Scholar Publishing Group
Nature Environmental Protection
https://doi.org/10.38007/NEP.2023.040203
ISSN 2790-2684 Vol. 4, Issue 2: 22-29

Impact of Tourism Development in Nature Reserves on Ecological Environment under Virtual Reality Technology

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Keywords: Tourism Development, Ecological Environment, Virtual Reality Technology, Traditional Technology

Abstract: Carrying out ecotourism activities in the nature reserve is a complex engineering project. The destruction of protected species and ecological environment by human factors often occurs. The nature reserve may cause damage to the protected objects due to the development of ecotourism, leading to the decline of tourism resources, as well as the imbalance between the basic construction equipment and the surrounding landscape environment. In order to better explore the impact of tourism development in nature reserves on the ecological environment, this paper would facilitate the research of Virtual Reality (VR) technology. Through experiments, it was found that compared with the research based on traditional technology, VR-based technology can more accurately simulate the polluted ecological environment. The accuracy of simulation was more than 94%, while the accuracy of simulation based on traditional technology was 91%. By extracting the pollution of the ecological environment for simulation, tourism developers can be prepared in advance to avoid further deterioration of the ecological environment.

1. Introduction

With the transformation and upgrading of the industrial chain, it has increased the proportion of the tertiary industry in the society and promoted the development of the tourism industry across the country. The ongoing industrial upgrading aims to expand the industry, which would promote the development and expansion of the tourism industry across the country. As a tourist resort, the nature reserve has always attracted many tourists to visit and has great development value and economic benefits. Under such influence, the government departments of the nature reserve have begun to vigorously develop tourism. However, no matter the tourist activities or the basic

construction of the tourist destination development, there is no doubt that it would affect the ecological model of the nature reserve. In order to reduce the impact of the tourism development project on the nature reserve, it ensures that the whole process of the development and capital construction is not only harmonious and orderly, but also can protect the ecological environment. Due to the unreasonable reception of tourists in many tourist attractions, the tourist activities generated by overloaded tourists have greatly exceeded the self-purification capacity of the ecological environment in the reserve, which eventually led to serious ecological environment damage and air pollution in the tourist destinations, and would lead to the loss of attraction and gradual decline of some tourist destinations. Therefore, this paper would use VR technology to explore measures to deal with the decline of the natural environment of tourist destinations.

The ecological environment is the most intuitive object of tourism development, and the most easily reflected standard of the change in the environment of tourism destination is the ecological environment. Therefore, in the environmental impact experiment of tourism destination, the exploration of the impact of tourism on all things in nature is the most important, and a lot of scientific research work has been carried out in this regard. Han F. L discussed the impact of tourism activities on the environmental carrying capacity, vegetation landscape and atmospheric environment of the natural ecological reserve, and sought the coordinated development and ecology of tourism activities. The results showed that the results of different components of tourism carrying capacity varied greatly. The greater the interference of tourism activities, the smaller the ecological benefit value of the sample [1]. Baloch Qadar Bakhsh proposed a model framework for the development of sustainable ecotourism, including supportive government policy interventions to ensure the effective protection of the environment and natural resources without damaging the economic viability and social welfare of local people. In addition, the variables and structures of the study can be replicated to other destinations to seek valuable inputs for sustainable destination management in other places [2]. Khoi Nguyen Huu discussed the asymmetric impact of Singapore's tourism development on the ecological footprint. By applying the nonlinear autoregressive distribution lag method, the results showed that only the positive changes in tourism development have significant and negative impact on the long-term ecological footprint, while the short-term impact is symmetric [3]. Paramati Sudharshan Reddy investigated the impact of tourism investment in 28 European Union countries on tourism development and carbon dioxide emissions. The empirical results of panel cointegration test confirmed that there is a long-term equilibrium relationship between variables. Tourism investment has significant positive and negative impacts on tourism development and carbon dioxide emissions respectively [4]. The research content on the impact of tourism development on the ecological environment in nature reserves is very rich, but few experts and scholars consider the use of virtual reality technology to study it, so this study is valuable.

The impact of tourism development on the tourism environment is inevitable. As long as tourism development is carried out, the ecological environment and human, social and natural environment of the tourist destination may be affected [5-6]. However, this does not mean that all tourism development activities would have an impact on the natural environment of the destination, because the quality of the tourism environment is not only related to the improper tourism development, but also related to the self-purification treatment capacity of the tourism destination. When the digestion and absorption capacity of the tourist destination for external impacts is up to the limit, it would cause damage to the ecological environment if it exceeds its acceptable range. In this paper, people use VR technology to study the impact of tourism development on the ecological environment, evaluate the impact source according to the existing impact, help the reserve better carry out environmental monitoring, control the hospitality flow, and formulate scientific and reasonable ecological detection for the reserve, so as to achieve the purpose of maintaining ecological

management.

2. Evaluation Methods of Tourism Development in Nature Reserves on Ecological Environment

2.1. Overview of Virtual Reality Technology

Virtual Reality (VR), also known as spirit technology, is to build a very real virtual environment with the help of computers, that is, to create a three-dimensional world that reflects the physical objects and interaction for users by simulation. Through various sensor devices, users can interact directly with the virtual environment and observe the entities in the environment [7-8]. Virtual reality technology can not only simulate three-dimensional space, but also include immersion or partial immersion. Fundamentally, virtual reality is a cutting-edge computer user interface, which maximizes the convenience of user operation, thus reducing user pressure and improving the working efficiency of the entire system.

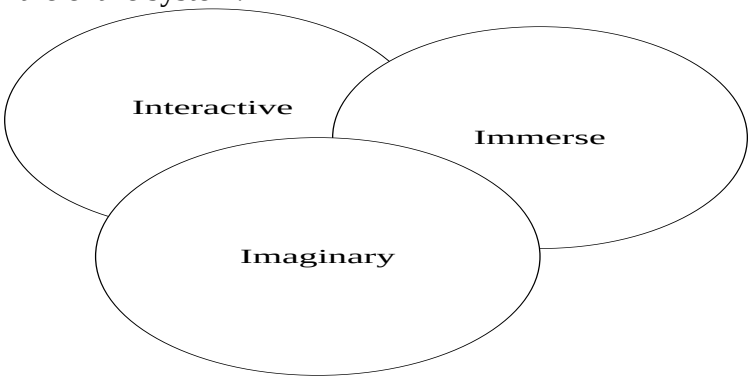

Figure 1. Relationship between the three features

VR technology is generally divided into two ways: narrow and broad. In a narrow sense, VR generally refers to human-computer interaction technology, which allows participants to immerse themselves in the virtual environment and notice the virtual three-dimensional environment images around them through virtual visual equipment [9-10]. Broad VR refers to the use of computers to realistically simulate the objective world, express the objective reality in a digital way, and interact with people or materials in the virtual environment, so that participants have a sense of substitution, and realize the information interaction between people and the virtual environment, as shown in Figure 2.

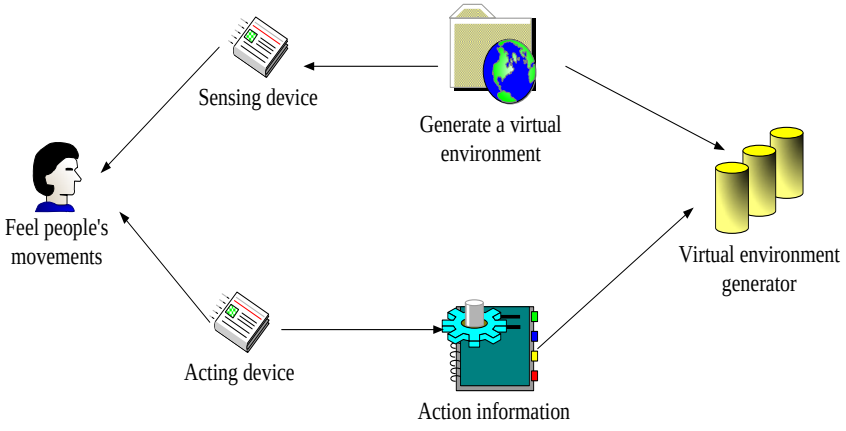

Figure 2. Information interaction between human and virtual environment

2.2. Impact of Tourism Development on Ecological Environment

(1) Too many tourists lead to a gradual decline in the quality of the ecological environment

After the tourism development of the nature reserve, the total number of tourists received each year has been increasing. The impact of tourists' personal behavior on the ecosystem of the nature reserve is embodied in trampling, harvesting, and littering of tourism waste [11-12]. It is generally believed that trampling may affect the composition of biological community types and reduce the vitality of original vegetation species. Especially with the deepening of tourism development, the impact of this aspect is most prominent. The traces of tourists trampling on plant communities are very obvious. The soil layer on the tourism route is exposed, and the original plant communities recede. The water permeability decreases, and the soil erosion is easy to occur after the rainfall scouring.

(2) Impact on vegetation

Vegetation is the most direct display of the interaction of various factors in a region. It would fully and objectively reflect the effectiveness of ecological environment protection in the region. In a tourist area with natural scenery as the main body, vegetation is undoubtedly one of the most important scenic resources. A good vegetation biological community is the material condition for the coordinated development of the tourist area. However, with the deepening of tourism development and the continuous growth of the total number of tourists, the vegetation in the scenic area would also be damaged to varying degrees.

In order to scientifically and clearly comment on the impact of tourists' trampling on the soil environment, VR technology is used to analyze the soil of various scenic spots in the nature reserve under development. The calculation method is as follows:

$$SII_k = \sum_{i=1}^{3} m_i \sum_{j=1}^{3} \frac{|M_{ij} - M_{oj}|}{M_{oj}} \quad (1)$$

In the formula, SII_k is the soil impact index.

(3) Pollution of water source

The water pollution sources of tourist destinations can be divided into two types according to the different attributes of the pollution sources. The pollution source of the factory is the sewage discharged from the factory in the tourist destination. The source of pollution in daily life is water pollution produced by residents and tourists in tourist destinations. According to the path and method of its pollutants entering the water body, the pollution sources of tourist destinations can be divided into immediate pollution sources and indirect pollution sources. The immediate pollution source is the pollution source that points to the water body of the tourist destination. Indirect pollution sources refer to the pollution sources that are discharged into the soil by garbage and waste water, and then washed into the water body of the tourist destination by rainwater in the form of surface runoff. The classification specification of comprehensive pollution index is shown in Table 1.

Table 1. Grading standard of comprehensive pollution index

Pollution index	Grade	Pollution level
$H \leq 0.68$	1	Pollution-free
$0.68 < H \leq 0.99$	2	Warning line
$0.99 < H \leq 2$	3	Light pollution
$2 < H \leq 3$	4	Moderate pollution
$H > 3$	5	Severe pollution

The damage caused by water pollution can be expressed by the treatment cost, and the

calculation formula is as follows:

$$QI_i = \sqrt{\frac{[Max\left(\frac{X_i}{Y_{ij}}\right)]^2+(\frac{1}{m}\sum_{i=1}^{m}\frac{X_i}{Y_{ij}})^2}{2}} \quad (2)$$

By calculating the strength of single impact source F_{ij} and weight $\overline{p_{ij}}$, the comprehensive impact intensity F_k of tourism development and construction project is:

$$F_k = \sum_{i=1}^{k}\sum_{j=1}^{t}\overline{p_{ij}}F_{ij} \quad (i = 1,2,3,\cdots,k;\ j = 1,2,3,\cdots,t) \quad (3)$$

By analyzing the growth and decline of different wildlife populations, this paper can analyze the changes of wildlife population structure in the reserve. The calculation formula to be used is:

$$DFI_{Jm+1} = \frac{FI_{Jm}-FI_{Jm+1}}{FI_{Jm}} * 100(m = 1,2,3,\cdots,n) \quad (4)$$

3. Experimental Evaluation of Tourism Development and Ecological Environment of Nature Reserves Based on VR Technology

In order to vigorously develop the economy, many regions have begun to carry out tourism development for their natural reserves. Although tourism development has brought benefits in the short term, many regions have not protected the ecological environment of natural reserves well, resulting in environmental damage research. In order to better study the impact of tourism development in nature reserves on the ecological environment, based on VR technology, the nature reserves in Area A were studied, and the simulation accuracy of environmental damage in five aspects of tourism development in Area A, including vegetation, water, soil, biodiversity and air, was studied. It is beneficial for VR technology to simulate these five aspects of ecological environment problems. The accuracy of simulation was compared with that of simulation based on traditional technology. The specific comparison results are shown in Figure 3.

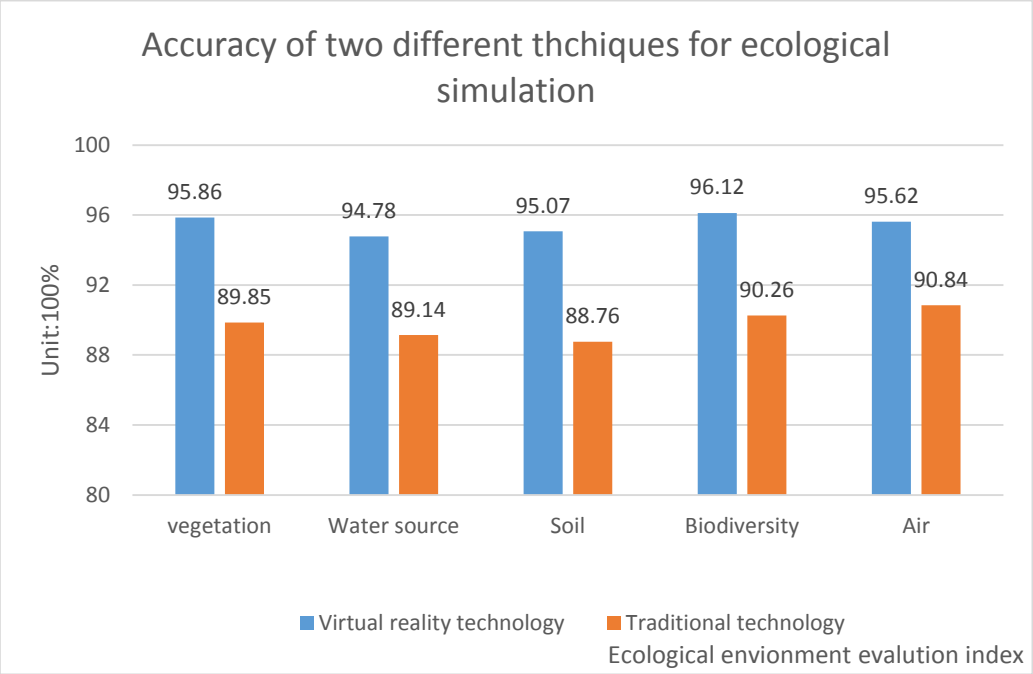

Figure 3. Accuracy of two different technologies for ecological environment simulation

As shown in Figure 3, the accuracy of simulation of ecological environment based on VR technology after tourism development in nature reserves was higher than that based on traditional technology. The accuracy of simulation of ecological environment based on VR technology was above 94%, while the accuracy of simulation of ecological environment based on traditional technology was below 91%. Among them, the simulation accuracy of biodiversity based on VR technology was 96.12%, 5.86% higher than that based on traditional technology. The accuracy of water source simulation based on VR technology was the lowest, which was only 94.78%, but it was 5.64% higher than that based on traditional technology. The accuracy of air simulation based on traditional technology was 90.84%, but it was still 4.78% lower than that based on VR technology. The accuracy of soil simulation based on traditional technology was the lowest, which was only 88.76%. It was 6.31% lower than the simulation accuracy based on VR technology. In terms of vegetation simulation accuracy, the simulation accuracy based on VR technology was 6.01% higher than that based on traditional technology. The above data showed that the VR technology can help the nature reserve to simulate air pollution, water pollution and vegetation damage very accurately during the tourism development, and can help the managers better know where the development of the scenic spot was restricted, and avoid irreparable damage to the nature reserve.

To really handle the relationship between tourism resources development and environmental protection, people must adhere to the principle of protection. In order to better and moderately develop tourism, based on VR technology, 20 experts were selected and scored from five aspects: scientifically determining tourism capacity, enhancing environmental awareness, strengthening environmental monitoring, implementing zoning management and protecting core habitat. These five aspects were numbered 1, 2, 3, 4 and 5. Using VR technology, tourism development had an impact on the ecological environment from these five aspects. The score was 1-5 points compared with that based on traditional technology. The higher the score, the better the effect. The more it looks, the better the ecological environment can be protected during tourism development. The specific score is shown in Figure 4.

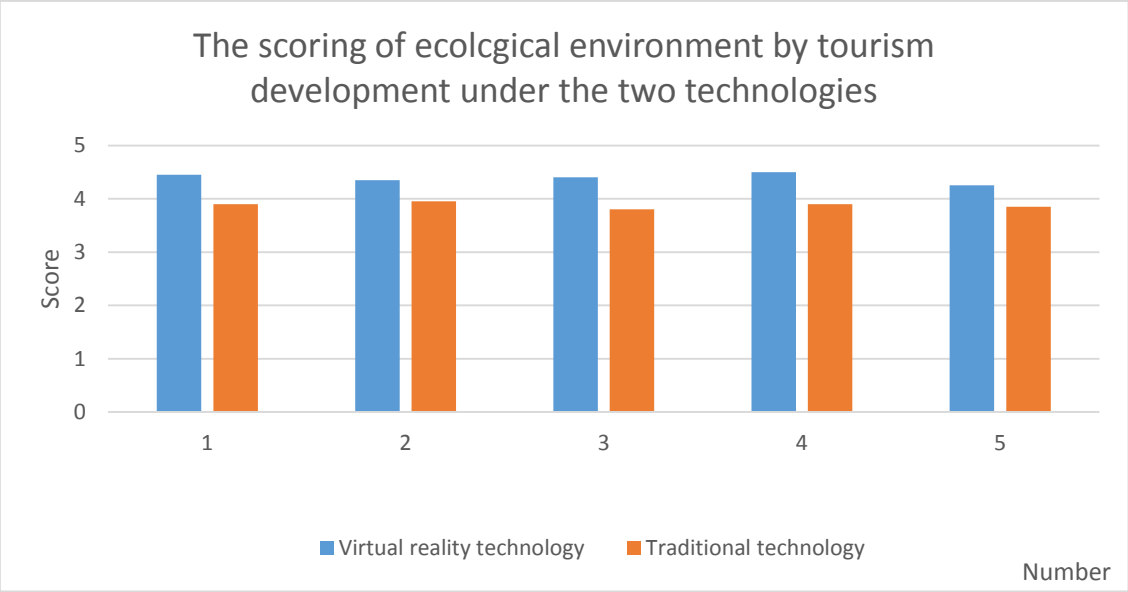

Figure 4. Rating of tourism development on ecological environment under two technologies

As shown in Figure 4, experts based on VR technology scored higher than experts based on traditional technology in all aspects of the ecological environment. Among them, experts based on VR technology scored more than 4.2 points in all aspects, while experts based on traditional technology scored less than 4 points. The experts of tourism development based on VR technology

gave the highest score of 4.5 points in No. 4, which was 0.6 points higher than that of experts based on traditional technology. However, experts based on VR technology gave the lowest score of 4.25 points for protecting the core habitat in No. 5, but still scored 0.4 points higher than experts based on traditional technology. The experts of tourism development based on traditional technology gave the highest score of 3.95 points in No. 2 to enhance environmental awareness, but it was still 0.4 points lower than that of experts based on VR technology. However, based on traditional technology, experts gave the lowest score of 3.8 points in the aspect of No. 3 environmental monitoring. The score was 0.6 points lower than that of experts based on VR technology. The above data showed that the capacity of tourism can be scientifically determined during the tourism development of the nature reserve; the environmental protection knowledge can be better publicized to tourists; the environmental protection awareness of tourists can be improved; the monitoring of the ecological environment can also be strengthened; the zoning management can be implemented at the same time, which can better protect the biological diversity.

4. Conclusion

The profits from the tourism development of the nature reserve provide an economic basis for its own ecological environment protection, but on the other hand, with the deepening of the tourism development of the nature reserve, the air pollution that may be caused and the uncivilized activities and behaviors of some tourists would inevitably have some impact on the ecological environment in the nature reserve, some of which are even irreparable damage. When developing tourism, how to improve the relationship between tourism and ecological environment protection is an important guarantee to promote the sustainable development of natural reserves. Therefore, based on VR technology, this paper studied the impact of tourism development on the ecological environment. Excessive tourism development would seriously damage the ecological environment. At the same time, using VR technology can better control the capacity of tourism, help better protect the core habitat, and help protect biodiversity.

Funding

This article is not supported by any foundation.

Data Availability

Data sharing is not applicable to this article as no new data were created or analysed in this study.

Conflict of Interest

The author states that this article has no conflict of interest.

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