Journal of Cases on Information Technology
Volume 28 • Issue 1 • January-December 2026

Research on the Sustainability and Cultural Inheritance of Fashion Design Based on CAD and Multimedia Technology

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Received: December 16th, 2024 | **Accepted:** December 30th, 2025

ABSTRACT

Computer-aided design (CAD) and multimedia technology, as important tools of digital design, are widely used in the field of fashion design. In this article, the author discusses the synergy between computer-aided design and multimedia technology in improving the efficiency of fashion design resources and cultural expression. Mathematical modeling, quantitative evaluation, and case analysis indicated that the integration of the two technologies not only optimizes the design process and improves the utilization rate of materials but also realizes the digital extraction, redesign, and modern expression of cultural elements. The author puts forward a set of comprehensive frameworks that integrate concepts of green design and technical reality and provides theoretical support and practical reference for the sustainable development and cultural innovation of fashion design.

KEYWORDS

Computer-Aided Design, Multimedia Technology, Fashion Design, Sustainability, Cultural Heritage

INTRODUCTION

Against the background of global sustainable development and the protection of cultural diversity, the fashion design industry is facing profound transformation. Green design, which emphasizes the realization of environmental protection goals by reducing resource consumption and optimizing production processes, has become an important trend in the industry (Akter et al., 2022; Fung et al., 2021). At the same time, with the increasing enhancement of cultural identity, the integration of traditional culture into fashion design has also become a central topic (Li, 2024). However, the traditional design mode has obvious limitations with respect to resource utilization and cultural expression, and it is difficult for modern designers to address the dual needs of greening and cultural innovation.

The rise of computer-aided design (CAD) technology and multimedia technology has brought new possibilities to the field of fashion design (Milinic Bogdanovic & Bogojevic, 2021). CAD technology is a kind of design and drawing tool that uses computer software, which is widely used in various fields, including machinery, architecture, electronics, and clothing design (Ikubanni et al., 2022). In the field of fashion design, CAD technology helps designers create 2-dimension (2D) or 3-dimension (3D) drawings and models through special design software, and users can design, edit, optimize, and simulate them on the computer screen (Bi & Wang, 2020; Yang et al., 2021).

DOI: 10.4018/JCIT.398392

Traditional clothing design relies on hand-drawn plans and plate-making, whereas a CAD system can generate accurate clothing drawings and plate-making images by computer, which is convenient for modification and optimization (Wang & Wang, 2024). CAD technology enables designers to simulate, using a computer, the 3D effect of clothing, the texture of fabric, and the wearing effect, which greatly improves design efficiency (Liu, 2022). CAD technology is not limited to the design stage; it can also be applied to the production process. When design drawings are inputted directly into automatic production equipment, production efficiency and accuracy can be greatly improved. A CAD system helps designers realize various combinations of fabrics, colors, and styles and quickly simulate different effects through digital technology. This can effectively test different collocation schemes and reduce the cost and time of physical production (Fan, 2022; Hu, 2020). At present, there are many professional CAD software packages on the market, such as Optitex (https://optitex.com/), Gerber Accumark (https://www.lectra.com/en/fashion/products/gerber-accumark-fashion), and TUKAcad (https://tukatech.com/tukacad/; Khawar et al., 2024; Ranjan et al., 2020).

With the wide application of these technologies, though, the industry is also facing deep-seated cultural challenges. In the process of pursuing efficiency and standardization, the manual texture, regional symbols, ritual meaning, and intergenerational inheritance logic contained in traditional patterns are often simplified into replicable vector graphics, which leads to their subtlety and contextual uniqueness being weakened or even eliminated in digital conversion. More alarming is that the design templates and aesthetic preferences built into the global mainstream CAD platforms may invisibly promote a technology-driven cultural homogenization, bring local cultural expressions into a unified visual paradigm, and weaken cultural diversity. As cultural anthropologists have pointed out through ethnographic research, traditional handicrafts are not only the carrier of decorative patterns but also the materialization of historical memory, social relations, and identity (Li, 2024; Vert et al., 2021). If digital tools focus only on form extraction and ignore the cultural semantic system behind it, technological empowerment may become an accelerator of cultural dilution.

In this research, I aimed to solve three core problems in the integration of CAD and multimedia technology in cultural heritage clothing design: (a) low resource utilization rate, (b) insufficient expression of cultural connotation, and (c) difficult quantification of user satisfaction. I thus established three mutually supporting research objectives: (a) build an intelligent design model by cooperatively optimizing materials and energy consumption and improving resource efficiency; (b) establish a high-fidelity digital path of cultural elements to realize the true reproduction and innovative expression of the essence of traditional crafts; and (c) develop an operable user satisfaction evaluation system to quantify the comprehensive performance of digital cultural products in aesthetics, culture, innovation, and interaction. To achieve these goals, I first dynamically coupled the CAD layout algorithm with the feedback data of the multimedia virtual fitting system through mathematical modeling and constructed a multi-objective resource optimization model with material utilization rate and energy consumption reduction rate as the core. Second, I proposed a cultural digitalization high-fidelity acquisition–rule based driving–expert collaboration path that integrates multimodal image processing technologies, such as 2D Fourier transform and texture analysis, with a parameterized system embedded with cultural design rules and ensured the coordinated development of technology and humanities through a closed-loop evaluation mechanism that involved cultural scholars and users. Finally, I used the Delphi method to build a quantitative evaluation model of user satisfaction.

LITERATURE REVIEW

CAD has become a core tool of fashion design, especially in the digital process, that significantly improves the design accuracy and shortens the cycle. Zheng (2022) conducted a study that was based on the immersive virtual reality model and discussed how CAD digital automation analysis can promote design innovation and improve efficiency. Through the use of virtual reality technology, CAD supports virtual fitting and sewing so that designers can check the fitting effect in real time and