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Article

Research on Immersive Experience Design and Tourist Perception of Smart Tourism from the Perspective of the Metaverse

Zhaojian Liu ^{1,*} and Liling Huang ²

¹ Faculty of Hospitality and Tourism Management, Macau University of Science and Technology, Macao, China

² School of Management, Guangxi University for Nationalities, Nanning, China

* Correspondence: Zhaojian Liu, Faculty of Hospitality and Tourism Management, Macau University of Science and Technology, Macao, China

Abstract: With the rapid rise and development of the metaverse, its integration with smart tourism has become a central focus of academic research and industry practice. The metaverse, characterized by virtual-real integration, immersion, interactivity, and persistence, offers unprecedented opportunities to reshape the design of immersive tourism experiences and to reconfigure how tourists perceive destinations, services, and value. This paper aims to systematically explore the key elements of immersive experience design in smart tourism from the perspective of the metaverse and to examine their impact on tourists' cognitive, emotional, and behavioral perceptions. First, the study outlines the current status of the integration between the metaverse and smart tourism, summarizing typical application scenarios and technological pathways. Second, through literature review and case analysis, it identifies relevant theoretical foundations, including experience economy, presence, and technology acceptance, and constructs an analytical framework for metaverse-enabled tourism experiences. Third, the paper analyzes the main factors influencing tourist perception, such as immersion quality, interaction design, content authenticity, and virtual-real linkage, and discusses their implications for satisfaction, engagement, and intention to visit or revisit. Finally, based on empirical insights and best practices, the study proposes optimization strategies for destination managers and tourism enterprises in terms of experience planning, platform construction, content development, and governance. The findings enrich research on the metaverse and smart tourism and provide practical guidance for promoting innovative, high-quality development of the tourism industry.

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1. Introduction

In recent years, Metaverse technology has evolved from concept to practical application, driven by breakthrough developments in core technologies such as VR, AR, blockchain, and artificial intelligence [1]. It has profoundly impacted the development of various industries, including the tourism sector. As a result of the integration of tourism and information technology, smart tourism is evolving towards an immersive and personalized experience, having undergone digitalization and networking stages. At present, tourists' demand for tourism experiences is no longer limited to traditional sightseeing but is more about participation, emotional resonance, and unique memories. The emergence of the metaverse provides a new approach to meet this demand.

Judging from the current status of industry development, many scenic spots and tourism companies domestically and internationally have begun to explore metaverse-related applications, such as the "Digital Forbidden City" VR experience project launched by the Forbidden City, which allows tourists to immerse themselves in the architectural beauty and historical heritage of the Forbidden City online. Practice has shown that the integration of the metaverse and smart tourism already has a certain realistic foundation [1, 2].

The existing research focuses on the application of VR and AR in the fields of the metaverse and smart tourism but rarely systematically analyzes the design elements of immersive experiences, such as content, space, and senses, and the correlation mechanism between tourists' perceptions. Moreover, there is insufficient empirical model construction for the relationship between the two in the metaverse scenario, making it challenging to support the practical needs of experience optimization [3, 4].

In this context, it is of great significance to conduct research on the immersive experience design and tourist perception of smart tourism from the perspective of the metaverse [3]. In theory, this paper integrates the research results from multiple fields, including the metaverse, smart tourism, immersive experience, and tourist perception, constructs a systematic theoretical framework, and addresses the shortcomings of current related research. In practice, it offers practical guidance for tourism enterprises on developing immersive experience products, optimizing technology applications, and enhancing service quality, thereby helping tourist destinations improve their competitiveness and promote high-quality, innovative development within the entire tourism industry.

2. Relevant Theoretical Basis

2.1. *The Core Theory of Metaverse and Smart Tourism*

The Metaverse is a digital space that integrates various advanced technologies, characterized by virtual reality integration, immersion, and interactivity. It is built upon the Internet and supported by multiple technologies to create a new digital ecosystem where the virtual and real worlds are closely interconnected. Within the Metaverse, users can engage in diverse activities using digital identities, experiencing scenarios similar to those in the physical world. Its foundational technologies include virtual reality (VR), augmented reality (AR), blockchain, artificial intelligence (AI), and digital twins [5]. The integration of these technologies provides robust technical support for the development and operation of the Metaverse.

Smart tourism involves the application of information technology to enhance the intelligence, convenience, and personalization of tourism activities. It integrates, analyzes, and utilizes tourism-related information to deliver comprehensive services to tourists, such as information queries and itinerary planning before travel, navigation and payment during travel, and evaluation and sharing after travel. Currently, the technological applications in smart tourism have expanded from basic Internet usage to include mobile Internet, big data, and artificial intelligence [2]. Additionally, the service model increasingly emphasizes personalization and precision, addressing the diverse needs of tourists. In the future, as technology continues to advance, smart tourism is anticipated to evolve toward greater intelligence, immersion, and scenario-based experiences.

2.2. *Immersive Experience and Tourist Perception Theory*

An immersive experience occurs when individuals are fully engaged in an activity, intensely focused, and may even lose track of their surroundings and the passage of time. Its main components include concentration and a distorted sense of time [6]. In the field of tourism, immersive experience holds significant application value. It enables tourists to experience the culture, landscape, and atmosphere of a destination, thereby enhancing their overall satisfaction with the tourism experience. For example, in some theme parks,

the carefully designed scene layout and interactive performances create an immersive experience that makes tourists feel as if they are in another world.

Tourist perception refers to the subjective understanding and evaluation of tourism products, services, and environments formed by tourists through their senses during the travel process [4]. It is influenced by various factors, including the quality and characteristics of tourism products, the attitude and professional level of service personnel, as well as the age, gender, education level, and travel experience of tourists. Tourist perception is highly significant in tourism research. It not only reflects the image and competitiveness of tourist destinations but also provides a crucial basis for tourism enterprises to design products, optimize services, and formulate effective marketing strategies. Understanding tourists' perceptions helps tourism enterprises better meet tourists' needs and improve their loyalty.

3. Design Elements of Smart Tourism Immersive Experience in the Context of the Metaverse

This section examines the design elements of smart tourism immersive experiences by comparing multiple cases and analyzing factor coding. The case selection adheres to principles of typicality and diversity, covering various types of tourist destinations, such as cultural sites, natural attractions, and theme parks, as well as projects incorporating metaverse applications like the VR experience at the Digital Palace Museum. This approach ensures the universality of the research conclusions [7]. Feature extraction is conducted using a four-dimensional analysis framework encompassing technology, content, space, and sensory aspects. Core design elements are systematically identified through the construction of a coding table. The verification process employs a triangulation method, which includes in-depth interviews with tourism enterprise developers, participatory observation of tourist experiences, and text analysis of user comments on online platforms. By integrating these diverse data sources, the extracted design elements are cross-verified to ensure their accuracy and reliability.

3.1. Technology and Content Immersion Design

VR and AR technologies play a crucial role in creating virtual tourism scenes and offering immersive guided tours. VR technology can create a completely virtual tourism environment for tourists, allowing them to experience scenic spots around the world without leaving their homes. For example, through VR equipment, tourists can stroll inside the Egyptian pyramids, observe the structure and murals of the pyramids up close, and get an immersive feeling [8]. AR technology can superimpose virtual information on real scenes to provide tourists with richer guided tour content. In museums, tourists use AR glasses to view detailed introductions to exhibits, including 3D models, which enhances the enjoyment and knowledge gained during the tour. Figure 1 shows the global smart tourism market size and forecast.

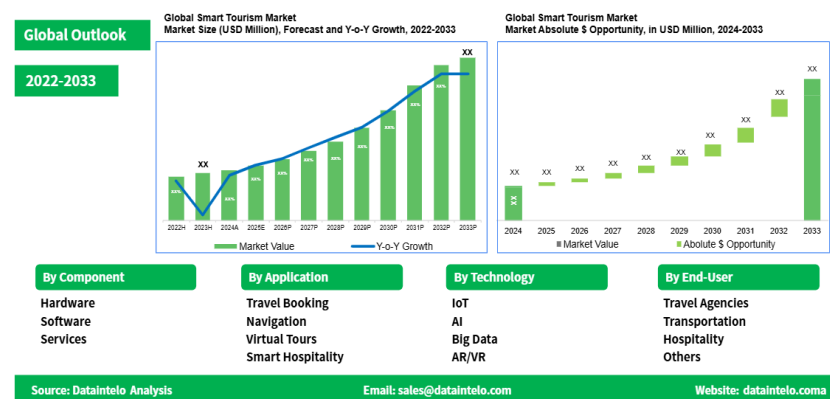


Figure 1. Global smart tourism market size and forecast.

Artificial intelligence and big data technologies offer robust support for personalized services in smart tourism. Artificial intelligence recommends personalized travel routes, attractions, and services to tourists based on their historical travel data, browsing history, and preference settings. For example, some apps recommend corresponding travel products based on the types of travel that tourists like, such as natural scenery, historical culture, or leisure and vacation [9]. Big data analysis can provide a deep understanding of tourists' needs and behavioral characteristics, helping tourism companies optimize product design and service processes. Additionally, digital twin technology can accurately replicate real-world scenic spots and create virtual digital models of these scenic spots. Tourists can have interactive experiences in virtual scenic spots, such as simulated mountain climbing and boating, to prepare for travel activities.

In terms of immersion design, building a storyline and creating a theme atmosphere are effective ways to enhance tourists' sense of immersion. Taking a certain ancient city tour as an example, historical stories and legends of the ancient city can be unearthed to craft a storyline that unfolds throughout the entire tour process. During the tour, tourists become characters in the story, exploring the ancient city as the plot unfolds and experiencing the city's rich historical and cultural heritage. At the same time, a cohesive thematic atmosphere is established by the consistent design of the ancient city's architecture, street layout, and staff costumes.

Exploring local culture and expressing it innovatively through digital means can help tourists gain a deeper understanding and appreciation of the local culture. For example, some intangible cultural heritage, such as traditional opera and folk handicrafts, can be displayed and disseminated through virtual reality and animation. Visitors can experience the production process of traditional handicrafts through interactive devices or "watch" a wonderful virtual opera performance. In addition, setting up interactive sessions and game tasks effectively enhances the participation and immersion of tourists. In some theme parks, various level-breaking games are set up, and tourists need to complete a series of tasks before entering the next area. These tasks are often related to the park's theme, allowing tourists to better experience the park's characteristics during the game.

3.2. *Spatial and Sensory Immersive Design*

First, in the transformation and utilization of physical space, taking a natural scenic spot as an example, the scenic spot is divided into different functional areas, such as a sightseeing area, a rest area, and an entertainment area, through a reasonable spatial layout, making the tour process more orderly. At the same time, lighting and sound effects are used to create a different atmosphere. At night, the mountains and trees in the scenic area are beautifully illuminated, and with soft music, tourists can immerse themselves in a tranquil atmosphere. Landscape design is also crucial. Planting various flowers, plants, and trees in the scenic area creates a beautiful natural landscape, allowing tourists to experience the charm of nature during their tour.

Second, building virtual space can enable cross-regional tourism and expand the boundaries of the tourism experience. With the help of virtual reality technology, tourists can "go" to places that are difficult to reach due to long distances, inconvenient transportation, or other reasons. For example, tourists can "visit" the glaciers in Antarctica and the underwater world in the deep sea to gain a unique tourism experience. Virtual space also breaks the limitations of time, allowing tourists to experience scenes from different historical periods.

Third, the integration and interaction of physical and virtual space is an important way to enhance the immersive experience. Visitors can interact with virtual space through specific devices in physical space. In some museums, visitors have the opportunity to use gesture recognition devices to interact with virtual exhibits. This allows them to rotate exhibits and view internal structures. This interactive approach to combining virtual and real elements enhances the visitor experience, making it richer and more engaging.

Fourth, the use of multi-sensory stimulation can create a strong immersive experience. Visually realistic scene layouts and exquisite picture displays can bring a visual impact to tourists. In terms of hearing, sound effects and music that match the scene can significantly enhance the atmosphere [6, 10]. In terms of touch, some interactive devices allow tourists to experience different sensations, such as touching virtual animal fur and objects made of various materials. For smell and taste, the corresponding smell can be released through specific devices.

Personalized customization of sensory experiences can meet the diverse needs of tourists [11]. It is necessary to provide tourists with diverse sensory experiences tailored to their age, gender, preferences, and other individual characteristics. For example, for tourists who prefer quietness, sensory experiences with a peaceful atmosphere can be provided.

4. Analysis of Factors Affecting Tourists' Perception of Smart Tourism

4.1. Individual Tourists and Product Services

First, tourists of different ages have varying perceptions of the immersive experience of smart tourism based on the Metaverse. Younger tourists are generally more receptive to new technologies and adapt more easily to the smart tourism model [12]. They tend to be more interested in interactive and innovative elements, experiencing a stronger sense of immersion. In contrast, older tourists may face challenges due to their relative unfamiliarity with technology. Regarding gender, male tourists may prefer engaging in challenging and stimulating smart tourism activities, while female tourists might focus more on emotional experiences and attention to detail during their travels.

Secondly, education level and occupational background influence tourists' perceptions. Tourists with higher education levels often have a better understanding of concepts like the Metaverse and smart tourism, enabling them to appreciate the experience's connotations and value more comprehensively. Conversely, tourists with lower education levels may prioritize the experiential aspects [5]. Occupational background also plays a role, as tourists working in technology and Internet industries may focus on technical applications, while those in cultural and artistic fields may emphasize cultural significance and creative expression.

Third, tourists' travel preferences and experiences shape their expectations and perceptions. Tourists who enjoy adventure and exploration may have higher expectations for novel and unique experiences in Metaverse smart tourism. Those who prefer leisure and relaxation may prioritize comfort and convenience during their travels. Experienced travelers tend to have higher expectations for tourism products and services, making their perceptions more discerning. In contrast, first-time tourists may rate the experience more highly due to its novelty.

The quality of immersive experience design significantly impacts tourists' perceptions across dimensions such as technology, content, space, and sensory engagement. Stable technology, user-friendly operations, engaging content, well-organized spatial layouts, coordinated sensory experiences, and unique designs contribute to positive perceptions [6]. Conversely, frequent technical failures, unengaging content, and disorganized spaces can negatively affect tourists' experiences.

Moreover, the quality and personalization of services play a crucial role in enhancing tourists' perceptions. Enthusiastic and professional tour guide services, along with timely and effective responses, make tourists feel respected and valued, thereby increasing overall satisfaction. Personalized services, such as tailoring travel routes to individual needs, create a sense of uniqueness and exclusivity for tourists.

Finally, the pricing of Metaverse smart tourism products is closely linked to tourists' perceived value. When the price is reasonable and the experience aligns with or exceeds tourists' expectations, they tend to have a positive perception. However, if the price is too high and the experience fails to meet expectations, dissatisfaction is likely to arise.

4.2. Technology Application and Environment

Firstly, technical stability significantly impacts tourists' immersive experience and perception. During the experience of Metaverse smart tourism, technological failures can seriously affect the overall experience. For instance, when participating in a VR virtual tour, a sudden device freeze may cause the image to become static, frustrating and disappointing tourists, ultimately leading to a lower evaluation of their travel experience. The operability of the technology also influences tourists' participation. If the technology used in Metaverse smart tourism is overly complex and requires substantial time to learn and master, it can diminish tourists' enthusiasm to engage. Conversely, simple and convenient technology enables tourists to easily get started, better participate in the travel experience, and enhance their perception. To address challenges in technical operation, tourists can be assisted through detailed operation guides and simple training courses.

Secondly, the sense of novelty brought by technological innovation positively impacts tourists' perception and willingness to revisit. New technological applications can provide tourists with unprecedented experiences, satisfying their curiosity and desire to explore [13, 14]. For example, innovative interactive technologies can allow tourists to engage in more fluent conversations with characters in virtual scenes. This sense of novelty leaves a lasting impression on tourists, enhancing their evaluation of the travel experience and increasing the likelihood of a return visit.

The image of a tourist destination plays a crucial role in shaping tourists' perception of Metaverse smart tourism. Destinations with a strong brand image and reputation tend to elevate tourists' expectations during Metaverse-based smart tourism experiences, leading to more positive perceptions. Conversely, destinations with a weaker image may negatively influence tourists' experiences, even if the design and technological applications of Metaverse smart tourism are well-executed.

Additionally, the social and cultural environment affects tourists' acceptance and perception of Metaverse tourism. Diverse social and cultural settings shape people's values and consumption habits. In environments where new technologies and innovations are widely embraced, tourists are more inclined to try them, leading to a better understanding and enjoyment of the experience [3, 15]. In contrast, in more conservative areas, tourists may exhibit skepticism or resistance toward the concept of Metaverse tourism. Recommendations and comments from peers can also influence tourists' choices and perceptions of Metaverse tourism.

Moreover, the network environment and infrastructure are essential for ensuring a seamless experience [13]. Stable network speed and reliable signals support the smooth operation of virtual scenes and real-time data transmission, enhancing tourists' overall experience. Infrastructure at scenic spots, such as charging facilities and rest areas, significantly impacts tourists' comfort and satisfaction. An unstable network environment or inadequate infrastructure can cause inconvenience and detract from the overall experience.

5. Conclusion

This paper explores immersive experience design and tourist perception of smart tourism within the context of the metaverse, yielding several key conclusions. Immersive experience design elements such as technology, content, space, and sensory engagement are central to enhancing immersion. Technologies like VR, AR, and artificial intelligence play a pivotal role in supporting these experiences. Integrating cultural elements to boost appeal, merging virtual and physical spaces, and employing multi-sensory stimulation further amplify the immersive effect. Individual characteristics, including age and education level, significantly influence tourist perception. Factors such as product service quality, technology application, and environmental conditions are positively correlated with tourist perception, with technology stability and content appeal being particularly impactful.

Research demonstrates a strong positive correlation between the dimensions of immersive experience design and tourists' perceptions, indicating that well-executed design can effectively enhance satisfaction and participation. Consequently, tourism companies should prioritize optimizing technology applications, fostering content innovation, integrating cultural elements, and delivering personalized services to improve overall experiences.

This study acknowledges certain limitations, including a restricted sample size. Future research could address these limitations by expanding sample coverage and exploring dynamic perception mechanisms through longitudinal studies. Such efforts would provide more comprehensive theoretical and practical insights to support the sustainable development of smart tourism within the metaverse.

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