Applied Research of Tourism Development based on WebGIS and Virtual Reality Technology

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ABSTRACT: The continuous development of the tourism industry, the continuous improvement of computer technology and the combination of WebGIS and virtual reality technology has provided a strong technical support for the development of China's tourism industry. Based on this, the specific applications of WebGIS in the investigation and evaluation of tourism resources, the development and planning of tourism resources, the decision making of tourism marketing and the guidance of tourism were analyzed in this paper. The key technologies of virtual reality technologies were studied, and then the WebGIS and virtual reality technology were combined. Through the examples of the Forbidden City, the Qin Zhai, Old Summer Palace and so on, the important roles of the virtual reality technology in the three-dimensional virtual walkthrough of 360 degree, the protection of cultural relics and the reproduction of the historical landscapes were obtained. Practice has proved that the development and application of WebGIS and virtual reality technology in the tourism industry has created conditions for the practical application of virtual reality technology. And it has very broad prospects.

INTRODUCTION

The rapid development of digital technology has brought about great changes in all walks of life. With the changing of the times, the tourism industry is becoming more and more digitized. As the application of digital technology in the tourism industry, the digital tourism is directly used to promote the development of economic construction. The current tourism digital products can’t meet the needs of tourism consumers in the reciprocity, immersion and authenticity, which requires the use of virtual reality technology in the field of digital tourism, and it will continue to promote the healthy development of digital tourism. The World Wide Web Geographic Information System is called WebGIS, which is based on the internet platform and the client application software, and it uses the WWW protocol running on the world wide web of Geographic Information Systems [1]. Compared with the traditional desktop or GIS of local area network, WebGIS has opened up a vast space for GIS and acquisition, distribution, sharing and operation of information, so that GIS can be widely used in many fields such as resource and environment management and planning through Internet technology [2].

Resource survey and land planning are the two major application areas of traditional GIS, and in the development of tourism, GIS is also an effective means for investigation and planning of tourism resources [3]. WebGIS can complete other functions of GIS, while it can also be combined with Internet, and the application of GIS can be promoted in the network. Therefore, WebGIS can meet the needs of the related departments, enterprises and personnel of tourism [4]. At present, most of the tourism information products in our country have the functions of releasing and searching the tourism characteristic information, and it is rarely possible to display and introduce the landscape images vividly. Users can’t get a clear understanding of tourism resources through the tourism information platform [5]. In particular, the travel scenes, service environments and the introductions of historical relics still mostly stay in the use of pictures and texts, which lacks of virtual displays [6]. Virtual reality technology is developing rapidly, and this technology can make a more intuitive display of cultural relics, landscapes, residential environments and human landscapes, so as to enhance the publicity effect, and visitors can fully experience the authenticity, immersion and interactivity [7].

In recent years, digital tourism has been developing rapidly in the world. Guttentag D surveyed the use of the Internet in the United States, and the adult Internet users who have experienced
online travel accounted for 45% of all Internet users, in which 52% of users have experienced online virtual tourism, and it occupied a large proportion. Most of the tourists who carry on the virtual tour are the urban residents with good economic conditions and the high-quality groups with higher education [8]. All the countries in the world are trying to apply virtual reality technology to digital tourism. Germany's Fraunhof Institute of image processing used the virtual reality technology to develop a stand-alone model of the pocket tourism system, and in the process of play, it paid attentions to the reproduction of the original ruins [9]. The virtual digital tourism system is a kind of desktop virtual system, which is composed of two parts: helmet and microcomputer processing terminal. Cameras, glasses and microphones are added to the helmets worn by tourists. When visitors come to a damaged site, the camera can transmit the image information to the computer. The location of the tourists will be positioned by the computer, and the data in the database will be matched to read the three-dimensional simulation of the original site, then it will be sent to the display of the visitors, so as to achieve the effect of virtual tourism [10]. The research on digital tourism in China is relatively backward. The main content of the local tourism website is mainly to introduce the local cultural landscapes, historical sites, landscapes and so on through the texts and pictures, and the amount of information is small, it is difficult for tourists to get more information through the pale languages. Professional travel websites mainly carry on the travel intermediary and the electronic commerce and other businesses, and they focus on the promotion of expenses and the circulations and so on, which neglects the visitor's direct propaganda and the demonstration [11].

Digital tourism is the embodiment of the digital earth technology in the tourism industry, and the digital tourism technology is based on the three-dimensional simulation technology and network technology, so that the display of scenic spots or landscapes is more vivid and intuitive, and it also has the search function. And it can make full use of videos, panoramic images, virtual reality technologies and other means, so as to provide tourists with integrated tourism information services in food, accommodation, travel, shopping, entertainment and others. It improves the quality of the service, the level of internationalization of tourism and the core competitiveness.

2. Application of WebGIS in tourism development

2.1 On the application of tourism resource investigation and evaluation

GIS is mainly used in the investigation and evaluation of resources, and WebGIS also plays the same role. Tourism resource investigation is the premise of tourism development and planning. In practical applications, it is necessary to set up tourism special database, as shown in the following figure:

![Sketch map of tourism data by layer](image)

What can be seen from Figure 1 is that it is mainly related to the data of natural and cultural tourism resources. The natural tourism data refers to the topography, atmosphere, water, soil and vegetation. The cultural tourism resources data refers to the historic garden attractions, cultural and economic conditions, tourism services and administrative areas, etc. [12]. If we want to establish the tourism special database, firstly, we need to access data from the relevant government departments, such as planning, landscape, transportation, resource, tourism, scenic area and the surrounding area, map document, GPS data etc. And then the data obtained will be sorted to make the combination, and then it is stored in Oracle, MS SQL Server and other large database, so as to complete the establishment of tourism database. WebGIS application server can be used as the basis for the management of the scenic space and attribute data, so as to complete the investigation and evaluation of tourism resources finally [13].

WebGIS can investigate tourism resources. Firstly, through the Internet Explore or Netscape and other related client browsers we can obtain the operations. Then we select the layer to be submitted to the WebGIS server, such as the completion of the query and statistics of database. Finally it will generate statistics and data reports.
2.2 In the development and planning of tourism resources

The so-called tourism planning is the deployment of actions, which is to optimize the allocation of the tourism resource, the overall development of the tourism system, and the completion of the tourism development goals. The spatial data can be processed and analyzed by WebGIS. According to the principle of tourism resource development, the tourism managers plan and design the tourism electronic maps and forecast and compare the tourism development models, so as to determine the size and content of the development, the spatial distribution of the scenic spot, the overall framework and even the overall design of the tourism resource development [14]. The analysis and judgment of the traditional paper sketch combined with the data is not only inefficient, but also uncomprehensive. WebGIS has strong spatial analysis and computing capabilities, so that tourism planners can be more effective to achieve accurate maps and statistical charts. For example, according to the local tourist types, the consumption item, the number of tourists, travel time and other factors are analyzed and forecasted, so that the final completion of the corresponding location of hotels, tours and shopping centers is obtained, and the corresponding charts and plans will be generated too.

2.3 The application of WebGIS in tourism marketing

In tourism marketing, WebGIS is mainly for the survey, forecast and decision-making of the tourism market. It is similar to the survey and evaluation methods of tourism resources, tourism enterprises need to make statistics and analysis on the data of 5-8 layer in Figure 1, and the statistical analysis of the overall environments and facilities of the tourist areas is obtained, so as to select the most attractive tourist attractions, such as the natures and cultures, scenic spots and related services [15]. In the process of the investigation and analysis of the tourism market, related tourism enterprises are calculated according to the relevant forecasting models, such as probabilistic tourism models, trend extrapolations and so on, so as to predict the future development directions of tourism and provide effective data supports for enterprises in tourism marketing.

WebGIS can provide effective consulting services for tourists, although it can’t create good economic benefits, it plays an important role in the development of tourism market. Travel consultants in the browser's Web interface can obtain the latest and most effective travel information, such as scenic spots, ticket prices, roads, transportations, shopping, foods and lodgings and other important information. Compared with the general tourism website, the injection of geographic information in WebGIS can make its way become more intuitive and accurate, and it can dynamically generate real-time electronic maps of the area. In addition to providing basic information, the vector can also be enlarged and reduced. it can browse and select the electronic map information with different resolutions, so as to make the tourism consultants have an overall understanding of the surrounding environment [16]. Distance measurement and location query in WebGIS are important features that are different from traditional electronic maps. In the location query, it is possible to search the nearest and the best access route through the coding information. The distance measuring function enables the traveler to measure the distance of a straight line or a curve in two locations with an electronic ruler, so that the traveler can quickly determine the travel route and save time and costs.

3. Virtual reality technology

3.1 VR technology

Virtual reality technology can be called VR. It is able to use computers to create an immersive interactive environment based on computer technology. The three-dimensional virtual world can provide users with visual, auditory and tactile sensory simulations. Users use the related equipment to observe things within three degrees of space and interact with virtual objects in a natural way. When the user carries on the operation and the displacement, the computer can carry on the complex operation immediately, so that the accurate three-dimensional spatial video will produce the spot effect. Virtual reality computer technology simulation system integrates computer simulations, intelligent graphics, sensors, displays and other related technologies, which is the development direction of computer science and technology at present [17].
3.2 Domestic VR investment and financing status

So far, through the incomplete statistics, there are 117 VR industry investment cases, in which 58 cases are in hardware devices, 43 cases are in the production of contents, and the remaining 16 cases are in platform investment. Total investment has exceeded 4 billion Yuan. In 2015, the number of the annual investment cases was 57, and the scale of investment was 2 billion 400 million Yuan. In 2016, the number of the annual investment cases was 38, and the scale of investment was 1 billion 540 million Yuan [18]. Overall, the listed companies give the main investment, and the institutional investments are supplements. According to industry statistics, from 2013 to 2016, China's virtual reality technology industry investment includes seven categories, including games, lives, theme parks, movies, real estates, tourisms and other industries.

<table>
<thead>
<tr>
<th>Investment industry</th>
<th>The proportion</th>
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<tbody>
<tr>
<td>Game</td>
<td>31.04%</td>
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<tr>
<td>Live</td>
<td>17.10%</td>
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<tr>
<td>Theme parks</td>
<td>14.30%</td>
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<tr>
<td>The movie</td>
<td>11.40%</td>
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<tr>
<td>Tourism</td>
<td>8.60%</td>
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<tr>
<td>The real estate</td>
<td>8.60%</td>
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<tr>
<td>Video</td>
<td>8.60%</td>
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3.3 VR related technology

Computer graphics technology is called CG. It can use complex mathematical algorithms to convert 2D and 3D graphics to computer graphics, and it can be used in computer technology to produce virtual worlds, so that the objects of real life can be achieved and reconstructed in the three-dimensional world, and it also can simulate to preserve its physical properties, thereby creating a virtual world for virtual users.

Human-computer interaction technology allows users to get in the same sense of reality, sense, touch, hearing and other senses in the virtual world. And it can interact with the virtual reality world, including somatosensory control, gesture recognition, voice control, etc.

Motion tracking technology is to track the user's actions through infrared, camera and other sensors or the user's HMD and controller capture. When the user's limbs move, the virtual reality system can generate real-time feedback on its actions. The tracking system is good or bad is the key factor of the satisfaction of the user experience.

4. Tourism based on WebGIS and virtual reality technology

4.1 WebGIS and virtual reality technology are combined to realize virtual reality tourism

According to statistics, China's cities have built their own tourism e-commerce websites. However, virtual reality technology has not been used in tourism, and its introduction is only limited to the picture and text descriptions. Because the static landscape pictures can only show a fixed location and angle of the landscape, so the effect is very limited. Especially for the buildings, the mountains and the seas, the concept of a few scenic pictures to the user is still very vague [19]. Foreign companies have provided virtual reality services, such as the Comfort Travel of USA. With the development of computer and network technology, the new generation of 3D language X3D has the...
characteristics of small size, scalability and so on, it not only can be interoperable with Web, but also can be integrated with a variety of media. The combination of X3D and WebGIS obtain the realization of virtual reality tourism.

Electronic map function of WebGIS can complete the map generation, management and display and network sharing. Tourism thematic database can store DEM, TIN and other terrain data or building, road vector data, pictures and videos and other multimedia data. Application of virtual reality modeling technology can generate three-dimensional panoramic scenes. Tourism departments and enterprises can make the virtual representation of local sites, which is available to users to download and browse, and it can achieve the real-time virtual reality tourism. In the virtual tourism world, users can roam at any angle in any terrain. At the same time, tourists can also enter the building, dive into the underwater world and fly to the sky. When users are in the virtual tour, they also get the free access to the tour guide, which will provide users with a new travel experience, and it is more effective than text images [20].

Based on the tourism GIS, virtual reality technology, and real-time video system, we can realize the three-dimensional panoramic view of scenic spots and enhance the ability of marketing and service of scenic sites. Tourism GIS system uses geographic information technology to realize the electronic map of tourist attractions. Visitors can view real-time query map information. Tourism VR virtual reality system make three-dimensional modeling for scenic spots, so it is more vivid to reflect the panorama of attractions, and visitors can get immersive experiences.

4.2 Virtual reality tourism

Panoramic virtual reality is different from the traditional 3D image animation, which is based on the panoramic image of the real world. The camera takes 360 degrees to make a panoramic image. Through the computer virtual reality technology we can carry out a full range of interactive viewing of 360 degrees to restore the real world scene. This technology can not only make up for the disadvantage of passive observations in 3D animation, but also reduce the limitation of browsing routes and speeds. The application of the technology in the tourism industry allows users to choose the content by the independent choice for interactive browsing, which is more interactive.

Virtual reality technology is also able to reproduce what is non-existent or in danger. When tourists visit the ancient buildings, due to the destruction of the original building with times, it is difficult to retain the original shapes, and it is also difficult to imagine the original shape of the building. With the development of virtual technology, the problem can be solved well, and the technology of "real reappearance" is realized.

In addition, the virtual reality technology obtains the digital display of China's ancient cultural heritages, and it also has a good protection of cultural heritages. Moreover, the use of virtual reality technology can be a reasonable planning of tourist attractions. First of all, we need the virtual system modeling. And then through human-computer interaction to the virtual scenes, the planners can personally experience the advantages and disadvantages of the program, so the effect is detected, which does not need the actual implement and modifying, and the final implementation of the auxiliary program is not needed too.

5. The application example of virtual reality in tourism

5.1 The Forbidden City, transcending time and space
IBM Company worked together with the Palace Museum in 2006 to propose the project of "The Forbidden City, transcending time and space". Through collaborative innovation, IBM would use the world's leading IT technology and the new interactive audience experience system created by the Imperial Palace to provide visitors with real-time, online, interactive and unique experiences. It is an interactive experience beyond time and space.

The project of "The Forbidden City, transcending time and space" is China’s first historical and cultural scenic spot on the Internet. The 3D virtual world recreates the Museum of cultural and historical treasures, so that any visitors can use the Internet to enter the virtual world of the Forbidden City, have immersive experiences of ancient Chinese architectures, and experience the fun of browsing the museum.

The project shows that 3D technology can be used for large-scale educations and cultural experiences. In the Forbidden City, visitors can interact with the virtual world by using multimedia terminals. The project is the first virtual world created by the SOA service architecture. Blade Centers and Linux Blade servers of IBM are the important cores of this virtual world, which provides a powerful performance for the virtual world of the Forbidden City. Thousands of users can be online at the same time, and its scalability is comparable to large games. In the project, IBM uses a range of technologies, including WebSphere, Application Server, Tivoli, ESB (Message Broker), DB2 Viper, IBM BladeCenters and Linux open source components. The virtual world can be run in Linux, Windows and Mac operating environments.

5.2 Juan Qin studio
With the development of virtual reality technology, in September 26, 2010, the Imperial Palace Museum cooperated with Japanese relief printing, and they collected and preserved cultural heritage information based on the use of advanced digital technology, so the cultural heritage of the Forbidden City was introduced to the world audiences, which better demonstrated and publicized the excellent Chinese traditional cultures. During the first five years, the two formed the first Chinese and foreign cooperative research entity--"Institute of digital application of cultural assets", and they launched two large-scale virtual reality works --the Forbidden City: the Palace of the Emperor and The Three Main Halls. These two works clearly showed the Kangxi and Qianlong Dynasty of the Qing Dynasty through the three-dimensional model of high quality for the audiences, and they used the computer virtual reality technology to show the material and non-material cultural heritages better.

During the second five years, the two continued to promote the application of new technologies in the cultural heritages. Through the two PCVR works of Hall of Mental Cultivation and Juan Qin Studio. They turned the focus of the research into the collection, preservation and presentation of the collection data of the ancient architectures. After ten years of in-depth cooperation, the cultural assets of the Imperial Palace made the four digital virtual reality works. For example, Juan Qin Studio gave full play to the advantages of this technology, so that visitors could enjoy the appreciation of it. At the same time, the Emperor Qian Long's thoughts were well expressed. Juan Qin studio became a three-dimensional scene, so as to achieve the unity of scholarship, education, entertainment and appreciation.
5.3 Winter Palace

The Old Summer Palace has been burned by the Eight Allied forces for more than a century, which has been the pity of hearts of Chinese people. With the help of virtual reality technology and other high-techs, it is expected to reproduce it. At the international optics conference in Changchun, experts said that the reconstruction project of "Digital Old Summer Palace" would make significant progresses in this year by relying on optoelectronic technology. In order to restore the original appearance of the Old Summer Palace, we need to use the virtual reality. First of all, we need to access to historical data, and we can use computers to set up a digital model of the scene of the Old Summer Palace; then, through a variety of optical displays, these figures are superimposed on the existing ruins, so that the stereoscopic display technology can reproduce the original scene of Old Summer Palace.

According to the design plan of "virtual Old Summer Palace" project, Old Summer Palace will set up a large virtual reality experience center in the South Gate of the park. The experience center contains 120-degree screen cinemas, 360-degrees screen cinemas and 4D cinemas, and the digital city, virtual reality, visual simulation, Internet and multimedia technology will be used to reproduce the original Old Summer Palace by lively and interesting ways. Chen Mingjie, the director of Old Summer Palace management office, said that the site would use the virtual and real combination to restore some of the landscapes, so that visitors can see high-definition and three-dimensional virtual Old Summer Palace personally on the scene. In addition to several major theaters, there will be 10 new exhibition areas in the center. In the park, the layout of the main landscape nodes will have the scattered display items. Through time and space tunnels, visitors can experience the vicissitudes of Old Summer Palace step by step, which gives visitors a strong shock.

In April 2009, management office of Old Summer Palace and the planning and design Institute of Tsinghua University jointly launched the research project of "Digital Old Summer Palace". Through the panoramic three-dimensional virtual technology, they rebuilt the Old Summer Palace, and a large number of research data obtained the digital finishing, so as to establish an authoritative basic historical data base of Old Summer Palace. At the same time, the paper summarized the technical specifications, such as space divisions, time divisions, design rules, drawing standards and recovery accuracy evaluations. All of these have deepened the research on the official architecture and gardening art in Qing dynasty, and have filled the gap in the history of traditional architecture and Old Summer Palace.

6. Conclusions

With the rapid development of China's tourism e-commerce, the application of virtual reality technology, WebGIS and other related technologies in the tourism industry can make people more accurate and intuitive, which is very attractive to tourists. According to the characteristics of WebGIS, the application of WebGIS in the investigation and evaluation of tourism resources, the development and planning of tourism resources, tourism marketing and tourism guidance were studied in this paper, so that GIS could be widely used in many fields, such as resource and environment management and planning through Internet technology. Computer graphics, human-computer interactions, motion tracking and other VR related technologies were studied. Through the combination of WebGIS and virtual reality technology, we achieved the virtual reality tourism. Through the study of three virtual reality
applications in the Forbidden City, the Old Summer Palace and the Juan Qin studio, visitors do not have to go to the scene to feel the scene atmosphere and environment, and combined with human-computer interfaces, visitors can freely browse from various angles. Practice has proved that, based on WebGIS and virtual reality technology in the development of tourism applications, we can avoid the complex scene modeling and rendering, which achieves the virtual world tourism. It creates the conditions for the practical application of virtual reality technology, and combined with the current development of tourism e-commerce industry, its application prospects are very broad.

7. ACKNOWLEDGMENT

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8. REFERENCES