Design and Implementation of VR Multi-Dimensional Intelligent Tourism Information System

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Abstract. Intelligent tourism is the inevitable trend of tourism development. It perfectly integrates computer information technology and tourism to provide users with a good experience. With the help of three-dimensional computer graphics, wide-angle (wide-field) stereo display technology, user tracking technology, stereo technology, tactile/mechanical feedback technology, voice input and output technology, VR-based multi-dimensional intelligent tourism system provides personalized services for users both online and offline. It is further changing the existing traditional access mode of scenic spots, providing double-line browsing access mode, both online and offline. It is enlarging the overall popularity of the scenic area, at the same time, improving the tourist reception capacity and service level, and providing more and more fun experience for tourists.

1. Introduction
The research of virtual reality technology has a long history at home and abroad. In 1995, Professors Hobson and Williams first proposed the concept of virtual tourism[1-2]. They believe that virtual reality in the future can achieve a complete tourism experience without leaving home, and virtual reality technology will have a huge impact on the development of tourism, promote the development of tourism, and make tourism enter a virtual new era. In 1999, Bristow believed that the attitude of early tourists towards tourism was to pursue real tourism experience as much as possible. With the development of the time, tourists can use virtual reality technology to operate scenic spot tours, travel packages booking and so on. Therefore, modern mass tourists are gradually losing their interest in the pursuit of real tourism experience and turning to the virtual tourism experience of staying at home. In 2007, Bergen and Dittenbach applied a three-dimensional electronic multi-intelligence system to the field of tourism, and realized three-dimensional visualization of the system interface through the technology of three-dimensional game engine.

Compared with the developed countries of Western tourism, the development of Virtual Tourism in China started late, but it developed very rapidly. In 2001, Xu Suning put forward a new virtual tourism system. The system takes the Internet as the carrier to dynamically display the tourist destination landscape. Tourists can choose their own tour routes and speed, and can realize multi-view tour of the tourist landscape through the virtual tourism system. In 2016, Wang Xiaoyu proposed to use three-dimensional Max and Unity three-dimensional virtual reality technology, Kinect skeleton tracking technology and somatosensory human-computer interaction technology to create a virtual
three-dimensional roaming system of Mogao Grottoes in Dunhuang, and added helmet-mounted display to achieve immersion roaming effect, which is of great significance to the protection and promotion of Dunhuang sites.

2. System Architecture
The system consists of three parts: database, scenic area interface and user (see Fig.1). The virtual tour system mainly provides users with the following information: scenic map navigation, single-view scene panoramic image, and other auxiliary information, such as scenic features introduction, scenic history allusion, etc.

3. System Function Design
Based on the analysis of the development status of multi-dimensional intelligent tourism and the research of virtual technology, the functions of this system are designed as follows:

- Map guide for virtual attractions. Based on the visualized digital electronic map, the whole scenic area is displayed in the form of dynamic web pages, showing the comprehensive appearance of the scenic spot, the location relationship and layout of the scenic spots.
- Interactive three-dimensional panoramic roaming. Users individually set up the interesting spots in the scenic area, selects the appropriate route for three-dimensional panoramic roaming. During the roaming process, they can use keyboard direction keys, panoramic browser provided hot spots and other function combined keys to adjust and control the forward, backward and viewing angle of the camera map, so as to achieve arbitrary selection of scenic spots in the three-dimensional scene to rotate, walk and switch scenic spots. Scenic spots are browsed in different modes.
- Scenic information retrieval. By using the key combination of panorama and hot spots, users can query the information of the location they are interested in panoramic tour, so as to deepen their understanding of the background and allusion of scenic spots. The system provides information introduction in the form of text, picture, video and audio for a scenic spot. At the
same time, users can access the corresponding sub-pages of the website through the links provided for in-depth understanding.

- Online services provided. It offers online scenic system usage guide, so that users can use the system to roam panoramically smoothly through the guide. At the same time, it aims to provide online real-time answer service to users and help users in the process of scenic roaming to solve the problem.

4. Realization of the Function of Multi-Dimensional Intelligent Tourism Information System

The VR multi-dimensional smart tourism information system is an open system that provides users with panoramic views of scenic spots. Users can have a more intuitive understanding of the scenic landscape, which is conducive to improving the functions of the tourism website, promoting local tourism resources, and making the management decisions of tourism management departments faster and more effective[3-4]. The system generates a photo-realistic panoramic virtual scene model. The system design structure is shown in Fig.2.

![Fig.2 Design Structural Diagram of VR-based Multi-dimensional Intelligent Tourism Information System](image)

After collecting two-dimensional images of scenic spots, the images are projected, deformed, stitched and fused. Then, the spatial database of scenic spots is established, and the data is attributed such as building of scenic spots are collected and stored in the database. By accessing the database, the various operations of the map such as browsing bidirectional query topology analysis, high break-line distance are completed, and then the electronic map of scenic spots is established. The display of panoramic virtual scene through node links can improve the electronic map and enhance the visual stereo sense. Through further design, we can get rid of the representation based on two-dimensional map and three-dimensional solid model, and replace the computer-aided three-dimensional representation to obtain more intuitive three-dimensional effect. Campus Digital Elevation Model (DEM) can be established, and DEM data can be used to establish the geometric model of terrain[5].
Aerial image of scenic area or digital orthophoto aerial image of scenic area can be used as surface texture data. Because aerial images can better express the shape of the top of a building, the three-dimensional building can only be partially expressed in aerial photos, so the texture of the top of the building can be obtained from aerial photos, while the texture of the building facade needs to be supplemented by means of ground photography.

At present, in order to facilitate users to roam the virtual panoramic space of scenic spots, the virtual scenic spot system uses the scenic electronic map as the navigation map, which is the most common and effective method. With the help of link points, users can click the mouse at any interested point of the displayed electronic map to enter the virtual panoramic space at the corresponding position[6]. They can also use hyperlink technology to access relevant web pages or query relevant information through the virtual panoramic space, and ultimately realize the visual planning and management of scenic spots. Based on the electronic map, the virtual scenic area information system based on panorama can be divided into two parts: the panorama generation subsystem and the navigation electronic map subsystem. The roaming subsystem can be understood as a navigation map or an operating environment, and its design method has many possibilities, such as C++, JAVA and other programming languages to design the system, in addition, CG animation can vividly realize most functions of electronic map.

5. Key Technologies of System Implementation

Virtual reality is a combination of multiple technologies, including real-time three-dimensional computer graphics technology, wide-angle (wide-view) stereo display technology, tracking technology for viewers' heads, eyes and hands, as well as tactile/force feedback, stereo, network transmission, voice Input and output technology[7], etc. These techniques are described separately below.

5.1 Real-time three-dimensional computer graphics

It is not too difficult to generate graphics and images using computer models. If there are enough accurate models and enough time, we can generate accurate images of various objects under different illumination conditions, and the center of gravity is real-time.

5.2 Wide-angle (wide-view) stereo display technology

When people look at the world around them, they get slightly different images because of the different positions of their eyes. When these images are merged in their minds, they form a whole picture of the world around them, which includes information about distances.

In the VR system, binocular stereo vision plays a big role. Different images is seen by the user's two eyes are generated separately and displayed on different monitors. Some systems use a single display, but while users wear special glasses, one eye can only see odd frame images, the other eye can only see even frame images, the difference between odd and even frames is the parallax produces stereoscopic sense.

5.3 User (Head and Eye) Tracking Technology

In an artificial environment, each object has a position and attitude relative to the Coordinative system, and so does the user. The scene that the user sees is determined by the position of the user and the direction of the head (eye).

In traditional computer graphics technology, the change of field of view is realized by mouse or keyboard. The user's visual system and motion perception system are separated. The virtual reality headset technology can change the perspective of the image by head tracking, so that the user's visual system and motion perception system can be linked, and the scene feels more realistic[8].

5.4 Stereo Technology

The user can determine the direction of sound source well. In the horizontal direction, because the time or distance at which the sound reaches the two ears is different, we usually use the difference in
phase and intensity of the sound to determine the direction of the sound[9]. The stereo effect we hear is achieved by using the left and right ears to hear different sounds recorded at different locations, so it is accompanied by a sense of direction. In real life, when the head turns, the direction of the sound is changed[10].

6. Conclusion
Virtual reality technology (VR) is an important direction of simulation technology. It is a combination of simulation technology and computer graphics, man-machine interface technology, multimedia technology, sensing technology and network technology. This paper introduces the implementation technology of VR-based multi-dimensional intelligent tourism information system. The most widely used methods are also introduced: the method based on panorama, system architecture and various key technologies. The system integrates traditional local browsing of single-view panorama, electronic map navigation, global roaming of multi-view panorama, information query and other functions. It aims to provide users with more and better travel experience.

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