

Intelligent Services and Experience Enhancement Pathways in Rural Tourism Empowered by Digital Intelligence

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ABSTRACT

With the rapid development of the digital economy, digital intelligence technology is profoundly transforming rural tourism services and tourist experiences. This paper focuses on rural tourism empowered by digital intelligence, exploring how intelligent technology enhances service quality and optimizes tourist experiences. From three core dimensions—intelligent information management, personalized service design, and immersive experience creation—the research analyzes the application of big data, artificial intelligence (AI), and the Internet of Things (IoT) in rural tourism. The research indicates that data-driven precision marketing and tourist behavior analysis can effectively improve service efficiency. Intelligent navigation, virtual reality (VR), and augmented reality (AR) technologies can create highly engaging tourism experiences, while constructing an intelligent management platform facilitates resource integration and service process optimization. This paper also presents strategic recommendations based on practical cases, analyzed from six perspectives: technology, data, industry, policy, society, and international cooperation. The research aims to provide valuable insights for the high-quality development of the tourism industry under the framework of rural revitalization.

Keywords: Digital Intelligence Empowerment; Rural Tourism; Big Data Analysis; Artificial Intelligence; Rural Revitalization

1. Introduction

1.1 Research Background and Significance

Rural tourism plays a crucial role in promoting rural revitalization. With strong support from national policies, it has shown great potential for development. The report of the 20th National Congress of the Communist Party of China emphasizes the comprehensive promotion of rural revitalization, urban-rural integration, and modernization efforts. The "14th Five-Year Plan for Digital Economy Development" calls for the acceleration of emerging technologies such as 5G, IoT, big data, and AI in agriculture and rural areas, aiming to build a "Digital Countryside."

However, rural tourism in China still faces challenges such as insufficient infrastructure, low service quality, and ecological protection pressures. Integrating

digital intelligence technology not only optimizes tourism service models and management efficiency but also explores a balance between economic growth and ecological conservation, ensuring high-quality and sustainable rural tourism development. Furthermore, international initiatives like Europe's "Smart Villages" program offer valuable insights, inspiring new approaches to rural tourism innovation in China. Thus, exploring how digital intelligence empowers intelligent services and enhances tourist experiences in rural tourism is of significant theoretical and practical value.

1.2 Domestic and International Research Status

Scholars worldwide have extensively studied the intelligent development of rural tourism, though differences exist in perspectives and application pathways. Domestic research focuses on the practical application

of smart technologies and management optimization. Li Ming & Zhang Wei (2022) explored big data-driven marketing strategies to enhance the attractiveness of rural tourism but lacked in-depth analysis of tourist behavioral dynamics. Zhang Hua & Liu Xin (2023) proposed a framework for smart service platforms but did not fully address the growing demand for personalized tourist experiences. International research tends to emphasize technological advancements. Jones et al. (2020) highlighted the importance of digital platforms in resource integration and community governance, while Smith et al. (2021) applied AI to predict tourist behavior and optimize experiences. However, these studies often face adaptability challenges when applied to China's diverse economic and cultural landscape. This paper adopts a multi-dimensional approach, integrating perspectives from technology, industry, policy, and society to address the gaps in existing research.

1.3 Research Objectives and Methods

This research explores innovative applications of intelligent technologies in rural tourism services and experiences, drawing from China's "Digital Countryside" plan and Europe's "Smart Villages" initiative. It focuses on four key areas: intelligent information management, personalized service design, immersive experience creation, and sustainable development.

Research methods include:

(1)Literature Review: By combing the relevant literature at home and abroad, this paper analyzes the theoretical basis and research status of intelligent development of rural tourism.

(2)Case Studies: Select and conduct an in-depth analysis of representative cases of intelligent rural tourism in China and Europe.

(3)Comparative Analysis: By comparing practical experiences from different regions, this research summarizes strategic recommendations applicable to China. It not only deepens and expands existing research findings but also proposes more actionable and practical strategies.

1.4 Research Innovation and Value

This research contributes in three key ways:

(1)Theoretical Contribution: Integrates domestic and international experiences to construct a comprehensive theoretical framework for intelligent rural tourism development, proposing systematic enhancement pathways from multiple dimensions, including technology, data, industry, policy, and society.

(2)Practical Innovation: Combines the "Digital Countryside" initiative with the "Smart Villages" practice to propose a series of concrete and feasible strategic recommendations, such as smart infrastructure development, data-sharing platform construction, and community-led participation mechanisms.

(3)Methodological Novelty: Conducts cross-regional comparative case studies to explore international pathways for China's intelligent rural tourism development, addressing gaps in regional practice comparisons and international experience adaptation.

This paper not only provides new insights into the theoretical development of intelligent rural tourism but also offers practical and actionable recommendations for policymakers and industry practitioners, contributing to the high-quality development of rural tourism in the digital transformation era.

2. Theoretical Foundation and Development Status of Digital Intelligence Empowerment for Rural Tourism

2.1 Concept and Value of Digital Intelligence Empowerment for Rural Tourism

Digital intelligence empowerment for rural tourism refers to an innovative model that enhances service quality, optimizes operational efficiency, and improves tourist experiences through the integrated application of digital and intelligent technologies (collectively referred to as "digital intelligence technology"). At its core, it leverages advanced technologies such as big data, artificial intelligence (AI), the Internet of Things (IoT), and virtual reality/augmented reality (VR/AR) to drive the transformation of rural tourism from a traditional offline model to a smarter, more personalized, and immersive experience.

The economic value of digital intelligence

empowerment for rural tourism lies in stimulating rural economic vitality, expanding employment opportunities, and increasing tourism revenue. Its social value is reflected in enhancing community engagement, fostering interactions between tourists and local residents, and promoting cultural identity. The ecological value is demonstrated through the use of smart technologies to support resource conservation and sustainable development. By leveraging digital intelligence, rural tourism not only serves as a key driver of rural economic growth but also contributes to the creation of a modern rural development model where humans and nature coexist harmoniously.

2.2 Core Directions for Intelligent Rural Tourism Development

2.2.1 Smart Information Management

Based on cutting-edge technologies such as the Internet of Things (IoT) and big data, an intelligent management platform integrating data collection, analysis, and management can be constructed to achieve the digital transformation of scenic area monitoring, resource integration, and tourist information management. By enabling real-time tracking of tourist flow, service demands, and resource conditions, the platform optimizes management processes, improves operational efficiency, and provides precise support for rural tourism.

2.2.2 Personalized Service Design

Guided by tourist demand, artificial intelligence algorithms are employed to deeply analyze tourist behavior data and preferences, enabling the design of highly customized tourism products and services. Through precise recommendations of unique travel routes, activity plans, and personalized dining options, tourists are provided with differentiated and immersive experiences. This transformation shifts from standardized services to a "one-to-one personalized service" model, significantly enhancing tourist satisfaction and overall experience.

2.2.3 Scenario-Based Immersive Experience

By utilizing virtual reality (VR) and augmented reality (AR) technologies, rural tourism scenes can be reimaged to create an interactive experience space

that seamlessly blends the virtual and real worlds. For example, tourists can "travel" back in time through VR to experience rural cultural heritage or engage in agricultural activities and handicraft making through AR interactive technology. This approach enhances the vividness and depth of participation in tourism experiences, fostering stronger sensory and emotional connections for tourists.

2.2.4 Ecological and Sustainable Development

Intelligent technologies can be employed to scientifically monitor and assess the development and utilization of rural ecological resources. For example, drones and environmental sensors can be used to monitor ecological carrying capacity, preventing the overexploitation of resources. By deeply integrating rural tourism with the concept of green development, this approach explores pathways for the coordinated development of economic benefits, cultural heritage preservation, and ecological protection, providing technological support and institutional guarantees for the sustainable development of rural tourism.

2.3 Application Pathways of Digital Intelligence Empowerment for Rural Tourism

2.3.1 Big Data-Driven Precision Services

Big data enables precise services and scientific decision-making in rural tourism through data collection, analysis, and application:

(1) Tourist Behavior Analysis: By collecting data on tourists' online searches, bookings, and reviews, preferences can be predicted to develop targeted marketing strategies.

(2) Dynamic Demand Matching: Real-time data analysis helps recommend tailored travel routes, activities, and accommodation/dining options that align with tourist needs, enhancing service personalization.

(3) Intelligent Resource Allocation: Big data analysis of tourist flow and consumption habits allows scenic areas to implement scientific crowd management and resource allocation strategies, preventing waste and overdevelopment.

2.3.2 Scenario-Based Applications of AI and IoT

Artificial intelligence (AI) and the Internet of Things (IoT) provide technological support for the intelligent

transformation of rural tourism:

(1) Smart Navigation and Guided Tours: IoT sensors and AI algorithms enable the development of intelligent guide devices or mobile apps that offer real-time location tracking, route planning, and audio explanations for tourists.

(2) Intelligent Sensing and Management: IoT devices deployed in scenic areas monitor environmental conditions such as temperature and tourist flow in real time, providing data-driven support for managers to optimize services and operational processes.

(3) Unmanned Service Equipment: AI-powered facilities such as self-service ticketing machines and smart waste sorting bins enhance operational efficiency and reduce management costs in scenic areas.

2.3.3 Immersive Experiences Empowered by VR/AR

VR/AR technologies enhance visual and interactive experiences, increasing tourist engagement and cultural awareness:

(1) Virtual Tours and Scene Restoration: VR technology reconstructs historical rural architecture and traditional cultural scenes, allowing tourists to "travel through time" and experience rural cultural evolution even in a modern setting.

(2) AR-Enhanced Reality Experiences: AR interactive devices placed in scenic areas enable tourists to use smartphones or smart glasses to access dynamic explanations of attractions, information about local flora and fauna, and engaging interactive games.

(3) Immersive Cultural Activities: VR/AR-based interactive projects, such as virtual farming and folk culture experiences, allow tourists to actively participate in rural activities, deepening their tourism experience and fostering emotional connections.

By integrating big data, AI, IoT, and VR/AR, digital intelligence technology provides a smart upgrade pathway for rural tourism. This not only optimizes service quality and operational efficiency but also significantly enhances tourist experiences. In the future, further popularization and deep application of these technologies in rural tourism will be a key driver for achieving rural revitalization and high-quality development.

3. Case Study Analysis and Insights

3.1 Case Study 1: Smart Rural Tourism Integrated Platform (China's "Digital Countryside" Initiative)

3.1.1 Background and Implementation

China's "Digital Countryside" initiative is a key component of the country's rural revitalization strategy, aiming to promote high-quality development of rural economies and tourism industries through the integration of digital intelligence technologies. For example, Anji County in Zhejiang Province has developed a county-wide integrated smart tourism service platform under the "Digital Countryside" initiative. This platform leverages big data, artificial intelligence (AI), and the Internet of Things (IoT) to provide a seamless, intelligent service experience for tourists, covering the entire journey from booking and travel to sightseeing and feedback.

3.1.2 Key Technological Applications

(1) Big Data-Driven Precision Marketing: Tourist behavior data is analyzed to determine age groups, interests, and consumption preferences, enabling personalized recommendations for travel routes and activities. For example, platform analytics revealed that family travelers prefer agritourism and outdoor recreational activities, leading to the launch of special holiday packages tailored to this demographic.

(2) Smart Navigation and Interactive Tour Guides: Mobile apps and smart guide devices allow tourists to access real-time recommended routes, attraction descriptions, and crowd density information, significantly improving tour efficiency.

(3) Real-Time Monitoring and Dynamic Management: IoT devices monitor tourist flow, environmental conditions, and infrastructure status in real time, providing data-driven insights for managers to ensure efficient and safe scenic area operations.

3.1.3 Outcomes and Significance

Since the launch of Anji County's digital countryside platform, the number of tourists has increased by 30% year-on-year, and tourist satisfaction has significantly improved. Additionally, digitalized operations have considerably reduced scenic area management costs,

offering a sustainable development pathway for rural tourism.

3.2 Case Study 2: International Smart Tourism Village (Europe's "Smart Villages" Initiative)

3.2.1 Background and Implementation

The "Smart Villages Initiative" is a strategic program launched by the European Union to drive the digital transformation of rural areas. By leveraging innovative technologies and smart services, this initiative aims to improve rural living conditions and economic environments, with rural tourism playing a key role. A notable example is Koli Village in Finland, which attracts a large number of tourists due to its stunning natural landscapes and rich cultural heritage.

3.2.2 Key Technological Applications

(1) Virtual Reality (VR) Experiences: Tourists can explore Koli Village's natural scenery and cultural heritage sites through VR before physically traveling, attracting more potential tourists. Additionally, local museums utilize VR to recreate historical and cultural narratives, allowing tourists to immerse themselves in the village's past and development.

(2) Ecological Monitoring System: Koli Village has installed smart environmental monitoring equipment to track air quality, water resources, and the impact of tourist activities on the ecosystem. These data-driven insights help preserve natural resources and support the sustainable development of eco-tourism.

(3) Smart Energy Management: The village employs an intelligent energy management system to optimize electricity consumption and heating efficiency, ensuring a sustainable and eco-friendly tourism experience.

3.2.3 Outcomes and Significance

The "Smart Villages" Initiative has transformed Koli Village into a globally recognized eco-tourism destination, with an annual tourist increase of over 20%. Furthermore, the integration of digital technologies has significantly improved the quality of life for local residents, creating a win-win situation for both rural tourism and community development.

3.3 Summary of Case Study Insights

The cases of Anji County's Smart Rural Tourism

Integrated Platform from China's "Digital Countryside" initiative and Koli Village from Europe's "Smart Villages" Initiative provide valuable lessons for the intelligent development of rural tourism.

(1) The Key to Advance Intelligent Rural Tourism: Deep Integration of Big Data and Smart Technologies

Anji County leverages big data to analyze tourist behavior patterns and consumption preferences, enabling precise marketing and customized services. Similarly, Koli Village utilizes VR technology to allow tourists to experience the destination virtually before traveling, enhancing engagement and expectations. This demonstrates that digital technology's ability to accurately understand tourist needs and offer personalized recommendations can significantly improve tourist satisfaction and drive tourism development.

(2) Construction of Intelligent Management Platforms and Real-Time Data Monitoring as Key Measures for Enhancing Scenic Area Management Efficiency

Anji County utilizes IoT devices to monitor tourist flow and environmental conditions in real-time, ensuring tourist safety and optimizing resource allocation. Meanwhile, Koli Village has innovated in eco-tourism by employing a smart environmental monitoring system to track air and water quality, ensuring the sustainable use of natural resources. This highlights that digital and IoT technologies enable precise monitoring in scenic area management, reducing operational costs and improving management efficiency.

(3) Green and Sustainable Development Principles as Fundamental Aspects of Success

Anji County's smart tourism platform has lowered operational costs and promoted the sustainable growth of rural tourism, while Koli Village's smart energy management system provides eco-friendly tourism experiences and protects the natural environment. This demonstrates that integrating green technology and intelligent management in rural tourism not only drives industry growth but also ensures long-term environmental sustainability.

(4) Technology-Driven Social Participation and

Economic Empowerment as Key Success Factors

The introduction of smart platforms in Anji County has enhanced the digital skills of rural residents and stimulated local economic growth. Meanwhile, Koli Village has improved the living standards of its residents by integrating smart tourism with ecological conservation. These cases demonstrate that the intelligent development of rural tourism not only drives the growth of the tourism industry itself but also significantly contributes to the overall advancement of rural economies and societies.

In conclusion, the widespread application of digital technologies, the implementation of intelligent management, the adoption of sustainable development principles, and the enhancement of social participation are critical factors for the success of smart rural tourism. The experiences from China and Europe provide valuable insights for other rural tourism destinations, offering guidance for the future exploration and refinement of rural tourism development strategies.

4. Strategic Recommendations for Digital Intelligence Empowerment for Rural Tourism

As a crucial driver of rural revitalization, the application of digital intelligence technology can optimize service models, enhance management efficiency, and create new pathways for sustainable development. The following strategic recommendations focus on six key dimensions: technology, data, industry, policy, society, and international cooperation.

4.1 Technological Empowerment: Optimizing Smart Infrastructure

As of June 2024, China's 5G user penetration rate has exceeded 60%. However, the 5G network coverage in rural areas remains insufficient to fully support the application of intelligent technologies. To ensure the successful implementation of smart rural tourism services, efforts should be made to accelerate the expansion of 5G networks and high-speed broadband across rural regions. Additionally, establishing an IoT-based perception system that covers scenic areas, villages, and public services will enhance the intelligence of tourism management and service delivery.

At the same time, the innovative application of smart terminal devices should be actively explored. Technologies such as smart wristbands, electronic guides, and multilingual virtual tour assistants can cater to the personalized needs of tourists and optimize their travel experiences. Furthermore, the development of integrated smart tourism platforms that combine artificial intelligence (AI), blockchain, and cloud computing should be encouraged. These platforms can be widely applied in tourism payment systems, scenic area management, and online services, ensuring a seamless connection between service providers and tourists, ultimately enabling efficient operations and high-quality services in rural tourism.

4.2 Data-Driven Development: Enhancing Big Data and AI Applications

A survey on rural tourism experiences revealed that only about 35% of tourists are satisfied with the intelligent services currently available, while nearly 50% believe that existing services fail to meet their personalized needs, particularly in route recommendations and immersive experience design. These shortcomings directly impact the overall perception of rural tourism, weakening word-of-mouth promotion.

To address this issue, a big data platform centered on tourist needs should be established, leveraging tourist behavior data, consumption habits, and feedback analysis. Real-time data analytics can support dynamic scenic area management and precision marketing strategies. Additionally, an innovative data governance mechanism should be introduced by setting up dedicated data-sharing and regulatory institutions. Establishing unified standards and protocols will ensure secure, efficient, and collaborative data interconnectivity through a tiered classification system.

Meanwhile, artificial intelligence (AI) should be utilized to enhance tourist flow predictions, dynamic optimization of travel routes, and personalized recommendations. The development of intelligent Q&A systems and multilingual voice assistants will enable real-time, responsive smart services, facilitating a comprehensive upgrade of rural tourism management

and services. These advancements will provide practical technological support for efficient tourism operations.

4.3 Industry Collaboration: Promoting Cross-Sector Integration

Rural tourism resources should serve as the core foundation for building a regional tourism brand, deeply integrating related industries such as agriculture, cultural creativity, and wellness tourism. This approach will drive the "Tourism+" model toward a high-quality, diversified experience.

A cross-sector collaboration mechanism should be innovatively developed. Partnerships with logistics and supply chain enterprises can lead to the launch of a "Rural Tourism + Direct-Supply Specialty Products" initiative. This initiative would seamlessly connect specialty agricultural products and handicrafts with tourism consumption scenarios, fostering the deep integration of rural economies with the tourism industry.

Additionally, the establishment of a Smart Rural Tourism Integrated Service Center is recommended. This center would consolidate accommodation, dining, guided tours, and transportation services to create a highly efficient and convenient one-stop service system. Such a system would not only enhance the overall tourist experience but also strengthen inter-industry linkages, injecting sustained growth momentum into the rural economy.

4.4 Policy Support: Establishing Innovation and Safeguard Mechanisms

Both national and local governments should formulate specialized policies to support the intelligent development of rural tourism. These policies should include financial subsidies, support for technological research and development (R&D), and tax incentives to encourage the innovation and widespread application of digital technologies in the rural tourism sector. A cross-regional collaboration mechanism should also be established to facilitate resource sharing and smart joint development of tourism assets. By creating a multi-regional smart rural tourism ecosystem, the industry can achieve integrated and coordinated regional tourism development.

Furthermore, a comprehensive regulatory system should be implemented. The introduction of independent third-party evaluation agencies can ensure scientific assessment and supervision of data security, technical standards, and the operation of smart platforms. This will guarantee fairness, compliance, and sustainability in the application of intelligent technologies, driving high-quality smart rural tourism development.

4.5 Social Participation: Enhancing Community and Tourist Interaction

A "community-led + technology-enabled" participation mechanism should be established. With government policy support and social capital investment, rural residents should receive systematic digital skills training, enabling them to actively participate as partners in smart tourism projects. This will enhance community ownership and equitable revenue-sharing.

A smart tourism platform focused on interactive experiences should be developed, featuring modules that encourage deep tourist engagement, such as eco-conservation volunteer programs, rural culture livestreaming, and interactive online experiences. These initiatives will strengthen emotional connections between tourists and local communities.

Additionally, the development of a "Smart Rural Memory Bank" should be supported. Through digital platforms, this initiative can preserve and showcase rural historical culture and modern development progress, helping to build a unique rural cultural brand. By fostering emotional resonance and a sense of belonging among tourists, this project will facilitate the digital preservation and dissemination of rural cultural values.

4.6 International Cooperation: Promoting Resource and Experience Sharing

Active participation in international tourism cooperation projects should be encouraged, particularly by aligning with advanced initiatives such as Europe's "Smart Villages" program. By learning from their successful experiences in smart technology application, resource management, and rural revitalization, China can further enhance the intelligent development of its rural tourism sector.

An international smart rural tourism sharing platform should be established to facilitate the global exchange of technological resources, operational expertise, and tourist behavior data, fostering mutual benefits and cooperation in the field of smart tourism.

Innovative promotional strategies should be developed by leveraging global social media and virtual reality (VR) technology. A "Global Rural Traveler Program" could be launched, allowing tourists to explore rural destinations through virtual guided tours before their trips. For instance, tourists could experience rice farming in Yunnan's terraced fields or cultural heritage in Anhui's Hui-style villages online, stimulating travel interest and increasing real-world visits. This approach would expand the global influence of China's rural tourism and promote deeper international collaboration in the digitalization of rural tourism, positioning "Chinese Rural Tourism" as a recognized global brand.

In summary, the key to digital intelligence empowerment for rural tourism lies in the practical implementation of technology and the efficient integration of resources. By optimizing smart infrastructure, expanding the application of big data and AI, fostering industry collaboration, and ensuring policy support and social participation, rural tourism can achieve a qualitative leap in service quality, management efficiency, and sustainable development. Furthermore, international cooperation will further unlock the potential of smart rural tourism, fostering deeper integration between rural revitalization and the global shared economy. This will inject new momentum into the high-quality development of rural revitalization and the tourism industry.

5. Conclusion and Outlook

5.1 Research Conclusions

This research explores how digital intelligence technologies empower intelligent services and enhance tourist experiences in rural tourism. Focusing on three core dimensions—smart information management, personalized service design, and immersive experience creation—it systematically analyzes the application pathways of big data, artificial intelligence (AI), the

Internet of Things (IoT), and virtual/augmented reality (VR/AR) in rural tourism. The key conclusions are as follows:

(1) Digital intelligence technologies significantly enhance service efficiency and tourist experience quality: Data-driven precision services demonstrate strong resource optimization capabilities. AI and IoT applications facilitate smart and scenario-based services, while VR/AR technologies enhance tourist immersion and engagement.

(2) Intelligent development is an inevitable trend for the high-quality growth of rural tourism: The widespread adoption of smart technologies addresses challenges such as homogeneous services, fragmented resources, and low management efficiency in traditional rural tourism. Additionally, digital intelligence injects new momentum into the industry, fostering innovation and competitiveness.

(3) A comprehensive coordination mechanism is crucial for driving intelligent development: The realization of smart rural tourism depends on technological innovation, industry collaboration, and policy support. Furthermore, improving public acceptance and adoption of smart tourism services is essential for successful implementation.

This research provides both theoretical support and practical guidance for the application of digital intelligence technologies in rural tourism, contributing to the enhancement of service quality and the transformation and upgrading of the tourism industry.

5.2 Outlook on the High-Quality Development of Rural Tourism

With the rapid advancement of the digital economy and intelligent technologies, smart rural tourism is expected to embrace even greater opportunities. In the pursuit of high-quality development, the following areas should be further strengthened:

(1) Comprehensive Smart Management: Establishing an integrated smart management platform to enable real-time monitoring and optimization of rural tourism resources, services, and tourist activities, creating a more efficient, safe, and convenient service system.

(2)Multi-Industry Collaborative Ecosystem: Promoting deep integration between rural tourism and sectors such as agriculture, culture, and wellness tourism, extending industrial value chains and building a digitally driven rural economic ecosystem.

(3)International Development and Brand Building: Leveraging smart technologies to enhance the service capabilities and competitiveness of rural tourism, positioning China's unique rural tourism brands in the global market and effectively telling the story of China's rural revitalization.

Looking ahead, digitally empowered rural tourism will shift from "quantitative growth" to "qualitative enhancement," playing an increasingly vital role in rural revitalization, urban-rural integration, and common prosperity. At the same time, continuous improvements in technology, policy frameworks, and social participation mechanisms will be essential for the comprehensive upgrade of smart rural tourism, contributing to the high-quality development of China's rural economy.

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