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Costume Digital Restoration of the Tomb Mural of YanFei ⋆

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Abstract

Based on the image and textual data, the characteristics of the style, structure and pattern of the costumes in the Tang tomb murals were analysed using garment engineering. The size of each part of the costumes was inferred using the proportion method, and a set of formulas was summarised. Based on comparing three kinds of pattern extraction algorithms, the Canny operator combined with the morphology algorithm was optimal for pattern extraction for costume restoration. 3D virtual technology was used to digitally restore the costumes of the tomb murals of YanFei. The effect of costume restoration was evaluated according to the rank sum operation method and questionnaire results.

Keywords: Digital Restoration; Costume Structure; Pattern Extraction; Image Segmentation Algorithm; 3D Virtual Technology; The YanFei's Tomb Mural Costumes

1 Introduction

The costume of the Tang Dynasty was at its peak in history, reflecting the prosperous social life and elegant cultural temperament of the people of the Tang Dynasty, showing the cultural and artistic charm of Chinese traditional costume. Research on Tang Dynasty costumes has covered many fields, and many conclusions and achievements have been made. The research was mostly based on the field of garment engineering from the perspective of apparel restoration, comprehensively applying the theories and methods of related disciplines, analysing the characteristics of the style, structure and pattern of the tomb murals in the Tang Dynasty. 3D virtual software was

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used to restore them, further improving and enriching the research contents in the field of Tang Dynasty ladies' costumes, and playing a certain role in inheriting and promoting the traditional clothing culture.

In the current information environment, combining cultural protection and digitalisation, information, computers, and other research have become the current popular directions. There are many relevant research studies and theories on the digital restoration of clothing, but the focus and perspectives are different, as most of them are based on archaeology [1], art, culture, and other fields. Domestic and foreign clothing digital virtual software also has been developed, such as CLO 3D, DC suite, Style 3D, and Vstitcher, etc., and have been widely used in clothing design [2, 3], garment pattern design [4, 5], clothing comfort evaluation [6], and other fields. In recent years, it has also been used in clothing simulation and restoration research. For example, Liu K et al. used 3D interactive garment pattern-making technology and virtual simulation technology to realise the development and restoration of ancient tomb mural costume patterns [7, 8]. Zhu C et al., through the research of traditional clothing, used CLO 3D to build 3D models of the digital restoration and display of the characters [9, 10]. Vein K used 3D scanning technology to scan and restore historical clothing and conduct in-depth research from the perspective of digitisation of cultural heritage [11]. Meier C used clothing 3D technology to restore the clothing image of 16th-century Spain and created a virtual clothing museum [12]. These research studies are mostly about costume design based on garment engineering. This research focuses on the costumes' structure analysis and size calculation and summarises a set of appropriate calculation formulas [13]. The extraction algorithm of costume patterns was valuable. The optical costume pattern extraction method was the image segmentation algorithm based on the Canny operator combined with mathematical morphology.

Very few costumes were left in the Tang Dynasty, and the research of related costumes mainly restored the style of Tang Dynasty costumes through the description of literature and images. The tomb murals in the Tang Dynasty were selected as the basic material of costume research by many scholars because of their unique advantages. They are of great research value to better reflect the social style of the current period. There are many costume images in the tomb murals of the Tang Dynasty, with rich and colourful images. Through the arrangement of the dress shape and style structure in the murals, they can be divided into three categories: "upper costume and skirt", Hu robe, and men's clothing. This research will restore the typical women's clothes of "upper costume and skirt" in the tomb murals of the Tang Dynasty.

The tomb mural of YanFei (refer to Fig. 1) is one of the typical representations of tomb murals in the Tang Dynasty. The characters in the murals are clear, and the overall damage degree is relatively light, which has certain advantages in restoration. This paper reproduces the traditional women's costumes of the Tang Dynasty through the digital restoration of the costumes of the mural and inherits and carries forward the traditional clothing culture.

2 Experimental Methods

2.1 General Scheme

Based on the research of the tomb mural of Tang Taizong, the costume structures and patterns were studied and carried out in 3D virtual restoration. Through the research and analysis of