Virtual Tourism Simulation System Based on VR Technology

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Abstract. With the development of tourism, the number of tourists in China has reached 6.7 billion every year. In order to alleviate the problem that the number of tourists in domestic popular scenic spots is too large to bear the burden, 3dsmax modeling software is used to realize 3D terrain and building wood construction, and unity3d platform is used to integrate to get 3D virtual scene. At the same time, the virtual tourism simulation system based on VR technology is realized by using VR hardware equipment in this paper, through the simulation of a park scene, the participants are investigated by questionnaire, and the function of the system is tested. The simulation system can meet the needs of tourism and provide a good direction for the future development of tourism.

Keywords: Tourism Industry; VR Technology; Virtual Tourism; 3D Modeling

1. Introduction
During the 12th Five Year Plan period, tourism industry has been fully integrated into the national strategic system, moving to the forefront of national economic construction and becoming a strategic pillar industry of national economy. But during the festival, most of the tourist attractions have more tourists, and travel is difficult. At the same time, due to the different levels of tourists, most tourists only take photos when visiting a strange tourist attraction, which can not make tourists realize the cultural charm of the scenic spot and the local local flavor [2]. Some scenic spots have developed and used applications to move tourism information and maps online, but still can't meet the needs of tourists. For those who have less leisure time, they can travel more quickly.

From ancient times to the present, human beings have a desire to explore and possess the unknown world, and this desire is often expressed in the form of dreams, such as the allusions of Zhuang Zhou dreaming of butterflies. Then, poetry, poetry and poetry came into being. Although words and symbols are important carriers and media for information exchange, the information they convey has limitations, which cannot make people live in the scene, and cannot experience and feel effectively. Therefore, abstract experience processing is needed in the brain. In order to break this limitation, human beings have been making continuous efforts and trying different forms. From the original cave murals, terracotta warriors to paintings, sculptures and other works of art, from today's perspective painting, 3D three-dimensional painting, stereogram to film, television, etc., it can be used as a low-level prototype of VR. In this stage, the sound, shape and dynamic simulation of the natural environment can be said to be the predecessor of VR, which is connected with the development of simulation technology. Back to the Warring States period in China, the ancient Chinese invented the acoustic kite to simulate flying animals. When people fly kites, kites fly like flying animals in the air...
and emit a pleasant Zheng sound. The technology of simulating the sound, shape and movement of flying animals and the interaction with human beings are the application of simulation technology. Later, kites were spread to the west, and they called them flying machines. Later, they were used as references to create airplanes. The second stage is the germination and birth of virtual reality, and also the period of exploring VR technology, which lays the foundation for the formation of the concept and theory of VR technology. In the third stage, the concept of VR came into being, and the related theories began to take shape. The definition and related information of VR were discussed. Coupled with a series of research achievements made by NASA, VR began to attract people's attention. Since then, the concept and theory of VR began to take shape. In the fourth stage, the exploration of VR has ups and downs [4]. The emergence and improvement of computer graphics card, the development of computer graphics technology, game engine and VR platform software, as well as the development of virtual reality hardware equipment have promoted the progress of virtual reality. VR technology has been gradually improved and widely used, which is well known and used by the public. After entering the 21st century, VR technology can be seen in World Expo, Spring Festival Gala, cultural and creative industries, Olympic Games, etc. The combination of VR with cultural creativity and digital media has produced VR art. Human computer interaction, augmented reality and other words have gradually entered our eyes.

Based on the mentioned tourism status, this design aims to develop a set of virtual tourism system, so that people can use virtual reality technology to browse the beautiful rivers and mountains of the motherland without leaving home. The continuous development of virtual reality technology and computer modeling technology provides the possibility of virtual tourism. Virtual reality technology can simulate a very similar environment with the real world, feel the surrounding things, and make people have a sense of immersion. The main idea of the design of the virtual tourism system is to collect the pictures and videos of the scenic spots, and to understand the topography of the scenic spot and the names and shapes of the buildings. According to these data, it can be used as the development data of image-based virtual reality technology. At the same time, we need to use 3dsmax and other modeling software to construct some things that do not exist in the image data of scenic spots. When the modeling is completed, the model needs to be integrated by unity3d platform, which is the virtual reality technology based on geometric modeling. In the construction of tourism system, two kinds of virtual reality technology are combined to create a virtual tourism environment. Finally, people can complete the tour of virtual tourism environment with the help of relevant virtual reality equipment. The virtual tourism system based on virtual reality technology can not only make people see the beautiful scenery thousands of miles away without leaving home, but also bring a new display method for scenic spots. Thus, to a certain extent, it alleviates the contradiction between human and environment, and plays a significant role in promoting the development of tourism industry.

2. Research on Virtual Tourism Simulation System Based on VR Technology

2.1. VR Technology
VR means virtual reality in Chinese. Virtual reality is not the real reality, but the combination of virtual and reality. It is a fictitious computer simulation system created by a series of corresponding computer technologies. Through VR technology, the realistic real scene can be virtual. In this virtual scene, virtual objects can be materialized through interactive devices, so as to make users feel better. When the image is brought into the real environment, the feeling of the experiencer is more intuitive, and the feeling of being on the scene arises spontaneously. VR technology has stimulated the interest of users to a great extent. This interactive environment generated on the computer by VR technology and making users feel more real is called virtual environment [5].

2.2. VR Modeling
Three dimensional modeling technologies in virtual reality is mainly divided into geometric modeling, physical modeling and motion modeling.
(1) Geometric modeling

Geometric modeling includes shape modeling and appearance modeling. Shape modeling uses points and lines to construct the outer boundary of the whole three-dimensional object, that is, only the boundary is used to represent the three-dimensional object. The commonly used shape modeling software includes AutoCAD, 3ds max, Maya and so on. Appearance modeling is the surface encapsulation of objects. The objects in the virtual world are mainly distinguished by the surface materials, and the realistic appearance mainly depends on its surface reflection and texture.

(2) Physical modeling

Physical modeling needs the combination of physics and computer graphics. It is a high-level modeling in virtual reality system, involving mechanical feedback. It is very important to reflect the physical characteristics of weight shape, surface deformation and hardness. Fractal technology and particle system are typical physical modeling methods.

(3) Motion modeling

In the virtual environment, it is necessary to use motion modeling to represent the dynamic characteristics of things. The typical motion modeling includes the movement and rotation of objects, the body movements of characters, and the change of object shape.

2.3. VR Engine

As the core of VR system, VR engine is responsible for organizing and coordinating the operation of all parts of VR system. Based on this platform, programmers can focus on the functional design and development of virtual reality system without considering the details of the underlying program [6].

At present, there are many VR engine software applications and industries. The common VR engine software is described as follows:

(1) Unity 3D

Unity 3D is a professional game engine developed by unity technologies. Through it, users can easily create objects including 3D animation, 3D video games, and 3D architecture and so on. It is a multi-platform integrated game development tool [7].

(2) Unreal Engine 4

UE (abbreviation of Unreal Engine) is the most widely authorized top game engine in the world. Due to its powerful rendering effect and the use of PBR physical material system, UE4 has a very good real-time rendering effect, which can achieve the effect similar to Vray still frame, and has become one of the developers' favorite engines [8].

(3) VR Platform

As the first batch of virtual reality software with independent intellectual property rights in China, vrplatform has the highest market share in China. It is popular among Chinese people for its pure Chinese interface, easy to use, WYSIWYG, etc.

2.4. VR Technology and Virtual Tourism

"Immersion" refers to the user's sense of presence in the virtual space. When the player puts on the virtual reality helmet, he can enter the virtual environment created by the computer, and has the feeling of being in the real world. It enables users to integrate into the environment and stories from the psychological and physiological levels, immerse themselves in them, and generate strong psychological identity [10].

The tourism industry, especially Fengshui tourism, is a three-dimensional subjective experience. Although video images can truly record the image of the landscape, both the shooting content and the presentation method are limited to two-dimensional screen, which can not fully show the charm of China's landscape. Moreover, watching through the screen will have a sense of distance that is difficult to eliminate, and the audience will clearly realize that they are only the audience, attention It is easy to be attracted by other things, and the sensory and psychological impression will not be very deep. In the past, only tourists who visit the scene can really feel the beauty of the scenery. Virtual reality technology has broken the traditional way of imaging, expanding the two-dimensional screen to
panoramic vision. The audience's point of view is the origin of coordinates, and the surrounding field of vision is the picture. It seems to be in it. It gives the audience a subjective perspective and a strong sense of presence, and brings a new viewing experience for the audience. Virtual reality technology can subvert the traditional experience form of tourism and increase the display dimension of landscape. In the virtual environment of three-dimensional modeling, the audience can roam independently and roam in various scenic tourism, 360 Enjoy the art of various landscapes, feel its beauty in close distance, experience is not limited by time and space, so that people thousands of miles away can feel the charm of ice and snow art even in midsummer, and also feel the warmth of seaside holidays in winter. At the same time, it breaks the regional and seasonal limitations of the traditional tourism mode.

2.5. Sequential Similarity Detection Algorithm
The basic principles are as follows:

Absolute error:

\[
\varepsilon(i, j, m_k, n_k) = \left| s^s(i, j) - s(i, j) - T(m_k, n_k) \right| \tag{1}
\]

\[
\hat{s}(i, j) = \frac{1}{M^2} \sum_{m=1}^{M} \sum_{n=1}^{M} s^s(m, n) \tag{2}
\]

\[
\hat{T} = \frac{1}{M^2} \sum_{m=1}^{M} \sum_{n=1}^{M} T(m, n) \tag{3}
\]

The detection surface of SSDA is as follows:

\[
I(i, j) = \left\{ f \min_{k \leq m} \left[ \sum_{k=1}^{\infty} \varepsilon(i, j, m_k, n_k) \geq T_k \right] \right\} \tag{4}
\]

3. Design and Development of Virtual Tourism Simulation System Based on VR Technology
In the first two sections, through the analysis and research of VR technology and VR system, the virtual tourism system based on VR technology is established on the basis of the generated virtual scene.

3.1. System Structure
The whole VR virtual tourism system is composed of software and hardware equipment; the hardware mainly includes: computer, monitor, VR helmet, handles, etc.; and the software mainly includes VR design software, behavior control and some related programs. The hardware equipment of virtual system provides installation environment for software and provides platform for software running. The organic combination of software and hardware provides guarantee for the successful operation of the whole system.

(1) VR helmet: the helmet contains many sensors, such as accelerometer, gyroscope, etc., which can accurately realize the rotation and positioning of the head. In order to ensure the use effect, it should also be used with 3D virtual reality scene and stereo display screen;

(2) Operating handle: the handle is an important device for users to interact with the virtual world. Using the handle, you can operate things in the virtual world to a certain extent, which can greatly increase the experience of users. At the same time, the existence of the operating handle replaces many controllers, bringing a new feeling to the experience;
(3) Locator: locator is the key part of virtual tourism system based on VR technology. The locator is mainly used to detect the position of the experiencer in the system, and transmit some data signals to the VR system. The working principle of the locator is generally laser positioning. The laser sensor inside the device is used to track the position, which provides 360° motion track detection for the whole system, so as to locate the precise position of the experiencer in the virtual world.

3.2. Function Setting
Function design should also add more immersive functions in VR virtual system, such as background explanation, video introduction and so on.

(1) Background explanation: it can make the Experiencers understand more about the culture of scenic spots when they roam in the virtual tourism system, which paves the way for future real-life tourism;

(2) Video and picture introduction: before visiting the virtual scenic spots, you can play some short documentaries with local characteristics, so that the Experiencers can enter the sightseeing state more quickly and feel the local customs and customs;

(3) Path roaming: when visitors are not familiar with the scenic spots, path roaming can automatically provide them with an optimal tour route, which can ensure the effect of scenic spots and save time.

4. Virtual Tourism System Implementation and Test Analysis Based on VR Technology
In the simulation experiment, a park is selected as the design object of the virtual tourism system. Through the collection of Park pictures, images and other data, combined with 3D modeling technology, a corner of 3D virtual tourism scene is established.

4.1. Response Speed Test of System Functions

![Figure 1. Response Time Test of Each Function](image)

After the test, all functions are running normally. Now, the response time of each function is tested. As shown in Figure 1, the response time of each function in the first test is 1.3s for background interpretation, 2.1S for video image introduction, and 1.1s for path roaming. The response time of each function is within 3S, which can meet the set requirements.

4.2. Investigation on the Use of Passers-by
According to the above test, the system can meet the basic functional requirements. By selecting the corresponding number of passers-by to test the system, through the way of questionnaire survey, analyze the existing problems of the system.
Table 1. Age distribution and gender distribution of selected participants

| Gender | Age  | 5-10 | 11-30 | 31-50 | 51-70 |
|--------|------|------|-------|-------|-------|
| Male   |      | 10   | 21    | 32    | 13    |
| Female |      | 10   | 23    | 28    | 14    |

A total of 76 men, aged 5-10 years 10, 11-30 years 21, 31-50 years 32, 51-70 years old 13; 75 women, aged 5-10 years old 10 people, 11-30 years old 23 people, 31-50 years old 28 people, 51-70 years old 14 people.

![Age and gender distribution](image)

**Figure 2.** Views of different genders and ages on the system

According to figure 2, the satisfaction degree of the system is basically high, reaching more than 90%, indicating that the future development prospect of the platform is relatively objective.

4.3. Questionnaire Survey

| Serial number | Total score | Mean value | Sort | Ease of use type | Total score | Mean value | Sort |
|---------------|-------------|------------|------|-----------------|-------------|------------|------|
| 1             | 8           | 0.93       | 3    | Fluencty        | 22          | 0.73       | 1    |
| 2             | 14          | 0.40       | 5    | Sensory experience | 80          | 1.33       | 4    |
| 3             | 6           | 0.47       | 1    | Habits of Yiology | 26          | 0.87       | 3    |
| 4             | 7           | 1.73       | 2    |                 | 22          | 0.73       | 1    |
| 5             | 26          | 2.73       | 4    |                 | 26          | 0.87       | 3    |
| 6             | 41          | 0.73       | 6    |                 | 22          | 0.73       | 2    |
| 7             | 11          | 0.73       | 7    |                 | 22          | 0.73       | 2    |
| 8             | 15          | 1.00       | 8    |                 | 22          | 0.73       | 2    |
In general, the overall usability of the system is good, except for sensory experience, the score of each index is below 1, and it is worth noting that in the sensory experience with poor performance, the scores of visual effect and auditory effect are small, which indicates that the audio-visual effect of the system is very good. The main reason for the poor overall sensory experience is that vertigo causes the problem score to be higher, which increases the overall index score. Vertigo is a common problem in all virtual reality products. Due to the particularity of virtual reality product experience environment, users must wear specific equipment to experience, and the technology and quality of experience hardware equipment at this stage can not eliminate vertigo. As far as the system itself is concerned, the ease of use has reached the set goal in all aspects of the indicators.

5. Conclusion
Through the introduction and analysis of virtual reality technology, a virtual tourism system based on VR technology is designed and studied. The application of the system can let people visit famous scenic spots around the world without leaving home, and enjoy the fun of playing in the virtual world. On the basis of this technology, we can also use this system to restore some damaged scenic spots in virtual environment, so that people can enjoy the historical and cultural landscape that they have never seen before. VR tourism will become more and more popular and popular. Therefore, VR tourism has great development potential to meet the system training. In addition, sample training needs longer training time. In the follow-up optimization, we should consider the combination of traditional feature point location and multi-objective optimization to speed up the model training and reduce the data needed for the training model.

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