Construction of Virtual Simulation Platform for Tourism

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Abstract This paper introduced the application of the WebGIS and virtual reality technology in the tourism industry and analyzed the existing problems in the tourism information system. Taking Daqing Oil Field Scenic Sport as an example, it introduced a method of constructing the virtual simulation platform for tourism based on the combination of WebGIS and virtual reality technology. Through the virtual simulation platform of Daqing Tourism Scenic Spot, it verified the design idea, methods, and technical feasibility of the virtual tourism system, and built a specific, feasible, and practical virtual simulation platform for tourism. It showed the bright prospects of virtual tourism development based on WebGIS and virtual reality technology.

Key words Virtual tourism, WebGIS, Virtual reality technology, Interactive control

1 Introduction

With the development of tourism, the dissemination form of tourist scenic spot is also improving constantly. The dissemination of the traditional scenic spot is based on the form of 2D graphics or images, which can only describe the scenic spot in the scenic area. The development of WebGIS and virtual reality technology exerts a great impact on the description of scenic spots.

WebGIS refers to the work of the GIS based on the Web. With the aid of WebGIS, spatial data can be released through the Internet, to provide users with spatial data browsing, query, and analysis functions. With the aid of the virtual reality technology, we can build a real-time, 3D virtual environment, and users can enter the virtual environment, watch and operate the computer-generated virtual world. The application of virtual reality technology in tourism is mainly manifested in the 3D visualization of urban landscape[1]. At present, the virtualization of tourism resources is basically realized in the way of 360-degree panoramic images technology to express their 3D visualization[2-4], which is not the simulation to the real object and can not observe the object from any angle, so they can not be called the real "virtual". Therefore, it is necessary to combine WebGIS with virtual reality technology to develop a virtual simulation platform for tourism according to the geographical characteristics of tourist areas for the purpose of rational use of resources, dissemination, development and planning of the tourist areas. The platform uses 2D geographic data to generate 3D landscape of scenic spots, and provide users with dynamic scene through the Internet or other carrier, so that the travel enthusiasts will choose the travel route, speed and viewpoint based on their intention. The platform will also help them to inquire about, browse and analyze the objects in the virtual environment, such as topography, resources, environment, and so on. Managers of tourist areas can analyze, track, and make plan and decision according to the situation of virtual tour.

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2 Architecture of the virtual tourism simulation platform

This study is to build a tourism-oriented 3D visualization platform which can provide geographic information query, simulate the full range of tourist attractions in a 3D way, realize virtual tourism beyond time and space restrictions and attract more tourists. On the whole, the virtual simulation platform for tourism mainly consists of three parts: 3D modeling sub-system, 3D scene generation sub-system and interactive control sub-system. The essence of 3D modeling sub-system is a graphic editing system, which mainly edits the acquired 2D data and transforms the 2D object model into the 3D object model. 3D scene generation sub-system is responsible for spatial object reconstruction, management, visualization operation, attribute query, 3D object edition, and so on. The interactive control sub-system is to realize the real-time, interactive control, dynamic display, navigation, positioning and loading of objects in 3D scene.

2.1 Analysis on demands of 3D modeling sub-system The object in the 2D plane is expressed by (x, y) coordinates. The objects in the 3D scene are represented by the coordinates of (x, y, z). By comparison, the 3D data have a more value (z) than the 2D data. Therefore, through increasing the appropriate value of z in the data imported to the 3D modeling sub-system, we can generate the 3D model. The 3D modeling sub-system should have the following functions.

(i) Data import. The system can import various formats of data and support the popular data formats of GIS system.

(ii) 3D modeling. It can generate 3D model of the object

through editing the imported 2D graphics data.

(iii) View operation. It can realize operations such as zooming and panning graphics, modifying layer scale, coordinate translation, and so on.

2.2 Analysis on demands of 3D modeling sub-system The 3D scene generation sub-system is responsible for importing 3D models, initializing 3D scenes, generating and viewing 3D landscapes, and managing the entire scene. The 3D scene sub-system should have the following functions.

(i) 3D terrain reconstruction. It can provide digital elevation model (DEM) import, quickly build 3D terrain, and provide remote sensing image import, to achieve a wide range of terrain reconstruction.

(ii) Creating and editing the landscape buildings. It can delete and move buildings and modify the structure, shape, height, and other parameters at any time.

(iii) Rapid integration of space information and surface texture of 3D objects. Surface texture data can enhance detail description of the tourism landscape, so that the simulated tourism landscape will become more vivid.

(iv) 3D rendering. It can realize real time shade transformation, color matching, and light rotation.

(v) Model import. System is built with a powerful 3D modeling tool, so it can generate 3D model according to demands of the user. Besides, the system is provided with an external interface, so it can import models built by D3MAX and AutoCAD.

(vi) Space location. It can search the space objects and locate the space objects.

(vii) Attribute operations. It can search and edit attributes of space entities.

2.3 Analysis on demands of 3D scene interactive control sub-system The 3D scene interactive control sub-system is to realize the real-time, interactive control, dynamic display, and loading of objects in 3D scene.

(i) Roaming control of scene. Users can choose to automatically navigate roaming scenes or browse according to their needs.

(ii) Interaction with objects in the scene. Users can select any object in the scene to observe any angle, change the relevant parameters, and get different results.

3 Design and realization of the virtual simulation platform for tourism

Taking Daqing Oil Field Scenic Spot as an example, we elaborated the building of the virtual simulation platform for tourism. This simulation platform consists of three parts: 3D modeling sub-system, 3D scene sub-system, and 3D scene interactive control sub-system.

The 3D modeling sub-system can import the data of DME, roads, rivers, lakes and forest vegetation in Daqing Scenic Spot, process these data by layers, and set the projection coordinates of each layer, so that the projection coordinates of each layer are consistent with each other, to generate 3D model file. The 3D scene generation sub-system reads the 3D model file to generate the 3D scene. The interactive control sub-system can perform interactive control operations such as roaming and location of 3D scene.

3.1 Realization of 3D modeling sub-system The 3D modeling sub-system can import the basic data of Daqing Scenic Spot into the system and convert 2D data into 3D model data through the reorganization of the data. WebGIS interface configuration for Daqing Scenic Spot is illustrated in Fig. 1.

Fig. 1 WebGIS interface configuration for Daqing Scenic Spot

(i) Data import. Users can import the data of roads, rivers, lakes, forest vegetation and other data into the system. Various formats of data can be imported into the system, such as *.mxl, *.gml, *.Shp, *.tba, and *.gz formats of building data.

(ii) Layer setting and management. Different types of data layers can be assembled into a group, to realize unified management of each layer.

(iii) Characteristic attribute configuration of 3D model. In the imported data, only the terrain data are 3D. Other data are point, line or plane 2D data. In order to generate a 3D model in a 3D scene, it is necessary to configure these 2D data.

3.2 Realization of 3D scene generation sub-system The 3D scene generation sub-system generates 3D scene models, including terrain, roads, scenic spots, vegetation, water systems and other spatial objects, using the data generated by the 3D modeling sub-system, to realize 3D visualization of Daqing Scenic Spot.

(i) Terrain modeling.

Terrain model is mainly expressed by DEM data, which consist of regular grid or triangulated irregular network (TIN). The regular grid model is suitable for the spatial analysis, but the sampling points are regularly distributed, causing the large redundancy of DEM data, and accordingly leading to terrain distortion. TIN model can keep the characteristic points of terrain and prevent the distortion caused by simplified data, so the TIN model is more suitable for real-time terrain display.

The DEM data of Daqing Scenic Spot can be used to generate visual 3D terrain, showing the ups and downs of the terrain and the distribution of scenic spots, lakes and mountains.

(ii) Building modeling.

Buildings are essential parts of landscape, especially in urban landscape and cultural landscape. The building model data are the geometric data of the building model. The data such as outline, height, and roof angle coordinates of the building can be

obtained by space measurement or by stereo map extraction from aerial photographs[5]. There are two methods to establish building models by 3D visualization system of tourism resources: one is to automatically generate 3D building model based on 2D building outline and building height, this method is suitable for buildings with more regular form; the other method is to establish building model with the aid of special modeling software, then use the system to import the model into a 3D scene, and this method is suitable for processing buildings with irregular forms (such as buildings and sculptures, *etc*. made up of many building blocks of different sizes).

In this paper, we adopted the second method and special 3D modeling software, 3ds max for instance. The building model mainly applies polygonal modeling method, to finally generate. 3ds format file.

(iii) Road modeling.

The road is also an important and indispensable part of a 3D scene. Road data can be obtained through aerial survey and field measurement. In 2D graphics, road data belong to linear data and consist of a number of continuous points. In 3D scene, it is necessary to convert these point data into planar data.

In this paper, our method is based on the point of the line as the center, with a certain width as the radius, new data points are inserted into both sides of points to form a new set of data points, the point set for the planar point set of roads. At the time of generating data point, the Delaunay triangular network is constructed by point-by-point insertion method to generate the road plane. In this way, linear data of road will be converted into planar data. Finally, road texture will be added and road superimposed to the ground.

(iv) Tree modeling.

Trees are irregular objects. Many scholars have studied the simulation of trees and have obtained a lot of theories and methods. Generally, tree simulation methods can be divided into three types: geometric object model, wireframe model and map model[6]. At present, the best tree model generation algorithm is fractal algorithm[7]. However, the model generated by fractal algorithm needs a large amount of data, and the calculation is rather complicated. For 3D real-time rendering, the efficiency is relatively low. This problem is particularly prominent for describing vegetation.

In order to increase the real-time rendering efficiency of the simulation system, we applied the cross-mapping method to simulate the trees. Firstly, we created two intersecting planes in 3ds max. The two planes intersect at 90 degrees, and then set the true tree texture for two intersecting planes. The texture image adopted the PNG format. PNG images support alpha transparency attribute and can process the transparent colors and opaque areas of the trees. The cross tree model can display the trees from the front, back, left and right sides, to make the trees become 3D. Since this model used real tree photos, the effect is more realistic, the data are less, and the processing is rapid.

3.3 Realization of 3D scene interactive control sub-system

Using the 3D scene data generated by the 3D scene generation system, it is able to perform interactive control operations such as roaming, navigation, and location of 3D scene. The 3D virtual simulation effect of Daqing Scenic Spot is illustrated in Fig. 2.

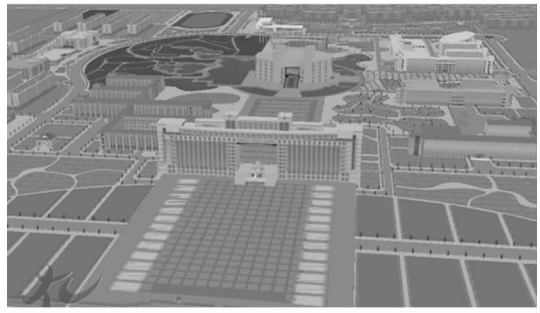

Fig. 2 The 3D virtual simulation effect of Daqing Scenic Spot

(i) Scene navigation.

Scene navigation simulates the real flight roaming state, roams in a simulated 3D scene at will, observes the terrain of Daqing Scenic Spot from various angles, as well as browses Daqing area.

(ii) Path roaming.

The system supports automatic roaming of custom path and historical path. For custom roaming, roaming path, path direction, roaming speed, view point height and other parameters must be preset, it will automatically roam according to the preset roaming parameters. Historical roaming makes records of previous roaming, and then repeats the roaming way.

(iii) Scene location.

Daqing Scenic Spot is vast in territory, rich in tourism resources. There are many tourist attractions. In the 3D scene, users can not search spots aimlessly. Through space location, users can find interested attractions, more accurately locate the attractions, and it can display the attribute information of attractions. Users can enter the name of attraction in this system to locate the desired place.

(iv) 3D scene information publishing.

Finally, we publish the generated 3D scene into a web page. Users can access this platform through the Internet to complete a perfect travel.

4 Conclusions

In this paper, we proposed a modeling method based on WebGIS and virtual reality technology for different kinds of objects and interactive control method of 3D scene and built the virtual simulation platform for tourism. Through this platform, it is expected to propagate the tourist area better. Besides, in accordance with the statistics of users' access to the platform, it is expected to make better planning and management of tourist areas, to provide decision-making support, and better promote the development of tourism industry. Through the initial operation, this platform can achieve good social effects and economic benefits, demonstrating the broad prospects of virtual tourism system.

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speaker is online.

3.1 Data collection The real-time collection of loudspeaker online rate is based on the above-mentioned file (hereinafter referred to as "online file"). The data acquisition software uses the information stored in a default XML file to identify the information of various loudspeaker sites. At the beginning of software running, the information will be read into a < List > type variable, and when the software interprets online file, this variable will find the information of the site corresponding to online file. And then the information is sorted out into the required data to be written in the remote database through the LAN. The multi-threaded processing is used for the process of writing database.

3.2 Storing process in database In this system, the core of all tasks is the database. The database used here is SQL2003 database. The storing process method is used for the reading and writing of database. The advantages of stored procedures: (i) allowing modular programming, that is, we can call the process at any time in the program after creating only one process; (ii) allowing faster execution, that is, if the operation needs to execute or repeat a large number of SQL statements, the execution of storing process is faster than that of the SQL statement; (iii) reducing network traffic, for example, a process of operation in need of hundreds of SQL codes can be completed by one execution statement, and there is no need to send hundreds of lines of codes in the network; (iv) better security mechanism, that is, for the users who do not have permission to execute storing process, they can also be authorized to execute a stored process. In this database, six storing processes are established, and they perform different tasks and return different results.

3.3 Loudspeaker online rate query The loudspeaker online rate query is an effective measure adopted by Benxi Meteorological Bureau to manage the loudspeakers in the region. The basic query time unit of this query software is a month, that is, we can search the 1-N month online rate data. This is the need of loudspeaker management work. In the loudspeaker online rate query software, it needs 197 kinds of query results in 3 categories, and some query results can not be obtained at a time. Therefore, the query software is very powerful in function, and the combination of query methods is very flexible. If the query method of storing process is not used, many SQL query statements will appear in the source codes, reducing the execution efficiency and readability of the codes. The frequent connection to database will increase burden on the SQL database server and slow down the query. The query results are displayed in two ListView controls, and the query results can be saved to Excel documents according to needs. Thus the loudspeaker online rate is reported to the governments at all levels on this basis, and it can play a supervisory role.

3.4 Loudspeaker online rate SMS alert software This is an autorun software. The SMS transmission objects are stored in an Excel document in advance, and with the operation of the software, the information is read into memory variable. At 0: 15 every day, the software will automatically calculate the loudspeaker online rate of the day before according to different areas in address list, and it is saved to a temporary text file. Then, based on user-defined time, the information in the temporary file is read, and sent to the persons in the address book by GSMMode module.

4 Conclusions

In 2015, Benxi Meteorological Bureau focused on improving the loudspeaker online rate, and achieved remarkable success. From January to July, the online rate of meteorological early-warning loudspeakers was 93.83% in the city; during the flood season (May to July), the online rate was 98.69%, much higher than that of Liaoning Provincial Meteorological Bureau; from May to September, the online rate achieved the goal of 85%.

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