Digital Tools Empower the Cultural and Tourism Industry to Achieve Integrated Development Through "Scenario Creation + Service Upgrade"

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ABSTRACT Digital technologies are reshaping the architecture of intelligent service systems by enabling immersive interaction, adaptive information processing, and networked resource coordination. This study investigates the integrated development of the cultural and tourism industry through a "scenario creation + service upgrade" framework driven by digital tools. An intelligent service architecture is established by combining virtual reality, augmented reality, big data analytics, artificial intelligence, edge computing, and smart service platforms to support immersive experience generation, dynamic resource allocation, and personalized service delivery. The proposed framework further incorporates unified data governance, real-time visitor analysis, intelligent recommendation, and adaptive scheduling mechanisms to overcome fragmented information resources, low service intelligence, and insufficient digital integration. Through systematic analysis of digital transformation pathways, the study demonstrates that immersive scene construction and data-driven service optimization can significantly enhance operational efficiency, user engagement, and sustainable industrial development. Beyond cultural tourism applications, the proposed architecture provides methodological references for distributed information processing, intelligent sensing platforms, adaptive service coordination, and communication-enabled digital infrastructures, with potential implications for smart environments and engineering applications related to Electromagnetic Waves, Antennas and Propagation.

INDEX TERMS digital sensing, distributed information processing, adaptive service coordination, intelligent infrastructure

I. INTRODUCTION

IN the digital economy era, the deep integration of digital technology with the cultural tourism industry and smart weaving and high-performance fiber production has become a major driving force for industrial transformation. This synergy facilitates a comprehensive upgrading of regional identity by linking immersive tourism experiences with the industrial precision and digital frameworks. The cultural tourism industry is an important component of the national economy, and its development quality directly affects people's living standards and the satisfaction of their cultural needs. The extensive use of digital tools brings the dual benefits of scenario creation and service improvement to the cultural tourism industry, enabling it to shift from sightseeing tourism to immersive experience tourism. However, the cultural tourism industry still faces many challenges in its digital transformation, urgently requiring the exploration of effective integrated development pathways. From the perspective of digital tool empowerment, this paper systematically explores scenario creation and service improvement in the cultural tourism industry while integrating the technical heritage and high-performance artistry. This approach provides theoretical suggestions for the high-quality development of regional identity by linking immersive tourism services with the advanced digital architecture.

II. THE SIGNIFICANCE OF DIGITAL TOOLS IN EMPOWERING THE INTEGRATED DEVELOPMENT OF THE CULTURAL AND TOURISM INDUSTRY

Digital tools empowering the cultural and tourism industry can be summarized as a dynamic, multi-dimensional ecosystem characterized by non-linear feedback loops, as shown in Figure 1. While categorized into three levels, these dimensions are deeply interdependent: macro-level resource precision directly dictates the quality of micro-level interactions, while micro-level visitor data flows back to optimize the broader industrial architecture.

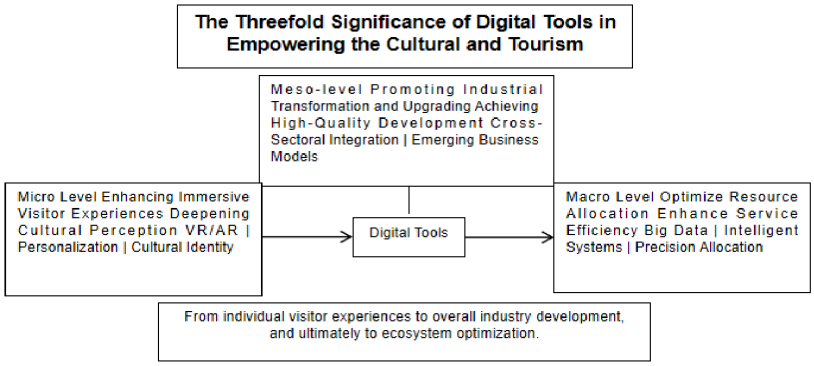

FIGURE 1. A logical framework diagram illustrating the significance of digital tools in empowering the integrated development of the cultural and tourism industry

A. ENHANCE THE IMMERSIVE EXPERIENCE AND CULTURAL AWARENESS OF TOURISTS

Digital tools use virtual reality, augmented reality and other technologies to break through the spatial and temporal constraints of traditional cultural and tourism experiences, creating an all-round, multi-sensory immersive cultural experience environment for tourists. Digital scene creation transforms abstract content such as history, culture and folk customs into visual and interactive experience forms, allowing tourists to develop a deep cultural identity in a space that blends the virtual and the real, achieving personalized content push, greatly improving the effectiveness of cultural dissemination and experience satisfaction, and prompting cultural and tourism consumption to shift from superficial sightseeing to in-depth experience [1].

B. PROMOTING THE TRANSFORMATION, UPGRADING, AND HIGH-QUALITY DEVELOPMENT OF THE CULTURAL AND TOURISM INDUSTRY

Digital tools have given the tourism industry new impetus for development, accelerating the transformation of industrial structure towards adaptability and business mode. By using digital technology to break through the limitations of traditional business models, new forms of cultural and tourism products and services can be developed, the industrial chain can be extended, the innovative development and utilization of cultural and tourism resources can be promoted, and the efficiency of resource conversion and economic benefits can be improved [2]. Digital tools promote the cross-border integration of the cultural and tourism industry with science and technology, creative industries, etc., giving rise to new business forms such as smart tourism and cultural creativity, improving industrial competitiveness, and promoting the development of the industry towards high added value and high quality [3].

C. PROMOTE THE OPTIMAL ALLOCATION OF CULTURAL AND TOURISM RESOURCES AND IMPROVE SERVICE EFFICIENCY

Digital tools achieve the goal of accurate allocation and efficient use of cultural and tourism resources through data collection, analysis and application. Big data technology monitors tourist flow, consumption preferences and other information in real time, so as to provide scientific reference for resource allocation and service improvement. Intelligent management system can improve the operation level of scenic spots, save management costs and improve tourist experience [4]. Digital platform integrates scattered cultural and tourism resources, breaks down information barriers, enables resource sharing and collaborative development, optimizes service process, shortens response time, improves service accuracy and convenience, and improves the sustainable development capability of the industry [5].

III. PROBLEMS IN THE CREATION OF SCENES AND UPGRADING OF SERVICES IN THE CULTURAL TOURISM INDUSTRY

Figure 2 shows the core issues currently facing the digital transformation of the cultural and tourism industry and their interrelationships.

A. INSUFFICIENT ABILITY TO CREATE DIGITAL SCENARIOS AND LACK OF IMMERSIVE EXPERIENCES

The application of technology in the construction of digital scenes in the current cultural tourism industry is not enough. Whether it is in-depth application or extensive use, it has not reached a good state. Many cultural tourism scenic spots are still stuck on simple digital display, without forming a truly immersive scene design, and without giving full play to the core role of digital technology in scene creation. The application rate of virtual reality and augmented reality technologies is not high. Industry benchmarks suggest that a lack of immersive digital layers correlates with lower 'time-on-site' metrics [6]. In this context, low VR/AR utilization functions as a bottleneck; without these tools, scenic spots fail to provide the high-engagement services required to

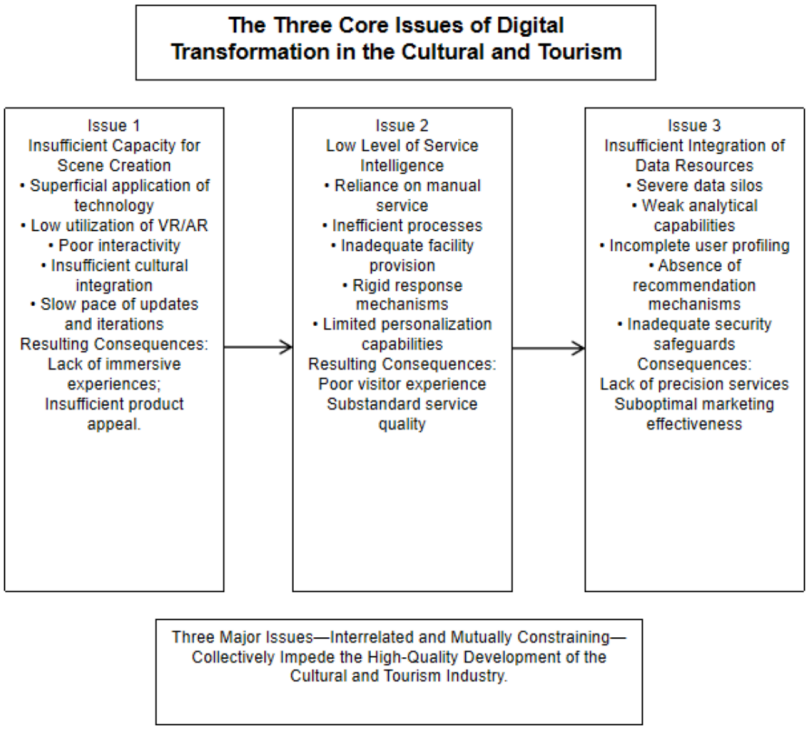

FIGURE 2. Correlation Diagram of Core Issues in the Digital Transformation of the Cultural Tourism Industry

compete with modern digital-native entertainment, directly leading to perceptions of substandard service quality among younger demographics [7].

B. THE SERVICE MODEL IS TRADITIONAL AND SIMPLISTIC, WITH A LOW LEVEL OF INTELLIGENCE

The cultural tourism industry is still mainly based on traditional manual services, and the construction of intelligent service system is seriously lagging behind. The service process lacks digital transformation, and the processes of reservation, consultation, and guidance are very inefficient, resulting in a poor tourist experience. The configuration of intelligent service facilities is insufficient, and the coverage of self-service terminals, intelligent guide systems and other equipment is low. Even if they are available, they have problems such as simple functions and complicated operation, which cannot effectively alleviate the pressure of manual services. The service response mechanism is inflexible and lacks the ability to adjust in real time, resulting in insufficient service supply during peak tourist seasons. The ability to provide personalized services is lacking. Personalized service solutions are not provided according to the different needs of tourists, and the phenomenon of service homogenization is serious [8]. Service personnel lack digital skills, are not proficient in operating intelligent equipment, and lack digital service awareness, which will reduce the overall service quality and tourist satisfaction [9].

C. INSUFFICIENT DATA RESOURCE INTEGRATION AND LACK OF PRECISE SERVICE CAPABILITIES

The data resources of the cultural and tourism industry are scattered and lack a unified system for data collection, storage and management, resulting in a large number of data silos. Data cannot be shared between departments and scenic spots, and information sharing and collaborative application cannot be realized, resulting in the data value not being fully realized. Data analysis capabilities are poor, there is a lack of professional data analysis teams and tools, and a large amount of data has not been deeply mined, so the data cannot be transformed into effective support for service decision-making. Tourist profiles are not fully created, and the understanding of tourist behavior characteristics, consumption preferences and other information is inaccurate, resulting in a difference between service supply and actual demand [10]. There is a lack of precise marketing and personalized recommendation mechanisms, and the inability to provide corresponding products and services based on tourist characteristics results in poor marketing effects and low conversion rates. The data security system is not sound, there is a lack of privacy protection awareness, and there is a risk of data leakage, which reduces tourists' trust in digital services [11].

IV. STRATEGIES FOR EMPOWERING THE INTEGRATED DEVELOPMENT OF THE CULTURAL AND TOURISM INDUSTRY WITH DIGITAL TOOLS

A. UTILIZE VR/AR AND OTHER TECHNOLOGIES TO CREATE IMMERSIVE CULTURAL TOURISM SCENARIOS

Further strengthen the application of virtual reality and augmented reality technologies by first establishing a unified data backbone that eliminates existing silos. This strategy ensures that immersive digital spaces are not merely isolated hardware deployments but are fed by real-time, integrated data streams from cultural heritage databases and visitor management systems, thereby solving the core hindrance of fragmented information. Use three-dimensional modeling, panoramic images and other technical means to restore historical scenes and reproduce cultural relics, and provide tourists with cultural perception in virtual space and time. Develop digital content with strong interactivity, set up diverse experience paths and triggering mechanisms to enhance tourists' sense of participation and immersion. Use digital narratives to integrate regional culture and historical stories into scene design, making the cultural connotation and emotional level of the scene deeper. Establish a scene content update mechanism utilizing edge computing nodes to manage the high computational overhead of 3D asset rendering. To maintain a 'highly immersive' experience, the system must support dynamic data refresh rates of at least 60Hz for visual assets, ensuring that updates to cultural narratives or environmental changes are synchronized across the digital architecture without latency. Improve the level of technical equipment by incorporating inclusive design principles that account for the 'digital divide.' To ensure accessibility for all age groups, interfaces must minimize cognitive load and offer non-VR alternatives for elderly tourists who may experience physiological discomfort from high-immersion environments [12]. Strengthen scene safety protection management, set up necessary safety warnings and protective measures to ensure the safety of tourists in the immersive experience process. Applying VR/AR technology to cultural and tourism scenes can be implemented in three aspects: technology, content and security, as shown in Table 1.

TABLE 1. Implementation Framework for Creating Immersive VR/AR Scenes

Dimension	Core Elements	Implementation Strategy	Expected Results
Technical layer	Scene building	3D modeling restores historical scenes, and panoramic images reproduce cultural relics.	Achieving a cross-time and space cultural experience
Technical layer	Equipment Configuration	Optimize device performance and lower the barrier to entry.	Improve applicability to all age groups
Content layer	Cultural integration	Embedding local culture and historical stories to enhance digital narrative	Enhance cultural identity
Content layer	Interactive Design	Set up diverse experience paths and trigger mechanisms	Increase engagement and immersion
Operational layer	Content Update	Establish a periodic iteration cycle for digital assets based on user engagement metrics and seasonal cultural themes.	Sustainability of visitor interest and engagement
Security layer	Safety Management	Set up safety tips and protective measures	Ensure the safety of tourists

By creating a systematic scene, we can develop cultural and tourism experience products with core competitiveness [13].

B. BUILD A SMART SERVICE PLATFORM TO ACHIEVE INTELLIGENT SERVICE UPGRADES

Create an integrated smart service platform to integrate services such as booking, payment, tour guide, and consultation, and provide one-stop service supply. Deploy smart service terminal equipment, such as self-service machines and smart tour guide screens, at key nodes in the scenic area to provide tourists with

convenient information inquiry and business handling services. Develop mobile service applications and use mini-programs, apps, and other carriers to provide online and offline integrated services, so that tourists can obtain the services they need anytime and anywhere. Use artificial intelligence customer service system and natural language processing technology to power location-aware interactive kiosks. By deploying these NLP-driven interfaces at physical landmarks, tourists can engage in real-time, voice-activated dialogue regarding local history, solving the 'poor interactivity' of static displays through context-sensitive AI assistance, thereby improving the response speed and accuracy of consultation services. Create a dynamic service scheduling system and arrange service resources based on real-time passenger flow data to improve the service supply situation [14]. Improve the service evaluation and feedback system, listen to tourists' opinions, and continuously improve service quality. The construction of the smart service platform should start from three aspects: platform functions, smart facilities, and service mechanisms, and build a smart service platform upgrade system as shown in Table 2.

TABLE 2. Functional Architecture and Implementation Key Points of the Smart Service Platform

Construction Module	Key Functions	Technical support	Service Improvement
Integration Platform	Integrated booking, payment, guided tour, and consultation	Cloud platform + API interface	Achieve one-stop service process
Smart terminal	Deployment of Self-Service Kiosks and Smart Interactive Displays	IoT + Touch Interaction	Improve service accessibility
Mobile application	Mini Programs/Apps integrate online and offline channels	Mobile Internet	Access to services anytime, anywhere
AI Customer Service	Intelligent question answering and consultation response	Natural Language Processing	Improve response speed
Dynamic scheduling	Automatic resource allocation based on passenger flow	Real-time data analysis	Optimize supply structure
Feedback optimization	Service Evaluation and Continuous Improvement	Evaluation system + data analysis	Improve tourist satisfaction

Strengthen the training of service personnel, improve their digital service skills and intelligent equipment operation capabilities, and ensure that online and offline services can cooperate with each other. Rely on the establishment of a smart platform to improve service efficiency, improve

service experience satisfaction, and achieve the goal of intelligent and refined service methods [15].

C. ESTABLISH A BIG DATA ANALYTICS SYSTEM TO PROVIDE PRECISE AND PERSONALIZED SERVICES

Create a unified data collection and management platform to integrate data resources from scenic spots, hotels, transportation, and other aspects, breaking down data silos and achieving data interoperability and centralized storage. Establish a standardized data governance system, specifying the processes for data collection, cleaning, and storage to ensure data validity. Employ advanced data analysis tools and algorithms to conduct in-depth analysis of tourist behavior patterns, consumption habits, and preferences, creating an accurate tourist profile system. Develop an intelligent recommendation engine based on data analysis results, providing personalized tourism products and service solutions to different types of tourists, thereby improving service matching and tourist satisfaction. Establish a predictive and early warning mechanism, using historical and real-time data to predict visitor flow and demand, providing decision support for resource allocation and service preparation. Improve the data security system, employing data encryption, access control, and other methods to ensure tourist safety and confidentiality in accordance with laws and regulations protecting personal privacy. The big data analysis system should create a closed-loop system where data governance, analysis and application, and security are interconnected, forming the precise service support architecture shown in Table 3.

TABLE 3. Path to Building a Big Data Precision Service System

System hierarchy	Core mission	Technical methods	Application value
Data governance	Multi-channel data integration and standardization	Data platform + ETL tools	Breaking down data barriers
Data governance	Data cleaning and quality control	Data governance standards	Ensure data availability
Analysis Applications	Tourist profiling	Behavioral analysis + clustering algorithm	Achieve accurate identification
Analysis Applications	Intelligent recommendation engine	Collaborative filtering + deep learning	Provide personalized services
Analysis Applications	Prediction and early warning mechanism	Time series + machine learning	Supporting scientific decision-making
Security	Privacy protection and data encryption	Encryption technology + access control	Protect tourists' trust

Establish a professional data analytics team to improve data application capabilities and decision support levels. Leveraging big data, shift service decisions from experience-based to data-driven, thereby enhancing service accuracy and personalization.

V. CONCLUSION

Digital tools provide strong support and innovative impetus for the creation of scenarios and the improvement of services in the cultural and tourism industry while advancing the digital architecture and high-performance production. This integration enhances regional service ecosystems by linking immersive tourism experiences with the technical heritage and industrial craftsmanship.

By using virtual reality technology to create immersive scenarios, leveraging smart service platforms to achieve intelligent services, and utilizing big data to provide precise services, prominent problems in current development can be effectively addressed, enabling a transformation and upgrade from traditional models to digital and intelligent models. This integrated development approach can improve the quality of the tourist experience, optimize the industrial structure, enhance competitiveness, and inject new impetus into the high-quality development of the cultural and tourism industry. With the continuous development and in-depth application of digital technology, driven by both scenario creation and service upgrades, the cultural and tourism industry will continuously innovate, improve itself, expand its industrial boundaries, meet the growing demand of the people for cultural tourism, and contribute to building a culturally strong nation. This approach preserves regional heritage by integrating the precision and craftsmanship of local industries into the digital tourism narrative. By integrating these sectors, the framework ensures a sustainable digital transformation that preserves both regional hospitality and the advanced industrial craftsmanship.

AUTHOR CONTRIBUTIONS

Weiwei Zhou designed, collected and analyzed the data, and drafted the manuscript. Weiwei Zhou conducted the study, critically revised the manuscript for important intellectual content, and gave final approval of the version to be published. Weiwei Zhou participated fully in the work, take public responsibility for appropriate portions of the content, and agreed to be accountable for all aspects of the work in ensuring that questions related to the accuracy or integrity of any part of the work are appropriately investigated and resolved.

CONFLICTS OF INTEREST

The author declares no conflict of interest.

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