The Application of VR Visual Communication and AI Design in the Commercial Promotion of Chinese Ethnic Traditional Costumes

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Abstract: Digital apparel is becoming a new trend in fashion design. Traditional costumes face challenges in preservation and inheritance. VR displays and AI-driven design offer new solutions. They help build digital platforms for promoting traditional garments. These platforms highlight the commercial value of cultural clothing. VR exhibitions can be made contextual and gamified. This approach improves the user experience. It also provides new feasible pathways for advancing the ethnic costume industry toward digitalization, personalization, and internationalization.

Keywords: VR Technology; AI-Driven Design; Ethnic Traditional Costumes; Business Models; New Productive Forces

1. Introduction

Traditional Chinese ethnic clothing embodies a profound historical and cultural heritage. It not only reflects the unique esthetic concepts and lifestyles of different ethnic groups but also serves as a crucial symbol of ethnic identity and cultural recognition. The diversity of forms, patterns, and techniques demonstrates the integration of geographical environment and ethnic spirit. Its distinctive designs and craftsmanship provide inspiration for contemporary fashion and can be integrated with industries such as tourism and cultural creativity, resulting in products with strong market appeal. Through industrial development, it not only generates economic benefits but also promotes the dissemination and enhancement of traditional cultural influence.

The application of VR presentation and AI design offers new feasible pathways for the commercial promotion of traditional Chinese ethnic clothing. The integration of these technologies not only enhances interactivity and attractiveness in promotion but also expands the market potential of traditional clothing, thereby supporting the dual realization of cultural inheritance and commercial value. Furthermore, the incorporation of gamification strategies increases appeal and contributes to deepening consumer understanding and recognition of traditional culture, which in turn facilitates the transformation of cultural resources into commercial value.

2. Research Background

2.1 The Maturity of VR Display Technology

VR technology refers to a computer-generated three-dimensional virtual environment, which, combined with head-mounted displays and interactive devices, provides immersive visual, auditory, and interactive experiences, allowing users to feel as if they are physically present in a real-world scenario[1].

In recent years, virtual reality (VR) and visual communication technologies have attracted increasing attention and have been widely applied in the commercial promotion of traditional Chinese ethnic clothing. In China, researchers and practitioners actively explore the use of VR technology to provide users with virtual fitting experiences. For example, in certain exhibitions, visitors can wear VR devices to virtually try on traditional garments from different dynasties, thereby experiencing the charm of Chinese traditional culture. At the same time, through digital means, traditional crafts and costumes can be better preserved and disseminated, injecting new vitality into cultural heritage. Internationally, some scholars have examined clothing design in the context of the metaverse, while others have proposed research on web-based virtual costume museums[2]. These online platforms exhibit and disseminate traditional clothing culture, offering new approaches to the digital preservation of traditional craftsmanship.

With the continuous advancement of VR technology, VR display has been widely applied

in the fashion industry, such as in virtual fitting rooms, fashion shows and product launches, virtual flagship stores and immersive shopping, design and prototyping, as well as training and production collaboration (Table 1). The detailed design of virtual scenes creates an immersive sense of presence. Meanwhile, VR technology enables interactive disassembly and modular design, enhancing user experience and increasing consumer willingness to purchase[3].

Table 1. Applications of VR [Owner-Draw] 1

Participation Mode	Brand	Effect
Virtual Fitting Room	Zara, Uniqlo	Customers wear VR headsets or use mobile devices with VR applications to try on different garments in a virtual space, allowing them to visualize how the clothing fits on their bodies without the need for physical fitting.
Fashion Shows and New Product Launches	Balenciaga, Tommy Hilfiger	By utilizing VR for fashion shows, audiences can experience the event with a "front-row perspective" in a virtual environment and even observe clothing details from different angles.
Virtual Flagship Stores and Immersive Shopping	Gucci	Brands build virtual stores through VR, enabling consumers to browse, select, and purchase clothing in a virtual space as if they were shopping in a physical store.
Design and Prototyping Process	Nike, Adidas	Designers construct and modify clothing styles directly within a VR environment, simulating fabric drape, color matching, and wearing effects, which significantly reduces the cost and time of physical prototyping.
Training and Production Collaboration	Walmart	Brands use VR to train retail or production staff, such as learning how to present new collections, arrange merchandise displays, or even simulate factory production processes.

2.2 The Rapid Development of AI Design

With the emergence of AI products such as ChatGPT and Doubao, AI technology has become increasingly mature, and people are now proficient in using AI tools. Meanwhile, advances in AI-based image processing have made clothing design using AI no longer a difficult task. Its powerful data processing and creative design capabilities provide unprecedented support for designers. Through recognition technology, AI can accurately identify the complex colors and patterns of ethnic clothing, assisting users in freely designing while offering virtual tours and intelligent assistants to explain the historical, traditional, and cultural meanings of garments. It can also provide personalized design recommendations based on user preferences[2].

For instance, platforms such as AiDLab utilize AI to automate design tasks, lowering entry barriers, unleashing designer creativity, and promoting sustainability by reducing textile waste. Brands such as Zara and H&M have also applied AI in their design and production processes to enhance innovation and improve market responsiveness. Overall, AI is driving the fashion industry toward digitalization, creativity, and sustainability.

2.3 Traditional Chinese Ethnic Clothing

China is a unified multi-ethnic country with fifty-six ethnic groups distributed across all regions of the nation. Among them, there are fifty-five minority groups. Compared with the Han, the largest ethnic group, the traditional clothing of most minority groups remains less known to the general public. Due to differences in geographical location and living environment, each minority group has developed distinct customs and cultural characteristics.

The elements of minority ethnic clothing exhibit significant diversity, primarily reflected in styles, accessories, patterns, colors, fabrics, and craftsmanship. In terms of style, common forms include cross-collar garments, one-piece dresses, and tunic-style clothing, which are largely influenced by local climate conditions and modes of labor. Accessories often include chest ornaments, headpieces, and earrings. Patterns embody the cultural connotations and esthetic sentiments of each ethnic group, while color schemes typically inherit the symbolic systems of their respective cultures. The choice of fabrics and craftsmanship is determined by local production methods[5].

Overall, traditional Chinese ethnic clothing is complex and diverse, encompassing rich cultural and esthetic values. It provides a solid foundation for the integration of traditional elements into modern design.

3. Technical Approach-A Case Study of the She Ethnic Group in Zhejiang

The complete commercial promotion process can be constructed through key stages such as AI

design, VR display, virtual fitting, digital marketing, and sales platforms, thereby forming an integrated chain from ethnic costume design to commercial sales. This approach enhances interactive experiences, attracts younger consumers, and promotes the digital transformation of traditional culture while increasing the commercial value of traditional garments.

Zhejiang Province has the largest She ethnic population in China, mainly distributed in Jingning, Wencheng, Taishun, and Longquan. Among them, Jingning She Autonomous County is the only She autonomous county in the country. The She ethnic culture is vibrant and diverse, with traditional costumes being its most representative cultural expression. At present, while the traditional craftsmanship of She clothing has been preserved, the number of inheritors remains limited. With the advancement of intangible cultural heritage protection and the integration of culture and tourism, She ethnic clothing has been revitalized through various forms such as digital modeling, cultural and creative design, and fashion interpretation. However, its integration with the market remains limited, and innovative pathways are still under exploration.

3.1 AI Design

The process of incorporating generative AI into clothing design primarily consists of four stages: data collection, design pattern learning, design innovation, and feedback with iteration[6]. Data collection serves as the foundation of AI-based design. To obtain a comprehensive dataset of She ethnic pattern images, multiple methods were employed, including scanning images and physical samples, searching for historical materials online, conducting field visits to local residents, and participating in local folk activities. In enriching data sources, emphasis was placed on ensuring diversity and representativeness of the samples.

In the second stage, AI learns the traditional patterns and color schemes of She clothing and, based on existing traditional designs, generates new complete garments. After mastering both text-based and image-based generative models, AI attempts style transfer to create innovative designs. Building on this foundation, AI is utilized to develop creative clothing designs that integrate She ethnic characteristics with modern fashion esthetics and wearing habits. This fusion enables an innovative combination of traditional and contemporary elements, offering new possibilities for the inheritance of traditional attire within modern civilization.

Finally, during the stage of innovative design, user feedback is continuously collected to allow AI to produce personalized designs that cater to different esthetic preferences while maintaining user freedom in the creative process. Simultaneously, cultural connotations behind patterns, colors, and other symbolic elements are provided to help users better understand the cultural heritage of the She ethnic group.

3.2 VR Virtual Fitting

After the digital processing of clothing information is completed, users can utilize VR technology to modify, tailor, and virtually try on the designed garments. The platform provides multiple options for tailoring methods, colors, patterns, and accessories, and can automatically generate corresponding three-dimensional clothing models and cutting diagrams. Users can adjust sizes and shapes through operations such as zooming in, zooming out, or adding design elements, allowing them to intuitively experience the visual effects of different tailoring and styling combinations on the finished product. This process not only helps users identify combinations that better suit their personal esthetic preferences but also opens possibilities for innovative designs based on traditional foundations. Given that ethnic clothing differs from modern apparel in wearing and tailoring methods and often features more complex structures, VR technology can effectively assist users in selecting appropriate styles and color schemes[7].

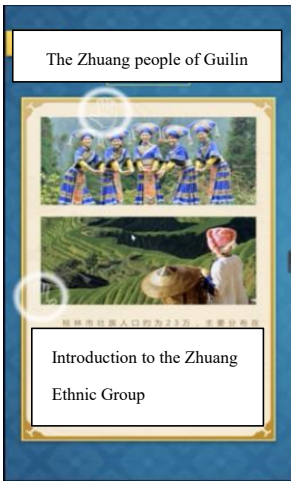

Figure 1. The Traditional Ethnic Clothing System [Guilin Museum in Guangxi].

The Traditional Ethnic Clothing system, developed by the Guilin Museum in Guangxi, employs three-dimensional virtual technology to digitally display traditional ethnic costumes, enabling viewers to intuitively understand the design characteristics and related information of various ethnic garments. On the hardware side, the system is equipped with Kinect cameras to enable human-body recognition and matching, allowing users to virtually try on costumes. During the interactive process, participants experience immersive visual sensations, which more effectively stimulate interest and engagement with Chinese ethnic culture.

3.3 Gamified Marketing

Gamified marketing refers to the application of game mechanisms and elements in marketing activities to enhance user engagement and competitive motivation, thereby increasing purchase intention. By creating enjoyment and interactivity, this approach strengthens user involvement in brand activities, promotes consumption, enhances loyalty, and facilitates word-of-mouth communication[4].

After users have created their own clothing designs, gamification can be used to further stimulate their interest. For instance, a points system can be implemented to quantify rewards for purchasing or designing clothing, allowing players to view others' scores, thus increasing transparency and motivation for participation. Alternatively, public welfare elements can be incorporated, where users' purchase-based rewards contribute to charitable causes, satisfying their sense of social responsibility. Additionally, narrative elements or storylines can be embedded in the user experience—integrating She ethnic folktales and customs, designing platform-exclusive IP characters, and thereby enhancing immersion and interactivity while simultaneously promoting She culture.

For example, the brand PurCotton has developed the "Daily Cotton Planting" game based on its textile industry background. In the game, users become virtual cotton farmers, watering cotton plants until they mature, and then harvesting them to exchange for cotton-based products. This interactive experience deepens users' understanding of PurCotton's brand vision of "Changing the world with cotton， " enhances product exposure through trial incentives, and promotes customer repurchase behavior.

3.4 Technical Limitations

However, current AI-generated imagery technologies still face several limitations. AI models are generally more capable of constructing visual effects than expressing knowledge related to garment structure. In practical applications, we find that existing image-generation models primarily learn and reproduce visual features, yet they lack a systematic understanding of clothing construction, pattern-making logic, and ergonomics. As a result, AI-generated apparel images often exhibit distorted details, unreasonable proportions, or structurally inconsistent elements. This problem becomes more pronounced when the models are applied to ethnic costumes, particularly those involving complex cutting techniques, where deformation frequently occurs.

In addition, AI struggles to accurately represent the physical properties of different fabrics, such as glossiness, softness, and elasticity. Ethnic garments often incorporate unique fabrics, many of which are handcrafted and lack material consistency, further increasing the difficulty for AI systems to model them accurately. This leads to discrepancies between the visual representation produced by AI and the actual physical performance of the garments.

At the same time, VR-based clothing displays also suffer from limitations in representing fabric behavior. Current VR systems show significant shortcomings in real-time simulation of material properties. Constrained by computational resources, such systems typically simplify the dynamic structure of fabrics, resulting in unrealistic representations of draping, stretching, and gravitational effects. Furthermore, the limited accuracy of lighting models makes it difficult to faithfully render materials with high reflectivity or complex textures, such as silk or leather, thereby reducing the visual credibility of the garment display.

4. Design Concept of the Business Model

The commercial promotion model of traditional clothing can be systematically constructed through digital platforms, forming a complete closed loop that encompasses cultural knowledge dissemination, personalized design experiences, immersive interactive displays, intelligent production customization, and diversified consumer conversion. This integrated

approach enables the revitalized inheritance of traditional culture while achieving deep integration with commercial value.

4.1 Operating Platform

The traditional clothing marketplace serves as the core operating platform, presented in both app and web formats. It includes functional modules such as a cultural knowledge base, AI design tools, VR immersive display, ordering system, and community interaction. The platform standardizes operational procedures and transaction rules to facilitate a personalized user experience while ensuring the basic foundations for transactions, collections, and creative activities.

4.2 AI Design

enerative AI drives the clothing design process. By inputting keywords (such as patterns, colors, styles, and esthetics) into the trained AI model, the system integrates data from the clothing database with modern esthetic principles to generate design drafts. Users can then modify tailoring and styles according to their personal preferences. Additionally, the AI system can recommend optimal combinations based on users' body shapes, skin tones, and intended use scenarios.

4.3 VR Display

The platform provides a virtual fitting function, allowing users to view real-time visualizations of how garments appear on their bodies through VR technology. As users move, they can observe the dynamic flow of fabrics. Furthermore, the system offers immersive fitting experiences in virtual environments such as palaces, marketplaces, and other culturally themed settings.

4.4 Ordering and Delivery

Customized services are available for user-designed garments. Once an order is placed, the clothing is produced in the factory and delivered to the customer's home, allowing users to receive the physical version of their digital designs. At the same time, a virtual wardrobe feature is provided, enabling users to display and collect other designed garments within a digital space.

4.5 Gamified Marketing

Each custom-designed garment is accompanied by a "digital collectible" (in NFT format) to ensure the collectible value of the design. A points-based system is implemented, where users can unlock achievements upon reaching certain thresholds. The platform also periodically launches activities such as "Wearing Hanfu to Attend the Online Temple Fair," where users earn points by completing tasks that can be redeemed for discounts or limited-edition products.

5. Acknowledgment

At present, virtual reality and artificial intelligence technologies are still in their developmental stages, facing challenges such as limited stability and relatively high technical barriers, and have yet to achieve full-scale mature application. Nevertheless, this business model provides an innovative framework for the dissemination and revitalization of traditional clothing. It not only enhances user personalization and engagement but also offers a feasible pathway for presenting and commercializing traditional culture within a modern context.

With the continuous advancement of related technologies, challenges such as high costs, long production cycles, and limited market awareness are expected to be gradually overcome. In the future, as AI, VR, and personalized customization technologies mature, traditional clothing will evolve from a static historical heritage into a perceptible, interactive, and creative living culture. This transformation will provide a model for the deep integration of cultural inheritance and modern commerce while opening broader prospects for digital cultural innovation. The growing potential of this model in the traditional clothing market offers valuable insights into the organic combination of cultural preservation and business development.

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