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Research on the Fusion Technology of Fashion Design and Neural Networks Based on Fashion Trends

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ABSTRACT

Traditional fashion design relies on the designer's experience, and there are limitations in fashion trend analysis and user demand response. Combining the characteristics of fashion design with Deep Learning, this paper constructs a multi-module intelligent model integrating trend prediction, key point detection, and design generation. The results show that Convolutional Neural Networks are superior to other models in the task of trend prediction on two fashion image data sets. Back Propagation Neural Networks combined with Principal Component Analysis dimension reduction significantly improves the training efficiency and model generalization ability. The model proposed in this study improves the scientificity of fashion trend analysis and design decision-making. It also provides technical support for a personalized clothing customization system based on communication networks and intelligent terminals, which embodies the deep integration of Artificial Intelligence, fashion design, and information technology and has a good interdisciplinary application prospect.

KEYWORDS

Fashion Trend, Fashion Design, Deep Learning, Neural Network, Key Point

INTRODUCTION

With the rapid development of computer technology and the social economy, demand for clothing quality and personalization has increased steadily, profoundly affecting all segments of the fashion industry (Maldini et al., 2019). Continuous advances in computer technology, particularly the widespread application of artificial intelligence (AI), big data analytics, and three-dimensional (3D) printing, have created unprecedented opportunities for fashion design, manufacturing, and personalized customization (Jeong et al., 2021; Wang et al., 2023; Yu, 2022). These technologies not only improve production efficiency and precision but also enable designers to explore and innovate in new ways to meet consumers' growing expectations for quality and uniqueness (Bansal & Jalal, 2019; Wang, 2025). Under increasingly affluent material conditions, consumers are no longer satisfied with basic clothing needs but place greater emphasis on fashion sensibility, brand culture, and personal expression (Bezerra et al., 2020; Deng & Liu, 2022; Fan, 2022). Consequently, fashion trends have become more diversified, faster evolving, and highly personalized.

The limitations of traditional fashion design modes have become increasingly apparent (Cilveli et al., 2020). Traditional fashion designers often face constraints in information acquisition, making

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it difficult to comprehensively and promptly grasp emerging international fashion trends. As a result of limited information exchange, designers may struggle to accurately anticipate future fashion directions, leading to a lack of forward-looking and innovative design outcomes (Garcia, 2023). Moreover, some designers rely excessively on online resources, which frequently lack systematic structure and relevance, hindering effective analysis, synthesis, and extraction of forward-looking design elements. In addition, excessive emphasis on traditional elements, coupled with insufficient integration of modern aesthetics and personalized demands, often results in designs that appear outdated and fail to attract younger consumers (Cong & Zhang, 2024; Jia, 2024; Särmäkari, 2021). Consequently, many fashion designs lack innovation, novelty, and distinctiveness, making it difficult for them to compete effectively in an increasingly competitive market.

This study aimed to address the limitations in information acquisition and the lack of forward-looking innovation in traditional fashion design by constructing a deep learning (DL)-based fashion design model. A multi-module integrated framework was proposed, combining long short-term memory (LSTM) networks, convolutional neural networks (CNN), and back propagation neural networks (BPNN). The framework encompassed the full process from fashion trend prediction and key point detection to design element classification, enabling accurate identification of emerging fashion trends and efficient generation of personalized designs. This approach improved design efficiency and accuracy while enhancing market adaptability and the capacity for personalized expression. Through application of the proposed model, designers can better understand consumer needs, extract and analyze fashion elements, and rapidly produce designs that align with both prevailing trends and individual preferences. The significance of this study lies in advancing intelligent fashion design, supporting deeper integration of creativity and technology, and offering consumers a wider range of diverse and personalized clothing options.

RELATED WORK

Tango et al. (2022) proposed an automatic clothing generation method based on image-to-image translation to address the high diversity of role-playing costume styles and shapes. This approach introduced a novel generative adversarial network architecture that enhanced global and local consistency in generated images, with experimental results demonstrating superior quantitative performance and visual realism compared with traditional methods. Baldrati et al. (2023) developed a multimodal conditional fashion image editing approach based on latent diffusion models, enabling the generation of high-quality, human-centered fashion images by integrating text, human pose, and clothing sketch prompts. The authors also extended the Dress Code and VITON-HD datasets by adding semi-automatic multimodal annotations, and experimental results confirmed strong authenticity and multimodal consistency. Wu and Li (2024) applied a generative adversarial network to the textile stage of the fashion design process, generating novel knitted textile images and conducting qualitative evaluations of their aesthetic quality. Their findings indicated that generative DL models can support creative and practical textile design and facilitate fashion design workflows. However, these studies primarily optimized pixel-level fidelity while overlooking engineering constraints such as three-dimensional garment structure, seams, fabric drape, and human movement. Consequently, generated outputs often exhibited errors, including misaligned sleeves or unclosed necklines, limiting their direct applicability to printing and production. In addition, these methods generally lacked effective interfaces with computer-aided design and computer-aided manufacturing systems.

Qiao (2021) proposed an intelligent fashion design model based on a parallel Gabor image feature extraction algorithm, which significantly reduced feature extraction time and improved real-time performance. Experimental results showed that the method effectively segmented fabric defects from backgrounds, accurately identified garment feature states, and achieved strong detection accuracy and real-time performance in multi-core environments. Zheng and Hong (2022) introduced a 3D fashion design knowledge graph modeling method based on a multimodal clustering network. By

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