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Exploration of the Impact of Virtual Reality Technology on Tourist Experience ——Take the Digital Exhibition Center of the Mogao Grottoes of Dunhuang as an example

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Abstract
In November 2022, the Central People's Government of the People's Republic of China issued the "Action Plan for the Integration and Development Development of Virtual Reality and Industry Application" (2022-2026). The state advocated combining virtual reality technology with various industries. In recent years, more and more scenic spots have begun to introduce virtual reality technology and develop virtual tourism, such as the digital display center of the Mogao Grottoes in Dunhuang, the Forbidden City Digital Cultural Scenic Area, and so on. At present, the research on virtual tourism on virtual tourism is mainly concentrated in the factors of tourists' choice of tourist destinations, virtual reality technology inquiry practical use in the development of scenic spots, etc., which have relatively few experience in tourists participating in virtual tourism. This article is based on the theme of virtual reality technology on the impact of tourists' experience. Using UGC data, it analyzes tourists' feedback on the experience of virtual tourism, and summarizes key factors affecting tourists' experience.

Keywords: *Virtual Reality Technology; Virtual tourism; Tourist experience; UGC data*

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I. INTRODUCTION

1.1 Research Background

1.1.1 Policy Background

In November 2022, the Central People's Government of the People's Republic of China issued the "Action Plan for the Integration and Development of Virtual Reality and Industry Applications" (2022-2026), which stated: "Accelerate the landing of virtual reality technology and multi industry and multi scenario applications. In order to achieve the development goals of large-scale and characteristic integrated applications, deepen the organic integration of virtual reality and industries in industrial production, cultural tourism, integrated media, education and training, sports and health, commercial and creative industries, performance and entertainment, safety and emergency response, disability assistance, smart cities and other fields.

In 2021, the Central People's Government of the People's Republic of China, together with the Ministry of Culture and Tourism, the Development and Reform Commission and other departments, issued the Opinions on Deepening the "Internet+Tourism" to Promote the High Quality Development of Tourism. The Opinions mentioned that "we should speed up the construction of smart tourism attractions and increase online tourism marketing efforts."

1.1.2 Market Background

In recent years, the level of China's national economy has been continuously improving. By 2023, the level of China's national economy will exceed 126 trillion yuan. With the continuous growth of the economy, people's quality of life is also getting higher and higher. In the first quarter of 2024, the number of domestic tourists reached 1.419 billion, a year-on-year increase of 16.7%. At the same time, major tourist attractions have also begun to combine virtual technologies such as AR and VR to develop smart tourism. The scene drama "Impression Pingyao" in Pingyao, Shanxi, uses VR technology to allow tourists to have a more immersive understanding of the history of Pingyao Ancient City, increasing their immersion and scene interaction during the tourism process.

1.2 Overview of Domestic Related Research

1.2.1 Overview of Research Overview

A total of 12122 academic journal articles were retrieved using the keyword "virtual reality technology" on China National Knowledge Infrastructure (CNKI), including 2209 papers from core journals of Peking University and 438 papers from CSSCI. A total of 494 academic papers were retrieved using the keyword 'virtual tourism', including 81 papers from core journals of Peking University and 51 papers from CSSCI. The research time span is relatively large, and there are also many studies on virtual reality technology, which are mostly combined with other industries, mainly focusing on the medical rehabilitation industry, with relatively few studies combined with the cultural and tourism industry.

1.2.2 Views of relevant scholars

With the continuous introduction of encouraging policies for the development of virtual reality technology by the country, many scholars in the tourism industry have also combined virtual reality technology with the tourism industry and put forward many beneficial viewpoints.

Li Xinjian et al. (2021) argue that virtual tourism is becoming increasingly important, as it not only provides potential tourists with digital sensory experiences, allowing them to experience the destination in advance, which helps tourists make decisions and has an impact on their on-site travel choices[1].

Zhao Weiwei et al. (2022) constructed a structural equation model by integrating TAM, ACSI, and expectancy theory. They found that virtual tourism experiences can affect the on-site tourism intentions of the "new generation" and have optimistic development prospects. Therefore, it is necessary to enhance the experience of virtual tourism[2].

Wang Xin and Bai Kai (2023) found through the application of mediation theory in time distortion and questionnaire survey method that the sense of presence has a significant positive impact on the emotional experience of virtual tourism participants, that is, the stronger the sense of presence, the more likely virtual tourism participants are to have a wonderful emotional experience[3].

1.3 Research Objective

Jaron Lanie first proposed the concept of "virtual reality" in 1989, which simulates real-life scenes to create a sense of perceptual substitution for the experiencer in a virtual environment. Virtual reality technology includes VR, AR, and other technologies. Virtual reality technology was first applied in the field of computers, and with the maturity and development of this technology, its application scope has gradually expanded to aviation, shipbuilding, construction, tourism and other fields. The research on virtual tourism in China began in the late 1990s[4]. In recent years, with the continuous promotion and advocacy of digital technology by the country, there have been more and more studies on the combination of virtual reality technology and tourism industry, mainly focusing on the design and implementation of virtual tourism systems and the exploration of the application of virtual reality technology in the protection of tourist attractions and cultural sites. There is relatively little research on how virtual reality technology affects tourist experience. Therefore, this article focuses on this and aims to explore how the application of virtual reality technology in the tourism industry affects tourist experience, and propose relevant countermeasures.

1.4 Research Methods

1.4.1 Literature analysis method

Using the research method of literature review, this study analyzes which industries are mainly combined with current scholars' research on virtual reality technology, and then focuses on the direction of virtual tourism to analyze scholars' research conclusions and viewpoints.

1.4.2 Reanalysis based on UGC data

The descendant collector was used to access the relevant evaluation of the digital exhibition center scenic spot in the Mogao Grottoes of Dunhuang on Weibo and Ctrip Travel official website, and the data was cleaned by manual reading, excluding unrelated samples such as pure advertising and malicious comments, and finally got effective comments.

II. ANALYSIS OF KEY CONCEPTS

2.1 Virtual Reality Technology

Virtual reality (VR) technology is a computer simulation system that can create and experience virtual worlds. It is also an interactive 3D dynamic visual and physical behavior system simulation that integrates multiple sources of information. It uses computers to generate a simulated environment that allows users to immerse themselves in the environment and create a sense of immersion, also known as spiritual technology. In order to better integrate information from both the real and virtual worlds, augmented reality (AR) technology has emerged. It involves using computer technology to simulate and overlay physical information (such as

visual information, sound, taste, touch, etc.) that is difficult to experience within a certain time and space range in the real world. The virtual information is then applied to the real world and perceived by human senses, achieving a sensory experience that transcends reality[5].

2.2 Tourism Experience

The tourism experience is defined as the degree of psychological satisfaction that tourists obtain through perceiving the external environment during the tourism process[6].

2.3 UGC data

User Generated Content (UGC) is a post visit evaluation formed by tourists towards tourist destinations, which has advantages such as multiple case sites, large data volume, long storage duration, and objective authenticity[7].

III. CASE STUDIES

The Mogao Grottoes of Dunhuang is the largest and most abundant Buddhist art shrine in the world. Among them, Cave 285 of the Western Wei Dynasty is the earliest existing Mogao Grottoes with a clear chronology of their construction. It was built during the four to five years of the Western Wei Dynasty. It is also one of the most abundant and well preserved caves in the Northern Dynasties of Dunhuang. It combines diverse artistic styles from home and abroad in terms of cave shape, mural content and other aspects, and is famous for its unique historical, artistic, social and other values.

Due to the popularity of tourism in recent years, the number of tourists to the Mogao Grottoes of Dunhuang has risen sharply, and uncivilized tourism has occurred frequently; In addition, the artistic value of Cave 285 is extremely high, and its historical significance is also extremely important. Therefore, the scenic area chose to close Cave 285 to better protect cultural relics. However, considering the strong feelings of tourists who want to visit Cave 285, the scenic spot has started to build a digital exhibition center of the Mogao Grottoes of Dunhuang, and restored Cave 285 1:1 using VR virtual reality technology for tourists to visit. The Mogao Grottoes Digital Exhibition Center utilizes the following virtual reality technologies:

3.1 3D Modeling Technology

By utilizing 3D modeling technology, the size and scene of 285 caves were replicated 1:1, and combined with the physical rendering and global dynamic lighting technology of the game engine, the colors and lighting conditions in the caves were restored.

3.2 VR Virtual Reality Technology

Using VR virtual reality technology, tourists only need to wear virtual 3D glasses to enjoy the murals up close, explore the details of the cave freely in 360 degrees, and even ascend to the "dome" to participate in the mural stories, immersing themselves in the scenes from thousands of years ago.

3.3 Holographic imaging technology

By utilizing holographic imaging technology, the murals, Buddha statues, and other artifacts in Cave 285 were fully restored, and the entire digital center was transformed into a spherical shape. The imaging materials were then created into a 20 minute documentary, allowing visitors to gain a detailed understanding of the history of Mogao Grottoes before their official visit.

IV.RESEARCH PROCESS

The research topic of this paper is tourist experience, so UGC data was used for analysis. Descendants collector was used to crawl large tourism, review, and communication websites such as Weibo, Ctrip, and Mafengwo. Due to the short development history of Dunhuang Digital Exhibition Center and its relatively low popularity compared to Mogao Grottoes, a total of 171 UGC data were crawled.

High frequency word analysis

Type	Category	Word Frequency	Text Content Example
Positive vocabulary (142)	Viewing effect	The viewing effect is worth it (34), shocking (22), immersive (12), , stunning (10).	Before viewing the Mogao Grottoes, you will come to the Digital Display Center to watch a 3D clip that tells the historical origins of the Mogao Grottoes. There is also a 1:1 display of the cave's murals and Buddha statues on the screen, which is very immersive and worth watching.
	Science popularization effect	The science popularization effect is good (41).	This exhibition center fully displays the architectural history and history of the Mogao Grottoes with numbers, which is very informative. It is recommended to

			come and watch before visiting the Mogao Grottoes.
	Scenic Area Services	Convenient parking service in the scenic area (23).	It only takes 20 minutes to come from Dunhuang city center, and there is a dedicated parking lot, which is quite convenient.
Negative vocabulary (29)	Viewing effect	Strong dizziness during movie watching (10), too short time (7)	I almost fell asleep (fainted) from the ball screen movie. The restoration in the ball screen is very realistic, but I feel dizzy and sleepy due to the way the camera shakes; Try to queue up earlier and choose the back seat, the front row looks too dizzy.
	Interesting content	uninteresting content (7), drowsiness (5)	To be honest, the filming is quite exquisite, but the dubbing is really a hypnotic rhythm. After 40 minutes, a big mouth wakes me up and I go to the scenic spot to check in; Two movies: Millennium Mogao, in my opinion, is very average and stands out compared to Dunhuang documentaries. The Dreamy Buddhist Temple is actually the most worth visiting, but many people close their eyes and rest their minds at this moment.

Statistics show that the overall positive evaluation of tourists on the digital exhibition center in the Mogao Grottoes of Dunhuang is significantly higher than the negative evaluation, which indicates that tourists are relatively satisfied with the overall network of the digital exhibition center in the Mogao Grottoes of Dunhuang. The positive evaluation is mainly reflected in the film watching experience and the effect of science popularization, which depicts the tourists' curiosity of seeking novelty and exploring the unknown. Negative evaluations are more worthy of our attention. Through the analysis of high-frequency words, it can be concluded that the factors that affect tourists' satisfaction with the application of virtual reality technology in scenic spots are mainly concentrated in the following areas:

4.1 Watching and experiencing movies

The viewing experience is a key factor in evaluating the success or failure of virtual reality technology application in scenic spots, which directly determines the satisfaction of tourists. The strong sense of dizziness reflects the unreasonable display of virtual reality technology in the scenic area. The digital spherical screen may not be suitable for every consumer, and the short time reflects that although tourists have gained the experience brought by virtual reality technology, this feeling is not long-lasting enough.

4.2 Science popularization effect

In cultural tourism attractions, virtual reality technology is often used for up close observation of cultural relics that tourists cannot access, or for using VR technology to recreate disappearing scenes. Therefore, most tourists are more interested in the popular science effect brought by virtual reality technology in scenic spots. The "uninteresting content" and "drowsiness" reflect that the content displayed in Dunhuang digital films is relatively single, and the attractiveness to tourists is not high enough.

V. RESEARCH CONCLUSION AND IMPLICATIONS

Based on Ctrip, Mafengwo, Weibo and other major user websites, this paper crawls UGC data, takes the relatively well-developed digital exhibition center of the Mogao Grottoes of Dunhuang as an example, establishes its analysis category based on positive and negative emotional factors, and puts forward practical development countermeasures The results indicate that:

5.1 Research Conclusion

(1) Overall, tourists are quite satisfied with the experience, with stunning visual effects, strong digital atmosphere, and high service quality being significant manifestations of positive emotions generated by tourists;
(2) The factors that affect tourists' satisfaction with their experience mainly include recreational time, movie watching experience, and level of science popularization.

5.2 Management Insights

With the continuous development of science and technology, many scenic spots have begun to use virtual reality technology, and a considerable number of scenic spots have successfully attracted consumers and achieved

success. However, after the novelty of tourists' curiosity fades away, it is worth considering how scenic spots can maintain the attractiveness of virtual reality technology, maintain tourists' experience, and obtain a continuous source of customers. After research and analysis, this article proposes the following development suggestions:

(1) Emphasize the promotion of virtual reality technology in scenic areas. Many scenic spots have introduced virtual reality technology, but lack promotion, resulting in many tourists not being aware that the scenic spots have virtual reality technology to experience, leading to a lack of deep experience and memory of the scenic spots.

(2) Enhance the interactive experience of virtual reality technology for tourists. At present, many scenic spots use virtual reality technology mainly to show tourists cultural relics or scenic spots that cannot be contacted closely, such as the digital exhibition center of the Mogao Grottoes of Dunhuang and the digital exhibition center of the Forbidden City. Although this form can bring a refreshing experience to tourists, it still remains at the level of sightseeing tourism. Scenic spots can use VR technology to generate some virtual character images, enhance interaction with tourists during the tour, and improve the interactive experience of tourists.

(3) Pay attention to the experience and feelings of tourists. Virtual reality technology, due to its unique sense of realism and technology, may cause discomfort such as dizziness and nausea for some people. When using virtual reality technology, scenic spots should always pay attention to tourists' experience and make adjustments based on these feelings.

5.3 Outlook and Shortcomings

(1) The research process is not perfect enough. Due to the relatively short research period, the study only referred to UGC data and lacked questionnaire surveys and interviews with tourists, resulting in an incomplete research process.

(2) The research perspective is relatively narrow. Only the experience brought by virtual reality technology to tourists has been explored, without delving into other subjects such as scenic spots and government agencies, resulting in a single perspective.

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