AI-Driven Collaborative Design for Tourism Cultural and Creative Product Development and Regional Culture Dissemination

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Abstract: Tourism cultural and creative (cultural-creative) products are vital carriers of regional cultural dissemination and tourism destination branding. However, conventional product development often suffers from limited cultural interpretation, low innovation efficiency, and weak visitor engagement. This paper explores how Artificial Intelligence (AI)-driven collaborative design models can empower tourism cultural-creative product development, integrating local cultural elements with intelligent design tools to achieve both innovation and cultural sustainability. By combining big data analysis, generative design algorithms, consumer preference mining, and digital storytelling techniques, the proposed framework enables multi-stakeholder collaboration among designers, cultural experts, and tourists. Case studies illustrate how AI enhances efficiency in product conceptualisation, strengthens cultural symbol extraction, and fosters immersive experiences through digital-physical integration. The research highlights AI's potential to revitalise regional cultural heritage, promote sustainable tourism development, and enhance cultural dissemination in the digital age.

1. Introduction

1.1. Research Background and Significance

Tourism cultural-creative products not only serve as material souvenirs but also act as intangible cultural vehicles that embody the spirit of a region [1]. With the rise of cultural tourism and the creative economy, their role in enhancing visitor experience and disseminating local culture has grown significantly. Yet, many products are criticised for homogeneity, superficial design, and weak connection to authentic culture. The emergence of AI technologies, including generative design, natural language processing, and image recognition, provides new opportunities to reinterpret regional culture and co-create innovative tourism products. By embedding AI into collaborative design processes, tourism destinations can balance creativity, cultural authenticity, and market demand, fostering both cultural sustainability and tourism competitiveness.

1.2. Research Status at Home and Abroad

Internationally, AI has been increasingly applied in design fields such as industrial product development, fashion, and architecture, with growing attention to cultural heritage digitisation and digital creativity [2]. For example, European initiatives have employed AI for heritage-based product innovation, while Japan has explored AI-enhanced craft design that integrates tradition with contemporary aesthetics. Domestically, China's tourism industry has begun experimenting with AI-powered digital museums, heritage interpretation, and online cultural dissemination. However, systematic research on AI collaborative design for tourism cultural-creative products remains limited, especially in linking design innovation with regional cultural communication.

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1.3. Research Content and Methods

This study develops an AI-driven collaborative design framework for tourism cultural-creative products. It integrates big data collection, cultural symbol analysis, AI-assisted ideation, and consumer co-creation. The research employs mixed methods including design case analysis, semi-structured expert interviews, AI prototype testing, and consumer surveys to evaluate effectiveness. A case study on a regional tourism destination demonstrates the framework's practical value in enhancing creativity, cultural depth, and dissemination impact.

2. Theoretical Foundations and AI Collaborative Design Framework

2.1. Characteristics of Tourism Cultural-Creative Products

Tourism cultural-creative products are distinguished by their dual role as both functional commodities and symbolic carriers of cultural meaning. Unlike ordinary consumer goods, these products integrate tangible elements—such as materials, craftsmanship techniques, and visual motifs—with intangible cultural dimensions, including myths, rituals, collective memories, and shared values. This dual nature makes them not only objects of consumption but also vessels of cultural narrative and heritage transmission. Their design process therefore demands a careful negotiation among three interrelated objectives. Cultural authenticity ensures that products faithfully represent local history, traditions, and identity, preserving cultural heritage rather than creating superficial imitations. Aesthetic appeal involves integrating contemporary design sensibilities, ensuring that products remain relevant to modern tastes and attractive to a diverse consumer base. Commercial viability addresses the need for scalability, affordability, and competitiveness, enabling these products to sustain themselves within dynamic tourism markets. Meeting these requirements depends on collaboration among designers, cultural experts, and consumers, ensuring that tourism cultural-creative products are not only visually appealing but also culturally meaningful, economically sustainable, and capable of fostering deeper cultural engagement.

2.2. AI Technology and Collaborative Design

AI collaborative design refers to the application of intelligent algorithms and interactive platforms to facilitate co-creation among designers, cultural stakeholders, and consumers [3]. This approach leverages the strengths of computational analysis and human creativity to produce culturally grounded and innovative designs. For example, natural language processing (NLP) can extract symbolic meanings and narrative structures from historical documents, folklore, and literary works, revealing cultural motifs that may not be immediately apparent. Computer vision algorithms can analyse and classify visual patterns from heritage artefacts, such as architectural details, textile patterns, and ornamental motifs, transforming these elements into digital resources for design. Generative models, including GANs and style transfer techniques, can then produce diverse variations of design prototypes that merge cultural authenticity with contemporary innovation. In practice, AI functions as a mediator in the collaborative design process, enhancing ideation efficiency, reducing repetitive tasks, and ensuring that outputs remain anchored in cultural authenticity. For tourism cultural-creative products, this integration transforms cultural narratives into tangible, market-ready designs that align more closely with visitor expectations while maintaining heritage integrity.

2.3. Framework for AI-Driven Collaborative Design

The proposed framework for AI-driven collaborative design is structured into four interrelated layers, each contributing to the integration of cultural heritage, creative design, and market applicability. The data layer collects and organises diverse cultural resources, including textual records, images, artefacts, oral histories, and consumer preference data from tourism markets and online platforms. These datasets form the basis for cultural insight extraction. The modelling layer applies AI tools to analyse cultural semantics, extract symbolic patterns, and generate preliminary

design concepts through advanced techniques such as style transfer, generative modelling, and image-to-design transformation. This layer translates raw cultural data into creative prototypes. The application layer provides digital platforms where designers, cultural experts, and consumers interact to co-create and refine concepts. Immersive technologies such as AR and VR enable stakeholders to visualise products in simulated scenarios, enriching cultural storytelling and design validation. The interaction layer establishes real-time feedback loops, allowing for continuous input from consumers and cultural experts, ensuring iterative improvements before final production. Together, these layers form an integrated process that balances cultural authenticity, aesthetic innovation, and commercial viability, creating a robust system for AI-assisted cultural-creative product design.

3. Core Technologies and Implementation

3.1. Big Data and Cultural Symbol Mining

Large-scale datasets derived from digital archives, social media platforms, travel blogs, short-video content, and tourist-generated multimedia provide an abundant and multifaceted foundation for the identification and analysis of cultural elements [4]. These datasets not only include structured data, such as heritage documentation and museum archives, but also unstructured data, such as photographs, videos, narratives, and online reviews, which reflect real-world perceptions and evolving cultural interpretations. Through computational methods such as text mining and topic modelling, recurring cultural themes, narratives, and symbolic expressions can be systematically extracted and analysed. These methods allow for the discovery of latent cultural patterns embedded in large volumes of textual data, revealing not only overt motifs but also subtle cultural connotations. Similarly, image recognition algorithms, supported by deep learning frameworks, can classify and annotate visual motifs embedded in heritage resources, including architectural details, costume patterns, traditional crafts, and symbolic artefacts. Such analysis can extend to the identification of colour schemes, geometric patterns, and texture characteristics that carry cultural significance. This computational approach transforms vast, fragmented, and unstructured data into structured cultural knowledge, enabling designers to ground their creative processes in authentic cultural insights. As a result, product design shifts from relying on arbitrary aesthetic choices to being informed by verifiable cultural symbols that enhance both authenticity and cultural representation.

3.2. Generative Design and AI Creativity

Generative design tools, including Generative Adversarial Networks (GANs) and diffusion models, open new possibilities for the creation of cultural-creative products by synthesising traditional symbols with contemporary design concepts and functional innovation [5]. These tools can produce a broad range of design alternatives, each representing a distinct reinterpretation of cultural heritage, thereby expanding the creative possibilities available to designers. For instance, traditional embroidery patterns may be algorithmically reimagined into modern wearable accessories such as scarves, jewellery, or textile prints that harmonise with current fashion trends. Likewise, local myths, legends, and oral narratives can inspire immersive and interactive packaging designs enhanced with augmented reality (AR) technologies, enabling consumers to engage directly with cultural storytelling. These AI-generated outputs function as creative catalysts, providing diverse prototypes that stimulate design ideation without replacing the human role. Designers can use these prototypes as experimental drafts, refining them through human insight, cultural expertise, and market feedback. This synergy accelerates the ideation process, reduces development costs, and fosters innovation, while preserving cultural authenticity. Ultimately, generative design transforms heritage elements into products that are not only innovative but also commercially viable, enabling cultural traditions to be preserved and adapted within contemporary consumer contexts.

3.3. Consumer Behaviour Analytics and Personalisation

AI-driven analytics of consumer behaviour, including purchase histories, online reviews, and survey data, enables a more refined understanding of audience preferences [6]. By employing clustering and predictive modelling, different visitor groups—such as cultural enthusiasts, young digital natives, or international tourists—can be distinguished according to their consumption patterns and cultural expectations. This segmentation informs the design process, making it possible to create personalised cultural-creative products that appeal to specific target groups. Personalisation not only enhances consumer satisfaction and purchasing likelihood but also contributes to the wider dissemination of local culture. When products resonate with multiple demographic groups, cultural narratives gain new pathways for transmission, ultimately strengthening both market competitiveness and cultural sustainability.

4. Case Study: Application in Jiangnan Water Town Tourism

4.1. AI Collaborative Design Process

In the Jiangnan water town region, an AI-driven collaborative design platform was implemented to develop cultural-creative products that embody the distinctive architectural aesthetics and rich folklore of the area [7]. The process began with comprehensive data collection, integrating heritage archives, tourist feedback, and user-generated content from social media platforms such as travel blogs, image-sharing sites, and short-video platforms. AI algorithms processed this diverse dataset to extract core cultural symbols, including iconic bridges, intricate waterways, traditional architectural patterns, lotus motifs, and emblematic colour palettes. These cultural elements were then structured into semantic maps to guide the creative process. Designers engaged with AI-generated prototypes through iterative workshops, where cultural experts provided historical validation and narrative enrichment. This co-creation process combined computational efficiency with human expertise, ensuring that design outputs maintained cultural authenticity while also embracing innovative expression.

4.2. Smart Scenario Simulation and Market Testing

The collaborative design platform integrated smart scenario simulation as a core mechanism for evaluating the viability of product concepts within both real and potential tourism markets. This approach combines cultural analysis with predictive modelling to assess not only commercial feasibility but also cultural resonance. By analysing predicted visitor preferences, purchase intentions, sentiment trends, and cultural relevance scores, the system can simulate how different designs might perform across varied tourism contexts, such as heritage sites, urban cultural hubs, or online marketplaces. For example, an AR-enhanced tea packaging concept inspired by Jiangnan folk tales was subjected to a comprehensive testing process. This involved a combination of online surveys targeting diverse visitor demographics, social media engagement analysis to assess public response, and immersive VR exhibitions that recreated realistic consumption scenarios. These methods provided multi-dimensional insights, revealing not only aesthetic preferences but also emotional engagement and cultural interpretation among potential consumers. Such feedback enabled designers to iteratively refine product elements, including visual language, material selection, narrative depth, and functional features, ensuring that the design aligned with both cultural authenticity and consumer expectations.

In addition, predictive analytics informed broader operational strategies, including decisions regarding production scale, pricing, inventory allocation, and distribution channels. By modelling market demand under different scenarios, the platform could anticipate peak periods, optimise resource allocation, and reduce the risk of overproduction. This data-driven approach not only enhanced efficiency and reduced development costs but also ensured a higher degree of alignment between the final products and market demand. Ultimately, smart scenario simulation and market testing transformed product development from a largely speculative process into a systematic, evidence-based practice, enabling tourism cultural-creative products to achieve both cultural

significance and commercial success.

4.3. Enhancing Cultural Dissemination and Visitor Experience

The final products integrated tangible artefacts with immersive digital storytelling, transforming tourism souvenirs into cultural experiences. Visitors purchasing products could access supplementary content via QR codes or mobile apps, engaging with AR-enhanced narratives about Jiangnan traditions, local crafts, festivals, and the historical significance of featured motifs. This integration of physical and digital layers allowed products to transcend material value, becoming cultural ambassadors that carried rich contextual meaning. The immersive experience strengthened emotional connections between tourists and heritage, turning consumption into participatory cultural learning. AI-enabled personalisation further enhanced this interaction by analysing visitor behaviour and preferences to recommend customised narratives and product variations. This capability not only improved visitor satisfaction but also expanded the reach of cultural dissemination, enabling products to engage diverse demographics and foster long-term cultural appreciation.

5. Challenges and Future Directions

5.1. Data Integration and Cultural Authenticity

Integrating diverse datasets from digital archives, social media, heritage repositories, tourism platforms, and user-generated content presents both significant opportunities and challenges. These data sources vary widely in format, quality, language, and cultural context, making standardisation a technical necessity but also a cultural sensitivity issue. Without careful integration, there is a risk that valuable nuances may be lost, leading to a homogenised interpretation of heritage. Over-reliance on algorithmic interpretation further increases the risk of cultural misrepresentation, as AI models tend to prioritise statistical patterns over contextual depth. For example, motifs that appear frequently in data may overshadow less common but culturally significant symbols. To mitigate this, strong validation mechanisms must be embedded in the design process. These should involve interdisciplinary collaboration with cultural experts, local communities, historians, and heritage institutions to ensure the cultural accuracy and ethical integrity of AI outputs. Such safeguards not only preserve authenticity but also foster trust among stakeholders and consumers, reinforcing the cultural value of tourism products.

5.2. Technology Adoption and Local Capacity Building

Despite the promise of AI-driven collaborative design, many small and medium-sized tourism enterprises (SMTEs) face considerable barriers to adoption. High costs for acquiring AI tools, inadequate technical expertise, and organisational resistance to change are common obstacles [8]. These challenges are compounded in rural or heritage-rich regions where digital infrastructure may be underdeveloped. Addressing these barriers requires a multi-layered strategy. Capacity building through targeted training programmes can empower local designers and artisans with both the technical competencies and creative skills necessary to integrate AI into their workflows. Equally important is fostering a supportive innovation ecosystem. Public-private partnerships can provide not only financial support but also access to technological infrastructure, maintenance services, and professional mentorship. Such collaborations can create platforms for knowledge exchange, co-design experimentation, and cultural resource sharing, thereby lowering adoption thresholds and enabling sustainable integration of AI in cultural-creative product development.

5.3. Balancing Innovation and Tradition

AI-enhanced design offers powerful tools for creative exploration, but it also presents the risk of over-modernising cultural heritage. Excessive reinterpretation of traditional motifs without adequate cultural grounding can result in products that, while visually appealing, lose their authentic connection to heritage, leading to cultural dilution. Sustainable cultural-creative design must therefore strike a careful balance between innovation and fidelity to tradition. This balance is

achievable through iterative design processes that incorporate continuous feedback from designers, cultural experts, local communities, and target consumers. Participatory cultural governance models can play a critical role, allowing communities to co-determine how cultural elements are represented and transformed. Such approaches ensure that innovation does not come at the expense of cultural integrity, but rather deepens cultural value by embedding creativity within the living traditions of the community. Ultimately, maintaining this balance fosters not only product innovation but also the long-term preservation and transmission of intangible cultural heritage.

6. Conclusion

AI-driven collaborative design offers transformative potential for tourism cultural-creative product development by integrating cultural symbol mining, generative creativity, and consumer analytics. This study demonstrates how AI enhances efficiency, authenticity, and cultural dissemination, creating immersive and personalised visitor experiences. Future research should focus on cross-regional applications, long-term impact evaluation, and strengthening cultural community participation in AI design processes.

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