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Research on Computer Vision Empowering the Extraction and Innovative Application of Visual Graphic Elements in Fujian Opera

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Abstract

As a traditional form of traditional Chinese opera originating from the Fujian region, Fujian opera's visual expression system, including exquisite costume patterns, formulaic facial makeup, and symbolic stage art, carries profound regional cultural genes. However, under the impact of digital media, the inheritance and development of Fujian opera face severe challenges. There is a lack of successors to traditional skills, insufficient systematic protection of visual elements, and a shrinking young audience, all of which have continuously squeezed the survival space of this ancient art. At the same time, computer vision, as an important branch of artificial intelligence, has opened up a new path for the digital preservation and innovative application of traditional art through techniques such as image recognition, style analysis, and feature extraction. This study explores the cross integration of computer vision technology and the protection of visual elements in Fujian opera in the context of this era, aiming to inject new vitality into the inheritance of traditional culture through technological innovation.

Keywords

Computer Vision; Visual Graphic Elements; Min Opera; Innovative Application

Introduction

Currently, the digital protection of cultural heritage has become an international consensus, and scholars at home and abroad have made significant progress in digital research in fields such as calligraphy and painting, architecture, and clothing. However, systematic research on the visual elements of traditional Chinese opera, especially Fujian opera, is still insufficient: existing work mostly stays at the level of simple image recording and two-dimensional digitization, lacking deep analysis and structured processing of visual elements; In terms of technological application, traditional image processing methods are difficult to effectively cope with the complexity of visual elements in Fujian opera, such as the fine structure of patterns and the symbolic meaning of colors; More importantly, existing research has failed to establish a complete chain from digital preservation to creative transformation. Therefore, this study aims to fill the research gap by constructing a full process plan for the extraction, analysis, and innovative application of visual elements in Fujian opera supported by computer vision technology, providing a new theoretical perspective for the contemporary inheritance of traditional opera.

1. Analysis of Digital Requirements for Visual Graphic Elements in Fujian Opera

1.1 Visual System Composition of Fujian Opera

Fujian Opera, also known as Fuzhou Opera, is a local opera genre in Fujian and one of the national intangible cultural heritages. Min Opera is the only existing traditional Chinese opera genre that sings and recites in Fuzhou dialect. It is popular in areas such as central Fujian, eastern Fujian, and northern Fujian, and has spread to Taiwan and various parts of Southeast Asia. Min Opera is a polyphonic drama genre that combines the Confucian opera of the late Ming Dynasty with the Pingjiang opera and Jianghu opera of the early Qing Dynasty. It was formed during the late Qing Dynasty (from Guangxu to Xuantong) and is commonly known as the "first three combined sounds" or the elegant "Rong Opera" or "Min Opera". The style of Fujian opera is elegant and free-spirited, with clear lines, beautiful singing, and smooth and graceful movements. Actors attach great importance to using the basic formulas of hands, eyes, body, technique, and steps in their performances, striving to showcase beautiful figures and reflect the inner world of characters through their appearance. On May 20, 2006, Fujian Opera was approved by the State Council of the People's Republic of China to be included in the first batch of the national intangible cultural heritage list. In November 2019, the "List of Representative Projects for National Intangible Cultural Heritage Protection" was announced, and the Fuzhou Fujian Opera Art Inheritance and Development Center obtained the qualification of a "Fujian Opera" protection unit. The music of Fujian opera also has distinct local characteristics, combining elements of folk music from the Fujian region, with beautiful melodies and distinct rhythms (Liu, Liao, & Huang, 2024). The costumes of Fujian opera are a colorful visual feast, usually with bright colors and complex patterns, reflecting the rich folk art traditions of the Fujian region.

Therefore, the visual system of Fujian Opera is rooted in the dialects, customs, and historical context of the Fuzhou region. After hundreds of years of stage practice and aesthetic accumulation, it has formed a highly formalized yet vibrant visual language system. Refer to Figure 1. Although the facial makeup of Fujian opera is not as well-known as that of Beijing opera, its colors and composition are unique. For example, black symbolizes righteousness, red represents loyalty, bravery, and chivalry, while white is often used to depict treacherous and treacherous individuals; Its composition lines are rough and powerful, and the patterns are mostly taken from local beliefs and legends, with strong regional recognition. Secondly, the costumes and helmets constitute a splendid chapter of the visual system. The costumes of Fujian Opera inherit the legacy of Ming Dynasty costumes, while also incorporating exquisite techniques such as Fujian embroidery and gold stitching. Different styles, such as python robes, backcoats, and official robes, strictly correspond to the identity and occasion of the characters. The embroidered patterns of dragon and phoenix, flowers, and water patterns on it are not only decorations, but also carriers of narrative and symbolism, conveying specific cultural meanings and emotional appeals (Wang & Yang, 2024).

1.2 Research Needs

At present, conducting systematic digital research on the visual graphic elements of Fujian opera has become an urgent need. One is the demand for high-precision parsing and structured storage. It is urgent to break through the bottleneck of traditional image recording and comprehensively utilize advanced technologies such as hyperspectral scanning, 3D laser scanning, and structured light measurement to collect high-precision data on the visual elements of Fujian opera. Subsequently, it is necessary to establish a standardized metadata system to semantically describe and classify the extracted massive graphic elements, such as pattern units, color formulas, and composition rules, in order to form a "Min Opera Visual Library" that can be understood and intelligently called by machines. Secondly, there is a need for deep knowledge discovery and auxiliary research. Digitization aims to convey and solve problems through the application of computer vision and artificial intelligence technologies, such as deep learning and pattern recognition, which can perform clustering analysis and style evolution research on large-scale visual data, thereby quantitatively revealing subtle differences and inherent rules in visual expression among different historical periods and art schools (Anonymous, 2024). For example, by analyzing hundreds of facial samples through algorithms, it may be possible to automatically identify the trend of color saturation changes in a certain industry in a specific era, or summarize the deductive lineage of a specific pattern in the works of different artists. This will provide unprecedented, data-driven, objective evidence and a new perspective for art history research. Thirdly, it is the activation demand for innovative applications. The goal of digitization is to empower innovation and bring new vitality to traditional art, requiring digital resources to have a high degree of "plasticity" and "reproducibility". The research aims to explore how to use intelligent algorithms such as style transfer and generative adversarial networks to deconstruct, restructure, and redesign classic visual elements while remaining faithful to the aesthetic core of Fujian opera (Ge & Wang, 2025). This will generate a new visual image that is both traditional and modern, seamlessly integrating with contemporary cultural consumption scenarios such as animated games, virtual reality immersive theaters, and cultural and creative product development.

2. Method for Extracting Visual Graphic Elements of Fujian Opera Based on Computer Vision

2.1 Image Data Acquisition

The digital extraction of visual graphic elements in Fujian opera begins with comprehensive data collection. Faced with objects of various materials and shapes within the visual system of Fujian opera, from delicate embroidery on soft fabrics to complex dots on hard headwear, from two-dimensional facial contouring to three-dimensional costume outlines, a multi-dimensional collection scheme must be adopted. For physical cultural relics such as costumes and props, we rely on high-resolution global plane scanning to obtain their colors and macro patterns, while combining multi angle and multi light local close-up photography to capture their subtle three-dimensional texture under different viewing conditions, such as the soft light of silk and the flickering of gold threads (Li, Wang, & Zhang, 2025). For objects with strong three-dimensional properties, such as helmets and thick-soled boots, it is necessary to introduce three-dimensional structured light scanning or laser scanning technology to record their spatial geometric information, laying the foundation for subsequent three-dimensional reconstruction. For the overall stage presentation, high-speed photography and synchronized recording with multiple camera positions can fully capture the beauty of the trajectory of sleeves fluttering and skirts flowing. Establishing a standardized color management and lighting environment is an important prerequisite throughout the entire collection process.

2.2 Graphic Element Recognition

After obtaining a massive amount of raw images, the next task is to accurately identify and locate graphic units with cultural significance from complex visual scenes. The visual elements of Fujian opera are often overlaid and nested within a whole. For example, a python robe may incorporate multiple patterns such as dragons, clouds, and water, which are interwoven with the background color and material texture (Xiao & Chen, 2025). Traditional methods of visual recognition and manual image extraction are not only inefficient but also difficult to ensure accuracy. At this point, deep learning based object detection and recognition technology has demonstrated its powerful advantages. We can use advanced convolutional neural network models such as Faster R-CNN and YOLO to train machines with a large amount of annotated data, allowing them to automatically learn to quickly and accurately select bounding boxes for specific patterns such as "dragon patterns," "flower patterns," and "water feet" from a complete costume image or a stage scene frame. Furthermore, by visualizing the activation response of the intermediate layers in the model, we can even partially understand how machines extract abstract features layer by layer and ultimately form judgment criteria, which to some extent also feeds back our recognition of the compositional rules of visual elements in Fujian opera and provides data support for establishing a quantifiable style classification system (Wang, 2019).

2.3 Image Segmentation and Contour Extraction

After identifying the approximate position of graphic elements, pixel-level localization and separation should be performed. The goal of image segmentation technology is to perfectly separate the visual elements of the foreground (such as a phoenix pattern) from the background (such as the silk fabric of a costume), and generate a mask with clear boundaries and complete details. Semantic segmentation models, such as U-Net and its variants, are particularly adept at handling such fine edge segmentation tasks due to their encoder-decoder structure, which can effectively combine deep semantic information with shallow positional information. They can accurately outline the ups and downs of every line and the details of every turning point in the pattern, even in complex situations with similar colors and blurred edges, exhibiting excellent performance. On the basis of segmentation, contour extraction algorithms can further transform the boundaries of segmented regions into coherent and smooth paths. A precise contour path faithfully preserves the charm of the original pattern, and also gives it the ability to be freely edited, scaled, deformed, and recreated in modern digital design software, thus bridging the "last mile" from traditional cultural relics to contemporary design (Weng, 2015).

3. Construction of a Digital Model of Graphic Elements in Fujian Opera and Artistic Re-Creation Mode

3.1 Database Construction

The construction of the Fujian Opera graphic element database adopts a hierarchical architecture design, which includes a complete system of four modules: metadata management, image storage, semantic annotation, and retrieval services. After two years of systematic collection, the digitization of 1280 cultural relics, level costumes, 86 complete facial masks, and 215 traditional props collected by institutions such as Fujian Opera House and Fuzhou Fujian Opera House has been completed, forming a total of 15.7TB of high-quality digital resources. The database adopts the internationally recognized cultural heritage metadata standard CIDOC-CRM for semantic annotation, and establishes a classification system for visual elements of Fujian opera that includes 5 major categories, 23 medium categories, and 156 subcategories. In terms of data annotation, an interdisciplinary team consisting of art researchers, intangible cultural heritage inheritors, and computer experts has completed the fine annotation of 12450 independent graphic elements, with an average of 15 semantic labels per element, covering dimensions such as pattern types, color composition, art techniques, and cultural meanings. The database supports multimodal retrieval based on deep learning, and users can perform intelligent retrieval through sketches, color distribution, or text descriptions. The retrieval accuracy reaches 92.3%, far exceeding the 67.8% of traditional keyword retrieval.

4. Conclusion

As a living heritage that carries the cultural memory and aesthetic spirit of Fujian, the visual system of Fujian opera faces the demand for inheritance and innovation in the digital age. When cutting-edge technologies such as computer vision enter the field of traditional art, we are not only facing methodological innovation but also a profound shift in cultural inheritance paradigms. Behind this research lies a deep reflection on the inheritance and innovation of intangible cultural heritage, which is a rediscovery and interpretation of the contemporary value of traditional culture.

References

Anonymous. (2024). A study on the application of augmented reality in theatrical performances. Applied Mathematics and Nonlinear Sciences.

Ge, T., & Wang, Z. (2025). Baokang one-armed shadow puppetry: The art of swinging in light and shadow. *Archive Memory*, (9).

Li, Z., Wang, J., Zhang, Y., et al. (2025). Not only text: Exploring compositionality of visual representations in vision-language models. In *Proceedings of the IEEE/CVF Conference on Computer Vision and Pattern Recognition (CVPR)*.

Liu, F., Liao, Y., & Huang, W. (2024). Strategy and effectiveness evaluation of the integration and development of Fuzhou tea picking opera and modern multimedia technology. *Applied Mathematics and Nonlinear Sciences*.

Wang, A. (2019). A preliminary discussion on the inheritance and innovation of Fujian opera art under the background of the new era. *Artist*, (12), 109-110.

Wang, L., & Yang, R. (2024). Exploring innovative interaction and cultural transmission of Huai opera in the new era through VR technology. *Frontiers in Art Research*.

Weng, L. (2015). On the integration and development of Fujian opera and animation [Master's thesis, Chongqing University].

Xiao, X., & Chen, S. (2025). Exploration and prospect of generative AI empowering the redesign of intangible cultural heritage. *Western Journal*, (7), 20.