The Design and Realization of Smart Tourism System of Wuzhizhou Island Based on WeChat Platform

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Abstract The proposal of the "Internet plus" plan has injected new vitality into traditional tourism, and also added new content to the construction of “Smart tourism”. In the context of "Internet plus" and "Smart tourism", combining computer technology with tourism is a hot topic in current tourism research. This article integrated GIS technology, remote sensing technology and relevant computer technology in WeChat public platform to service the tourist industry, and provided solutions for “Smart tourism”. Firstly, this paper introduced the significance of constructing the Wuzhizhou island smart tourism system, and secondly, designed the system's overall function, and finally introduced the realization of Wuzhizhou island wisdom tourism system according to the design. This research has improved the deficiency of the traditional tourist service mode, and also improved the management level of the scenic spot, as well as served as a reference for informatization construction of other scenic spot.

Keywords WeChat platform; Wuzhizhou island; Smart Tourism; Remote Sense; GIS

1 Introduction

In September 2015, the national tourism administration, director of the east, Li Jinzao (2015) pointed out that the Chinese economy had come into the new normal period. In this period, the tourism industry would become the important new engine of China's economic growth. With the increasing demand of tourism, the "Great Tourism Power Country" character was beginning to appear (Ge Quansheng et al, 2015). Today, the rapid development of mobile Internet has affecting the tourism industry, and the national tourism administration has officially launched the “tourism + Internet” action plan (Lv Wen, 2015). Meanwhile, in the era of mobile Internet, driven by strong tourism demand, it was trend to operate the scenic spot as a model of "Smart tourism". Since WeChat launched in 2011, WeChat has been vigorous development, the amount of users increased rapidly, as of 2016, WeChat registered user volume exceeded 927 million. Meanwhile, the number of mobile applications in the WeChat public platform

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Hainan Natural Science Foundation of china: Study on coupling mechanism of tourism development and ecological environment in tropical marine ranching, taking Wuzhizhou Island in Sanya as an example(417068).
Hainan Social Philosophy Science Project: Study on carbon sink mechanism of tropical marine pasture(HNKS(YB)17-3)
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has reached 85,000 (Ma Li, 2016). We can use Mobile applications based on WeChat platform by “scan” or “shake”, which was more convenient than before, and has gotten the user's unanimous praise.

In the era of mobile Internet, the value created by the full use of information technology was enormous. In theory, this paper presented a solution that integrated a set of geographic information systems, remote sensing and other related technologies in WeChat platform that serviced to wisdom scenic tour, which innovated tourism information service and enriched the content of tourism research. In practice, designing and implementing a scenic tourist system that integrated tour guide, propagate, and payment in WeChat public platform, not only can provide better information services to tourists, but also can help scenic spot to propagate and operate better, so as to improve the management level and image of the scenic spot and also serve to the soft power, it can make up for the shortcomings of traditional tourism services, and then can enrich the content of tourism services, and also can provide reference for other scenic information construction. At the same time, this system added the Wuzhizhou Island Marine Environmental impact assessment module, which can provide the marine chlorophyll and suspended matter concentration map that can be used to provide reference for marine tourism activities and marine ecological restoration in Wuzhizhou Island.

2 Related Research

There was not much literature directly related to the study of WeChat scenic spots in China. In CNKI, we searched out of the literature with the subject word “WeChat scenic spot tour” and found that there were only 7 articles. This may relate to that WeChat's emergence was as a new media. However we searched articles in CNKI with subject word “Intelligent navigation”, there were 127 articles(as shown in Table 1), among them, there were 47 dissertations and 70 journal articles. Through sorting these documents, we found that the research of intelligent navigation system started very early in home and abroad, Chou L.D et al.(2004), who studied intelligent guided navigation system earlier, he developed an intelligent navigation system based on PDA platform, which can realize the automatic display of goods and multimedia interpretation, which became a representative of the early intelligent terminal navigation system. Albertini et al.(2005) implemented a vision based mobile museum navigation system through the identification algorithm, which provided navigation information by identifying the details in a picture that provided by a navigation camera. In 2008, with the advent of the IOS and Android App Stores, the development of the smart phone APP has undergone a qualitative leap. American Museum of natural history launch a mobile phone guide APP named “explorer”, which can automatically push of corresponding exhibition content to visitors’ mobile devices according to the visitors’ arrival of the exhibition hall. Its’ function was very abundant, and the interface was user-friendly, so it has gained a broad user's praise (Homchick J et al,2010). Zhong Zhipeng et al (2012) realized a self-service navigation of the museum on mobile terminal, which based on the mobile visual search technology to
automatically identify mass exhibits. During this period, the literature mainly focused on Intelligent Navigation, and with the development of smart phones and other hardware technologies, intelligent navigation technology has also been better developed.

By 2012, WeChat public platform was launched and provided developing interfaces, developers can put their web applications into the WeChat public platform. So many companies develop their own web applications on WeChat public platforms, relying on WeChat's powerful user group and the convenience of “sweep code” to promote. Qian Zheng (2015) realized an interactive mobile navigation system on WeChat public platform, takes the Wolf lane, fan Valley Scenic Spot in Fengyang, Anhui province as an example, which achieved good results. March 2016, People's Daily reported that the mountain area of Guizhou Province has launched a shake tour guide system (Tian Ju,2016). The tourists can get the voice introduction, scenic guide service, and ticket reservation service and so on through the WeChat platform, it eliminates the complexity of the traditional manual service. Since the launch of the WeChat public platform, it has been applied to a certain extent in the scenic area, but there was not a mature case that combined the intelligent navigation system with the WeChat platform. On the whole, neither the intelligent navigation nor the literature of WeChat scenic spot have been studied deeply the combination of intelligent navigation technology and WeChat public platform. But the research of intelligent navigation system started very early, and the number of literature on the subject of "intelligent navigation" is shown in Figure 1.

As can be seen from the chart above, the passion of studying intelligent navigation has been risen from 1999 to 2017, especially after the emergence of smart phones in 2011. Thus, before WeChat came out, Intelligent navigation system research has been developed very well, and has a relatively mature technical system. But after WeChat came out, there was still few scholars doing research on the combination of intelligent navigation system and WeChat platform. This paper combined the WeChat platform with the intelligent scenic spot navigation, and put forward the solution that combined the intelligent navigation system with the WeChat public platform to serve the “Smart tourism”, and also designed and implemented the smart tourism system of Wuzhizhou Island based on WeChat public platform, which can provide reference for the information construction of scenic spots.

**Fig. 1. The number of "intelligent navigation" literature statistics**
3 Demand Analyze and Overall Design of Smart Tourism System of Wuzhizhou Island

3.1 Wuzhizhou Island Profile

Wuzhizhou Island is located in Sanya, Hainan Province, in Haitang bay north of Sanya City, 2.7 kilometers from the nearest Wang Zhen Lin. It's 30 kilometers from downtown Sanya (as shown in Figure 2). The center of the island is located at latitude 18° 18′ and longitude 109° 45′. To the north, Nanwanhoudao is across the sea. To the south, Yalong Bay is adjacent. The island has a coastline of 5.7 kilometers and an area of about 1.48 square kilometers. It belongs to a tropical marine climate, with an annual average temperature of about 25°C. The island presents an irregular butterfly shape, and he terrain is low in the northwest and higher in the Southeast. The highest point of the island Wuzhiling is about 79.7 meters above sea level, here are rich in scenery on the island. It is a famous island tourism destination in Hainan, and has the reputation of "China's first diving base". In November 2016, it was named the national AAAAA class tourist attractions. It attracted about 8000 tourists every day.

3.2 Demand Analysis of Wuzhizhou Island Intelligent Travel System

The demand for smart travel system of Wuzhizhou Island mainly came from three aspects, they were tourist demand, scenic spot demand and system administrator demands, they were listed as below.

Tourist demand: Tourists can view the map of the scenic spots, tourist information, scenic spots information, scenic explain information, and the distribution information through the system through WeChat public platform. Meanwhile WeChat public platform can serve visitors before they travel, tourists can inquire about the corresponding tourism items, tourist routes, scenic spots activities and tourist price through WeChat public platform, it can provide a good reference for visitors' travel.

Scenic spot demand: The scenic spot can put up QR Code in every corner of the scenic spot, visitors can scan them, so it can get through the online and offline through WeChat scanning, it is very convenient to spread. At the same time, the mass messaging function of WeChat public platform can help the scenic spots to deliver announcements and other publicity materials. WeChat has a huge user group, using this channel, the scenic spots can be rapidly extended to a large number of users, and play a good role in publicity.

System administrator demands: The system administrator can publish news updates, release scenic spot promotions through the system. At the same time the administrator can check the tourist’s distribution map, and if necessary, the administrator can carry out emergency rescue or warning the mass incidents.
3.3 Overall Design of Wuzhizhou Island Smart Tourism System

(1) System Overall Structure Design

The intelligent navigation system of Wuzhizhou island is a system that based on WeChat public platform, although WeChat is a client, but the system is B/S model, and used Windows 7 as the operating system, HTML, JavaScript as major development language. The system used MySQL as the database management platform and Tomcat as a server, and was developed under the WeX5 platform. WeX5 is an open source free Hybrid APP development tool. In the platform the chrome browser, MySQL database and Tomcat server were built-in, and it is a development environment that integrated development, programming, debugging function. The overall design of the system is shown in Figure 3.

![Overall structure design of scenic intelligent navigation system](image)

(2) System Function Module Design

According to the features and sphere of business of Wuzhizhou Island Scenic, we design the intelligent navigation system and the Micro Website based on requirements. Among them, the intelligent navigation system includes functions of scenic map display, attractions introduction, scenic route planning, scenic route recommendation and tourist distribution dynamic display. The Micro Website includes the functions of Scenic spot introduction, Itinerary proposal, dynamic highlights, preferential activities and so on. In fact, the system is consisted of two separate systems, they get access to the custom menu of the WeChat public platform separately. There are also basic functions based on WeChat platform, such as WeChat payment and WeChat public message push. We can realize such function just by calling the API. The functional design of the system is shown in figure 4.
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Fig. 4. Wuzhizhou Island smart tourism system function diagram

4 System Data Processing and Database Design

4.1 Thematic Map Processing

Processing steps of thematic map based on ArcGIS included preliminary preparation, preliminary preparation, data acquisition, raster registration, projection coordinate system selection, data analysis and classification, vector database establishment, map vectorization and map output. The basic flow chart is shown in Figure 5.

Fig. 5. The basic flow chart of scenic map vectorization
Map data is a panoramic view of the Google map, which is downloaded by the 91 map assistant. After registered, we can download a panoramic image of the scenic area with a resolution ratio of 0.28 meters, which was shotted in January 30, 2017. And then, we use ArcGIS to vectorize the panoramic map. The layer processing of topographic maps is as follows.

Line layer: Scenic road;  
Surface layer: Building, trees, pool, gallery, beach promenade, pergola, cement, rock.

There were 9 layers in the line layer and face layer. In the line layer, the scenic road layer is divided into two attributes. When the property is 1, it means the rotary island highway, when the property is 2, indicates the path inside the scenic spot. In the surface layer, the building layer is divided into 2 attributes, when the property was 1, indicating the main building, and when the property was 2, the secondary building was indicated. According to the data analysis and delamination above, we establish the corresponding vector database in ArcCatlog. And then, vectorized the corresponding parts on the panorama. At last, export .PNG format picture of Wuzhizhou Island thematic map, as shown in Figure 6.

![Wuzhizhou Island scenic panorama and thematic map](image)

**Fig. 6.** Wuzhizhou Island scenic panorama (left)  Wuzhizhou Island Scenic thematic map (right)

### 4.2 Database Design of Scenic Spot

Because the scenic area is relatively small, information about the scenic spots on Baidu Map is relatively simple. Therefore, it is difficult to meet the needs of tourists in scenic spots, in order to show more tourism information data of the scenic spot, Local resources database of Wuzhizhou Island is needed to establish, and used MySQL as database. The database included geographical information table of tourist attractions, tourist resource information data table, micro website news update data table. The table structure is shown in table 1, table 2 and table 3.

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<thead>
<tr>
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<th>Description</th>
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<tr>
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<td>Scenic spot Longitude</td>
</tr>
<tr>
<td>Latitude</td>
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<td>Scenic spot Latitude</td>
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</table>
### Table 2 Tourist resource information data table

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<th>Description</th>
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</tr>
<tr>
<td>Name</td>
<td>varchar</td>
<td>20</td>
<td>yes</td>
<td>Scenic spot name</td>
</tr>
<tr>
<td>VideoFile</td>
<td>varchar</td>
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<td>yes</td>
<td>Video introduction URL</td>
</tr>
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<td>yes</td>
<td>Audio introduction URL</td>
</tr>
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<tr>
<td>TextFile</td>
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<td>Scenic text explanation</td>
</tr>
</tbody>
</table>

### Table 3 Micro website news update data table

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<th>Description</th>
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</tr>
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<td>string</td>
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<td>yes</td>
<td>Picture url</td>
</tr>
<tr>
<td>introduction</td>
<td>string</td>
<td>2000</td>
<td>yes</td>
<td>News content</td>
</tr>
</tbody>
</table>

## 5 System Realization

### 5.1 Realization of Micro Website of Wuzhizhou Island Tourism System

The micro website of Wuzhizhou Island tourism system using HTML, JavaScript, CSS as developing language, and used MySQL and Tomcat which is built-in WeX5 platform as database and server. The System included module of scenic spot introduction, itinerary proposal, dynamic highlights show, complaint and opinion, preferential activities, contact information, service project introduction. The main interface is shown in figure 7.

![Micro website’s main interface](image)

### 5.2 Realization of Navigation Module of Smart Tourism System of Wuzhizhou Island

(1) The Load and Display of Custom Slice of Scenic Map

A map slice is cutting the map into square pictures of rows and columns within the specified geographic coordinate range, according to the specified size and picture format, the map sections obtained from the cut map are also called tiles. Nowadays, Map segmentation is widely used in WebGIS, it put the map slices on the server side for the clients to visit(Zhao Dalong,2010). Using the method of caching pictures can reduce network load and average delay and also reduce disk access times effectively, thereby can improve the efficiency of loading the map(Zhang Junli,2009). First of all, we should deal with the thematic maps in Photoshop to resize the picture. The formula of resizing the thematic is as follows.

\[
\text{Source picture side length} = 256 \times 2^{[\text{zoom(max)}-\text{zoom(min)}]}
\]
In formula (1), \(z_{\text{om}} \text{(max)}\) indicated the maximum scale of scaling that needs to be sliced, and \(z_{\text{om}} \text{(min)}\) indicated the minimum scale of scaling that needs to be sliced. For example, if you want to slice the maximum level of the map was 18, and the minimum level was 15, so the source picture side length was \(256 \times 2^{18-15} = 2048\) pixel, if the source map was too large or too small, it would cause the length to exceed or shorter than the corresponding region on the map. Then using Baidu Map slicing tool to registrate and slice the prepared map, and stored the tiles in local, and then used API provided by Baidu Map to load the slice, and covered the scenic map in the original Baidu Map. The key code of loading custom slicing in Baidu Map is as follows.

```javascript
var tileLayer = new BMap.TileLayer({isTransparentPng: true});
tileLayer.getTilesUrl = function(tileCoord, zoom) {
    var x = tileCoord.x;
    var y = tileCoord.y;
    return 'tiles/' + zoom + '/tile' + x + '_' + y + '.png';
}
map.addTileLayer(tileLayer);
```

(2) The addition of Tourist Information and Information label

After covered the thematic maps of the scenic spot, the original information of scenic spots were covered, so we needed to re-add scenic information to Baidu Map. The principle of Baidu Map is the same as most GIS systems, they all organize the geographic information data hierarchically. Users can add annotation information to layers that they created on Baidu Map. Baidu Map provided the method `map.addOverlay (marker)` to add custom annotations. The system tagged the information of scenic spot by visiting the database that store the latitude and longitude and the corresponding information of the scenic spots. Then added the information form of the scenic spot through the method of `BMap.InfoWindow()` that provided by Baidu Map. In order to avoid the situation that when the zoom level is relatively small, the marker would be crowded, so we displayed the label in different layers by listening the mouse wheel event to get the zoom level. Screenshot of the system is shown in figure 8.

![Fig. 8. Custom information tagging of Wuzhizhou Island Scenic spot (zoom level 17(left), zoom level 16(right))]
3) Scenic Path Planning Function

Path planning and scenic spot search function are essential functions of every tourism system, the realization of this function of the system was relied on the path planning and search method that Baidu Map API has provided. The main function the API included walking path planning, driving navigation and local search. The main implementation interfaces are LocalSearch (local search), Walking Route (walking navigation), Driving Route (driving navigation). The scenic area was relatively small, in the scenic spot, most roads were walking roads, so we adopt the method of Walking Route to realize the scenic spots navigation.

In this system, the tourists can search any scenic spot in the information window provided, the system would match the name of the scenic spot in the database, and passed the longitude and latitude information of the scenic spot to the system, so as to search and display the shortest path. The following figure shows the route from the police station to the pirate bar.

![Fig. 9. Graph of the shortest path spanning of Wuzhizhou Island Scenic Spot](image)

The key code for path planning is as follows:

```javascript
var walk = new BMap.WalkingRoute(map,{renderOptions:{map:map,autoViewport:true}});
walk.search(start,end);
walk.setSearchCompleteCallback(function (rs) {
    var pts = walking.getResults().getPlan(0).getRoute(0).getPath();
    for (var i = 0; i < pts.length; i++) {
        chartData.push(new BMap.Point(pts[i].lat, pts[i].lng));
    }
});
```

4) Scenic environment monitoring module

Wuzhizhou Island Scenic developed tourism items, such as fishing, sea diving, motor boats, beach and sea travel, these tourism projects have some adverse effects on the marine environment. In order to monitor and evaluate marine environment, the module is evaluated by means of 3S spatial information technology and mathematical model to analyze the changes of chlorophyll concentration, total suspended matter concentration, phytoplankton and zooplankton in the water of Wuzhizhou Island in 2010-2014 years, and construct the inversion model to evaluate the water environment,
to monitor the development of Wuzhizhou Island tourism and the marine ecological health, in order to provide a reference for the tourism and ecological environment protection and restoration of Wuzhizhou Island.

6 Summary and Outlook

This paper proposed a solution of combining the intelligent navigation system with the WeChat public platform to service the tourism industry, which is based on a great deal of research on intelligent navigation system and WeChat platform. And according to the solution, we designed and realized the Wuzhizhou Island Smart Tourism System based on WeChat public platform, which not only made it convenient for tourists to visit scenic spots, but also convenient for scenic staff to manage the scenic spots. And it can be used by “shake” and “sweep”, which improved the shortcomings of traditional tourism service and enhanced the level of information in scenic spots, and can provide ideas for the information construction of other scenic spots.

Meanwhile, there were several shortcomings of this study: At first, the system belongs to pure B/S architecture, almost all of the resources are stored on the server side, and it would cost much of the traffic of mobile if we want to visit the resources of the system, which would bring some financial burden to the tourists who travel outside. In the process of social and economic development, the level of scenic intelligence would be gradually improved, and Wi-Fi coverage area would be increased, and the problem would gradually became better. Secondly, the pure web system based on WeChat platform has less response speed and fluency than native APP, which would be a discount on the user experience. Therefore, in the future research, we should strength the cache design of the system to avoid unnecessary waste of repeated loading. At the same time, we should combine the advantage of Hybrid APP architecture, to put some of the resources on local storage, so as to improve the user experience.

References


Lv Wen (2015). National Tourism Administration issued the 'Travel + Internet' action plan.


