Research on the Inheritance and Application of Virtual Digital Simulation Technology in the Custom-made Garments of Guang Embroidery

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Abstract. This paper digs up the application value, further explores the research and development status, and discusses the implementation method of virtual digital simulation technology used in Guang embroidery custom-made garments. As a means of implementation, virtual digital simulation design combined with the creative design of modern garment customization provides sufficient theoretical basis and practical reference for the inheritance and application of Guang embroidery craft in modern digital garment customization.

Keywords: Digitization; Virtual simulation; Guang embroidery; Customization; Garment design

1   Introduction

As a famous modelling art, Guang embroidery is one of the four famous embroideries in China. Clothing virtual simulation technology is a multidisciplinary and comprehensive technology that serves the clothing industry by using a digital platform to create a corresponding virtual model of clothing products. Today's digital and intelligent era is driving the application of new technologies such as virtual digital technology to the field of bespoke garment design, which in turn is driving the transformation and development of traditional garment craftsmanship. Virtual simulation technology alone can complete most of the processes of traditional garment customization. Thanks to its realistic physical display and reproduction of real scenes, customers can see their own virtual dressing effect even without having to be there in person, which not only reduces the cost of making customized clothing samples, but also shortens the product development cycle. The virtual garment design gives the custom-made garments a greater opportunity to show off their "skills", more importantly, it can be regarded as a new direction to try to promote the productive conservation of embroidery.[1]

2   The application value of virtual digital simulation technology of custom-made garments in Guang embroidery

Guang embroidery is one of the famous Guangdong-style embroideries as a form of modelling art, together with Jiangsu's Suzhou embroidery, Hunan embroidery and Sichuan embroidery, known as the Four Famous Embroideries of China. Guang embroidery refers to the embroidery of Guangzhou, Foshan, Nanhai, Panyu, Shunde, Dongguan, Bao'an, Xiangshan and Taishan, which is the general name for the folk embroidery craft of the Pearl River Delta, with Guang as the centre. It is said to have the same origin as the Li brocade, and includes embroidered calligraphy and paintings, embroidered costumes and bead embroidery, etc. It is famous both inside and outside for its artistic characteristics like full composition, evocative images, clear textures, rich colors, varied stitches, good variation and compatible aesthetic character.[2]

3   Construction of virtual simulation software environment

3.1   The overall framework of the system

For leather product design, style design, color design, pattern drawing, adaptive adjustment, etc. belong to the basic system functional requirements; human data collection, leather template selection, leather style recommendation and virtual fitting belong to the expansion requirements of the system. Based on the full consideration of leather clothing design requirements, this paper constructs the virtual simulation system framework for 3D design and production of leather clothing as shown in Figure 1. [5]
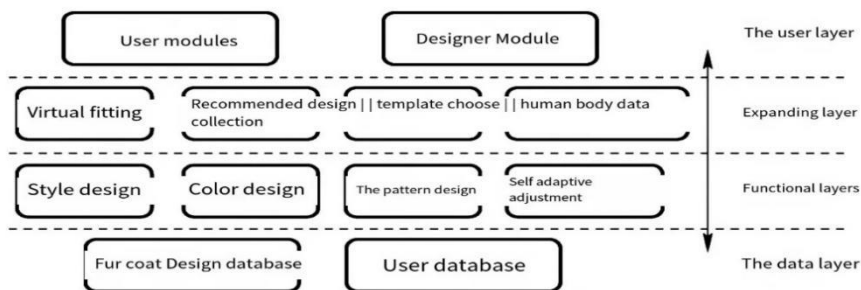

Fig. 1. The framework of the virtual simulation system for the 3D design and production of leather clothing

3.2   Internet Platform Deployment

Using the Internet platform for system construction and deployment can effectively reduce the design difficulty of the virtual simulation leather clothing design program.

The WeX5 development tools and cloud servers provided by the network platform can greatly reduce the operating cost of the virtual simulation leather clothing design program.
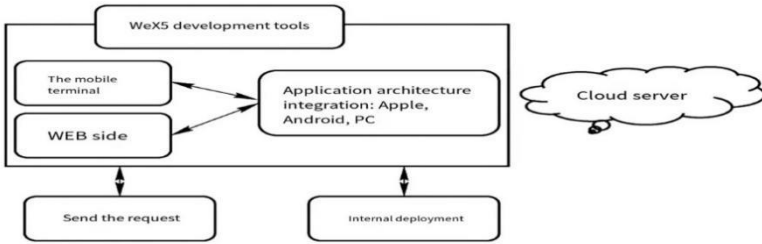

Fig. 2. Internet platform software development framework based on WeX5 development tools

The WeX5 development tool uses the MVC design pattern to realize the separation of data-view, code logic-page description, etc., and can support the design of various front-end applications such as mobile and WEB. In addition, the use of WeX5 development tool combined with cloud server can realize the adjustable function of virtual 3D design of leather clothing, and enhance the scalability of the system [7-8].

3.3   System function structure

Under normal circumstances, the design and production of leather clothing usually needs to go through the links of material selection, design, pattern making, fitting, and processing. The emergence of the virtual system is based on the original leather clothing design and production process.

Databases, big data and other technologies omit the selection of materials and virtualize the fittings. Figure 3 shows the functional structure of the virtual interactive leather garment design and production system constructed according to the optimized leather garment design and production process.
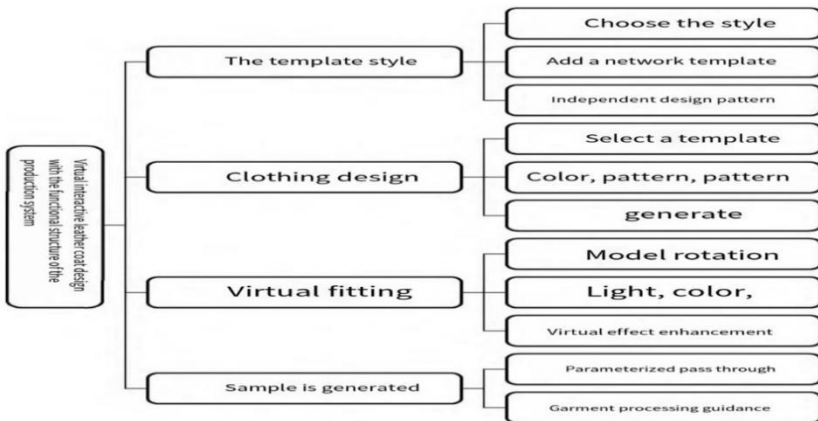

Fig. 3. Functional structure of virtual interactive leather clothing design and production system

4 The implementation of virtual digital simulation technology of custom-made garments in Guang embroidery

4.1 To study the Guang embroidery costume items.

The application of Guang embroidery cannot be separated from the artistic research of Guang embroidery. The basic research of Guang embroidery should be taken as the first point to deeply tap the cultural connotation and artistic characteristics of Guang embroidery, so as to pave the way for further research afterwards. The study of the art of Guang embroidery mainly includes colors, patterns, stitches, motifs and cases. Moreover, the characteristics of the art of Guang embroidery applied to garment design are summarized when analyzing cases of finished Guang embroidered garment items, so that reference library patterns of Guang embroidery craft design elements can be extracted, refined and summarized for eventual practical application in virtual Guang embroidered bespoke garment design. Through the study, summarization and conclusion of traditional Guang embroidered garment items, it is bound to identify elements that can be adopted, including external pattern symbols and internal connotations, and provide inspiration for the application of Guang embroidery in bespoke garments, thus exploring its techniques that can be act on bespoke garment design. [3]

4.2 To study the characteristics and forms of garment customization.

Firstly, actively learn from the development of custom-made garments abroad, extract strategies and models that are beneficial to the development of Guang embroidery, select the refined and discard the crude, and propose specific theoretical measures in relation to the characteristics of custom-made garments; secondly, find out the cultural and aesthetic patterns of customers in the Pearl River Delta and combine them with the actual characteristics of custom-made garments to find a practical way to introduce Guang embroidery; finally, excavate the nature of products and product development models of custom-made garments based on the product categories of Guang embroidered garments and the technical characteristics of the Guang embroidery process in four aspects: audience, classification, product characteristics and price.[4]

To study the design elements and applications of the Guang embroidery process in bespoke garments. The study examines the main points of style design, pattern distribution, fabric application and colour application that can be used in bespoke garments from the perspective of garment design.

To carry out a series of hands-on exercises on Guang embroidered garment design in combination with the virtual garment digital software, so as to complete a series of virtual garment design processes such as the construction of a human body model, virtual sewing, pattern and fabric simulation, pressure testing, style correction and virtual garment display in the virtual platform. Through the virtual simulation technology hands-on exercises, the problems arising from the Guang embroidery custom-made garment design in the virtual digital software are collated, the practical application steps are optimized and the theoretical refinement is summarized. Figure 4 shows the design

of a children's custom-made Hanfu with Guang embroidery technique. These two sets of children's clothing are cut into upper and lower, with the same garment type of upper for boys and girls. The design incorporates modern garment styles on account of traditional Hanfu, with a right overlapping collar, and a pleated skirt for girls while shorts for boys. The colors of the garment are bright and eye-catching in the traditional colors of Guang embroidery, and the four patterns of lychee, red cotton, bird and banana leaf are used in its design of the garment. The fabric of the garment is made of cotton and linen with skin-friendly and comfortable texture. [6]

Fig. 4. Travel clothing design of children

5   Virtual simulation software implementation and work performance test

5.1   System Implementation

Figure 5 shows the use effect of the virtual simulation software for national costume design and production based on WeX5 development tools designed in this paper. The software can digitize the detailed size of each piece of ethnic clothing, and can well realize the whole process simulation of ethnic clothing from design to production.
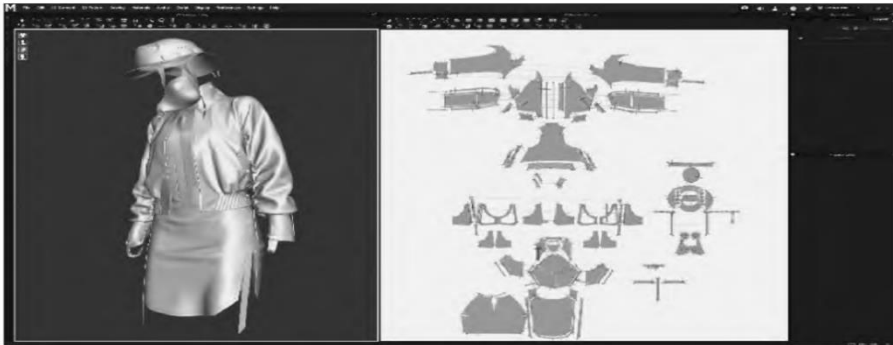

Fig. 5. Design and production effect of virtual simulation software

The adaptive adjustment of ethnic clothing pieces mainly relies on the method of global optimization. This function can greatly reduce the adjustment frequency and work intensity of ethnic clothing designers when designing clothing, and can basically achieve global optimization based on parameters such as points and lines of ethnic clothing. Assuming that the vector x is used to represent all the adjustable parts of the national costumes in the virtual design

Parameters x1, x2, x3, ..., xn, then randomly select a one-dimensional adjustable parameter variable xi of a piece of ethnic clothing to find the partial derivative can be expressed as:

$$\frac{\partial \sigma_T}{\partial x_i} = \lim_{\varphi \to 0} \frac{\sigma_T(x_1, \cdots x_1 + \varphi, \cdots) - \sigma_T(x_1, \cdots x_1, \cdots)}{\varphi}$$

σt represents the total value of the calculated systematic error described in Fig. 5; φ represents the independent variable derivative of the numerical gradient, and when the value of φ is sufficiently small, xi can be obtained with an approximate numerical derivative. Assuming that the error xi is higher than the system threshold, the system will correct the design parameters, etc., and enter the "determining 3D clothing feature points, lines, and positions" link again; assuming that the error xi is lower than the system threshold, the system will perform adaptive adjustment.

5.2   Work performance test

Software such as Marvelous Designer and CentricPLM are the most commonly used software in the field of clothing virtual design. This paper takes these two softwares as comparison items, and names MarvelousDesigner and CentricPLM as system A and system B respectively, and compares and analyzes the human body data collection accuracy and the level of self-adaptation of the second generation of the virtual software for 3D design and production of ethnic clothing designed in this paper to obtain the superiority of the system in some aspects of performance.

5.3   Adaptively adjust the iteration level

Self-adaptive adjustment iteration is the number of iterations required by the system itself to continuously adjust the clothing size by comparing the calculation error with the system threshold to achieve the best design effect. Generally speaking, the fewer the number of iterations, the more advanced the system's workflow and algorithm are. Table 1 shows the comparison results of the other two clothing virtual simulation design programs system A, system B and this system in terms of adaptively adjusting the number of iterations.

From the comparison of the number of adaptive adjustment iterations, the number of adaptive iterations required for the design of ethnic clothing pieces in various parts of the human body is less than that of the other two systems, and this system basically only needs about 20 iterations. To achieve the optimal design of different parts of the

garment, system A and system B need 54 to 74 and 42 to 61 iterations, respectively, to achieve the optimal design.

6   Conclusion

The virtual garment design exploration not only provides a reference example for the application of Guang embroidery to modern custom-made garment design, but also promotes the digitalization and modernization process of garment enterprises. With a modern aesthetic in mind, the application of Guang embroidery in this new segment of the garment market may provide an example for subsequent design exploration in this field. The application of the intangible cultural heritage of Guang embroidery to modern garment economic activities, the market economic benefits it generates can help to solve the financial needs of the relevant inheritors in the process of learning and passing on the craft, and is not without providing a new and experimental direction for the long-term development of Guang embroidery. It also provides a new mode of operation for fashionable design and production in Guang embroidery garment enterprises, and contributes to the promotion of the productive conservation of Guang embroidery.

Acknowledgments

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