancement of digital technology enables its combination with culture and art, so digital technology may be used in the application of traditional costume culture to achieve digital protection and innovation of films and television series, and digital scene shooting can be used to strengthen public understanding of traditional cultural costumes, and intelligent technology should be used to boost people's experience of traditional costumes, deepen the understanding of and love for national costumes, and boost cultural perception.

3.3 Strengthen the training of innovative talents with the help of digital technology

For the inheritance and promotion of traditional national costume culture, we should change our mindset and ideas as society develops, keep pace with the times, and innovate traditional national costume culture [5]. Meanwhile, in the process of developing and applying digital technology, it is necessary to foster innovative and versatile talents, intensify cultural innovation, reinforce the cultural cohesion of national costumes, and raise the status of national costume culture in traditional culture [6]. Moreover, it is essential to change the commercialization of traditional national costumes, strengthen the training of talents, innovate and design the development path of national costume culture, enhance cultural analysis, establish and improve the structure of personnel training, facilitate the close combination of cultural development and technology, advance the cultural inheritance and development of the whole nation, and boost national harmony.

4 Digital Fulfillment of Traditional Ethnic Clothing Culture: A Case of Fur-collar Leather Coat Unearthed from the Mongolian Tomb Cluster of the Northern Wei Dynasty.

4.1 Fur-collar Leather Coat Unearthed from the Mongolian Tomb Cluster of the Northern Wei Dynasty

The leather coat of Northern Wei dynasty is a collection of the Xilin Gol League Museum unearthed from the Mongolian tomb cluster of the Northern Wei dynasty near the Yihe Naoer, the Plain and Bordered White Banner, Xilin Gol League, Inner Mongolia. The tomb cluster is located north of the Six Towns and the Great Wall of the Northern Wei dynasty and is surrounded by a typical steppe landscape, making it the most northern tomb cluster of the Northern Wei dynasty in China. Unearthed from the Northern Wei Tomb Cluster near the Yihe Naoer, the Plain and Bordered White Banner, Xilin Gol League, the fur-collar leather coat of the Northern Wei dynasty, one of the top 10 archaeological discoveries in China in 2014, is a precious physical material for researching the grassland Silk Road, border history and ethnic communications, interactions and integrations during the Northern Wei period.

4.2 Digitalization of Northern Wei Leather Coat

Affected by multiple factors like the burial environment, there was a loss of internal water and lipid molecules from the leather product after was unearthed. Elastin and collagen fibers of the coat were seriously distorted due to thermos-oxidative aging, causing a narrowing of collagen fiber spacing and an increase in the friction between collagenous fiber bundles. As a result, the collagen fibers became thinner, shorter and mutually entangled, leading to a loss of softness and a seriously hardened and dried surface. The coat was restored by the museum, as shown below Fig. 1.

**Fig. 1.** Before restoration (left) after restoration (right)

Picture Resource: https://mp.weixin.qq.com/s/FjXslmN_sOLRUPpt6-HLNQ

Using the three-dimensional (3D) software, the processes of clothing piece drawing, cutting, pattern development and grain effect production. Then, the virtual try-on display of the clothing was fulfilled based on the Style 3D software, generating a rendering that can be appreciated from 360-degree angles.
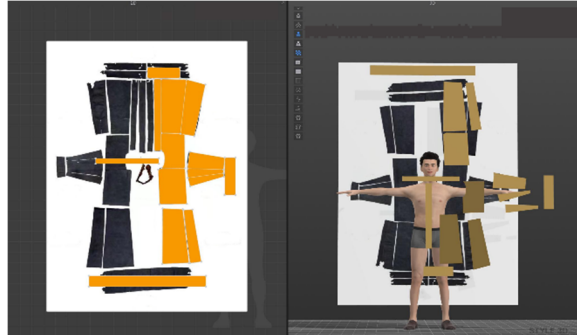
Fig. 2. Size restoration. [Computer drawing]

Size restoration.（Fig. 2.）The plane spread figure of existing pieces was imported into the 3D software. A male model was invoked, whose size was used as the default size (height 182, chest measurement 96, shoulder width 46, neckline circumference 40.5, and arm length 62.5). To better fit the clothing display effect, the model was set to assume a posture of 90-degree abduction of arms with feet naturally parted. To better restore the wearing effect, the image of the clothing was placed behind the model to find the wrists and sleeve openings based on the corresponding relationship between the clothing and the human body. The size of the plane spread figure was adjusted based on the length of the clothing, deriving the reference size of the pattern.
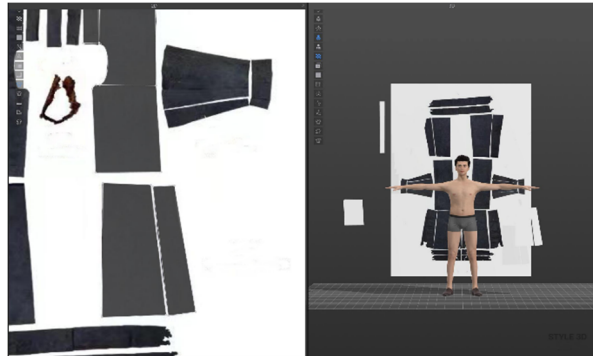

Fig. 3. Pattern tracing. [Computer drawing]

Pattern tracing.（Fig. 3.）2D patterns were drawn based on the plane spread figure, which was then placed against the position in the 3D drawing for comparison. The edges of the fragments of patterns were traced using drawing tools. Considering the basic symmetric relationship between the left and right patterns, we started tracing first on the right side of the figure (left side for the wearer). The edges were aligned with those of the pattern as much as possible through editing the point on curve tool. Specifically, the collar and drop back hem were asymmetric patterns, and thus their complete patterns needed to be traced.
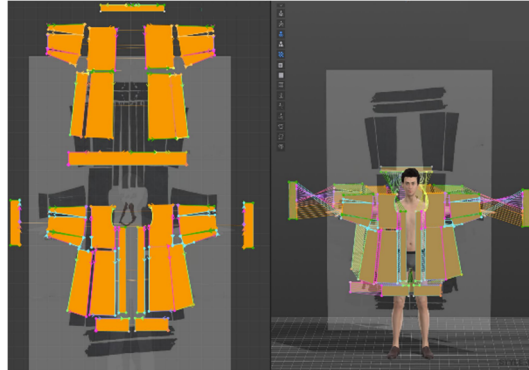
**Fig. 4.** Structural analysis. [Computer drawing]

Structural analysis.（Fig. 4.）The structure of the clothing was completed based on the figure of the physical clothing, and symmetric patterns were produced. According to an analysis of the physical clothing figure, the structure of the coat is characterized by a standing collar, front opening, A-shaped profile, quasi-circular sleeves, straight cut, a strap around collar and a sleeve length extending to the back of the hand. The original object was a leather coat. Unlike clothing made of other materials, leather clothing often adopts a montage stitching of small pieces in part of the structure in order to reduce material waste. After a careful analysis of the images, we extended the original three patterns, one larger and two smaller, of the sleeve fragments into a pattern comprised of two larger and four smaller pieces, resulting in a size close to the stitching position of the armhole. There was only a half of the physical sleeve opening fragment. Therefore, the original size was doubled to make a complete structure.
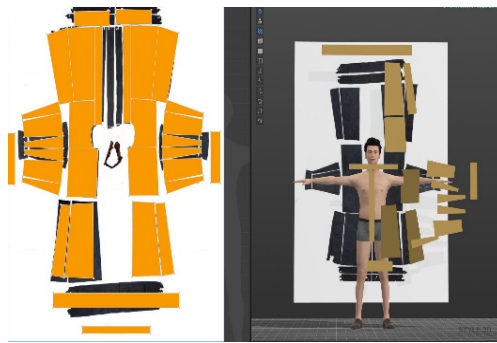
**Fig. 5.** Arranging pattern. [Computer drawing]

Arranging pattern.（Fig. 5.）Sewing thread was added. The position of the pattern was adjusted based on sewing relations. The pattern was placed to the corresponding location of the model and the free sewing tool was used to add sewing relations to the side seam, shoulder line, armhole, collar opening and sleeve opening of the pattern. All sewing relations were separately marked in color in the figure. Based on the position of the pattern, the completeness and accuracy of the settings of sewing relations were checked. When adding sewing thread, it was found that part of the sewing sizes had errors as the pattern was derived from direct tracing of fragments, resulting in an inability to sew up the pieces. Therefore, we made minor adjustments to

the pattern in the 2D window, and basically controlled the error between the two stitch lines between +-0.05cm.
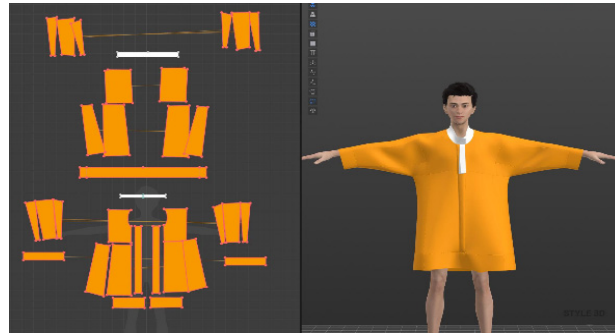
Fig. 6. Virtual sewing. [Computer drawing]

Virtual sewing.（Fig.6.）Sewing was simulated and shapes were adjusted. After sewing positions were confirmed and no entanglement between the pattern and model was found through left- and right-wise rotation. Then the Simulation button was clicked to start the try-on. The wearing status was adjusted using the hand icon to check the wearing effect.
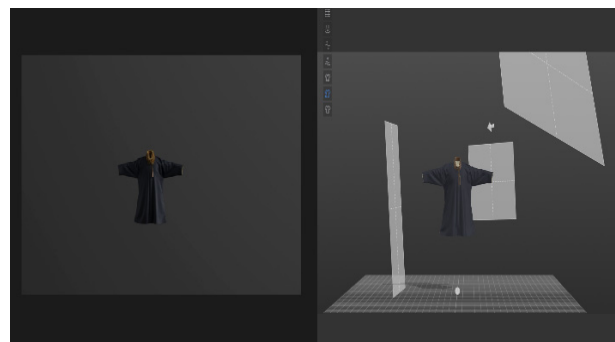
Fig. 7. Virtual display. [Computer drawing]

Virtual display. (Fig.7.) Parameters for lighting of the scene, rendering background and wind were set. After completing fabric setting, we opened the offline rendering tool to view the rendering effect. In the setting of rendering image properties, we selected an image size of 720*1280 and a background image with gradient grey color, which were saved in the png format. For the lighting property setting, we selected the contrasting light, and added a flat backlight source was added to increase the visibility of details at the back. To make the wearing effect more realistic, we set a spherical wind with a force of 200 within the clothing, creating a filling effect for the clothing in the simulation. After all settings were completed, Final Simulation was selected to view the final rendering image. (Fig. 8.)
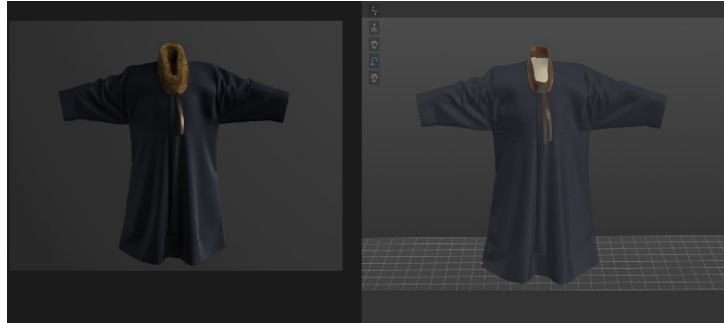
Fig. 8. Computer resortion [Computer drawing]

5   Conclusions

To sum up, in the age of rapid growth of digital technology, we should be able to make full use of it, combine it with traditional national costume culture, raise public awareness of national costume culture protection, change the concept of inheritance, drive the development of traditional culture in diverse ways and enable it to adapt to the ever-changing social needs, improve the ability to discern cultural consciousness in light of current developments, and weaken the impact of Western ideology and culture. In addition, in face of the plight of inheriting and promoting traditional culture, we should vigorously explore approaches in line with actual conditions, expand the scope and room for development, and encourage more people to understand and be involved in the protection, inheritance, and promotion of traditional culture.

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