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Research Article

Design of Mobile Intelligent Navigation System for Xi'an Qinling Wildlife Park

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With the continuous development of China's economy and the improvement of people's living standards, the tourism industry is getting stronger and stronger that it integrates food, living, transportation, entertainment, shopping, and other aspects. Among them, the core competitiveness is tourism resources, which are the foundation for the survival of the tourism industry. Sustainable development of the tourism industry makes higher requirements for the advancement and management of tourism resources. How to better meet customers' needs and continuously improve service quality has become the key to development. In this study, Xi'an Qinling Wildlife Park is taken as an example, and PHP + MYSQL and other technologies are used to construct a mobile intelligent navigation system with rich functions, simplicity, practicality, and stable performance. The whole system uses B/S mode, and the main development of the system has been completed from the perspectives of practical interface and rapid development.

1. Introduction

With the traditional industries accelerating the integration with the internet, numerous internet entrepreneurs are looking for opportunities in the collision between the internet and traditional industries, among which the tourism industry, which is closer to realization, has attracted enough market attention [1–3]. As early as 2009, in the "Opinions on Accelerating the Development of Tourism" issued by the State Council, it is a policy proposal to build a large-scale comprehensive platform that can share tourism information. Article 5 clearly puts forward "establishing and improving the tourism information service platform to promote the sharing of tourism information resources," and Article 10 puts forward "taking informatization as the main way to improve the efficiency of tourism services. We actively carry out online tourism services, online marketing, online booking, and online payment, make full use of social resources to build tourism data centers and call centers, and comprehensively improve the tourism information service level of tourism enterprises, scenic spots, and key tourist cities." During the 12th Five-Year Plan period, China took the development of smart tourism as a new bright spot and growth point and increased investment in the construction of smart scenic spots. The construction of smart scenic spots is conducive to optimizing the tourism environment, improving the management and service level of scenic spots, and ensuring the coordinated development among tourism ecological benefits, economic benefits, and social benefits. Since entering the 13th Five-Year Plan, driven by favorable national policies, rising per capita income, in-depth influence of the internet, rapid development of expressways, and other factors, the development of tourism also ushered in new strategic opportunities. The deep integration of internet and tourism is not only the inevitable trend of tourism development but also can trigger other industries to boost the regional and local economies by tourism, so as to form characteristic tourism, characteristic market, and characteristic mode [4, 5]. Xi'an Qinling Wildlife Park, as a national AAAA-level tourist scenic spot, integrates wildlife ex situ protection, popular scientific education, tourism, leisure, and vacation, which has great potential.

In this study, a complete design scheme for the mobile tourism navigation system is put forward. Aiming at Xi'an

Qinling Wildlife Park, the gaps in tourist attractions are filled, and the application of a mobile tourist guide is developed, which provides convenient services of tourist guide for tourists. It is of great significance to the comprehensive development of Xi'an Qinling Wildlife Park. PHP + MYSQL and other technologies are used to construct a mobile intelligent navigation system with rich functions, simplicity, practicality, and stable performance. The whole system uses B/S mode, and the main development of the system has been completed from the perspectives of practical interface and rapid development.

2. Analysis of Requirements

In the research and development of an application program, the discussion on the performance of the system to be realized, the conditions to be used, and whether the project has development value and feasibility are generally called demand analysis.

2.1. Functional Requirement Analysis. The purpose of developing the mobile intelligent navigation system of Xi'an Qinling Wildlife Park is to meet users' needs and facilitate them. Therefore, it is necessary to fully understand and master the overall design of functional objectives and users' working model of the system before starting the design, and then determine the functions of the system. The information data and the demand analysis of the three main types of users are described as follows [6, 7]:

(1) *Public Users.* They mainly refer to tourist consumers, namely, travelers. Travelers can browse tourism information and inquire about relevant information on tourism resources that they are interested in and of all nearby tourist attractions, etc.

(2) *Tourism Management Department*. The tourism management department can manage the tourism resource information in a unified way, provide tourism-related information, inquire about the information of tourism resource in the research area, and obtain the overall situation of each scenic spot.

(3) *Tourism Enterprises*. They generally refer to tourism providers, that is, travel agencies. They can establish close ties with tourist attractions, help tourist attractions publicize scenic spots, publicize their own services, and try their best to ensure a long-term service-consumption relationship with tourists.

2.2. Requirement Analysis of Performance. The overall performance of Xi'an Qinling Wildlife Park mobile intelligent navigation system needs to meet the following requirements: first, it should meet the requirements of concurrent users, and the mobile intelligent navigation system has numerous visitors, so the number of concurrent users to be met is set to 500; second, it is necessary to meet the requirements of stable operation, which requires 7×24 hours of uninterrupted operation; and third, the average response time of the system needs to be no more than 4 seconds. In addition, it should also be able to meet the following requirements:

(1) *Friendly Interface Design*. A simple, practical, and beautiful software interface helps to enhance the user experience, bring users a good working mood, and then help to improve work efficiency. The software interface is not only required to fully reflect the business functions of each module but also to be easy to operate and use, and the design styles of different pages should be unified.

(2) *Scalability*. In the development of the mobile intelligent navigation system of Xi'an Qinling Wildlife Park, the expandability and portability of its functions should be realized as much as possible, that is to say, for a single functional module, it must ensure its independence when implementing other functional modules in the future, which can be applied to other modules with minor changes.

(3) *Maintainability*. After the mobile intelligent navigation system has been completed and put into use, it is often possible that the system has abnormal functions due to problems with the network or server. Therefore, it is necessary to develop a system with strong maintainability, which is not only convenient for developers to maintain with less time and workload, but also to reduce the cost of system maintenance.

2.3. Systematic Role Analysis. Xi'an Qinling Wildlife Park mobile smart guide system involves the following roles: tourists, users, and administrators.

2.3.1. Tourists. Tourists are not official users of the system, so they cannot do all the operations. They can only browse information about scenic spots on the platform, including types of scenic spots, comments, etc., without the access to messages, comments, and other operations.

2.3.2. Users. After completing the registration on the system, tourists immediately become the official user of the system and can enjoy the recommendation service of basic scenic spots provided by the system, and they can view scenic spot information, leave a message, update and maintain personal information, etc., and finally evaluate and score the completed tourist spots when completing the transaction.

2.3.3. Administrator. Administrators mainly play a role in the management and maintenance of the system, including the maintenance of scenic spot information, the reply of messages, the processing of orders, and so on.

Accordingly, the role module of the system is shown in Figure 1.

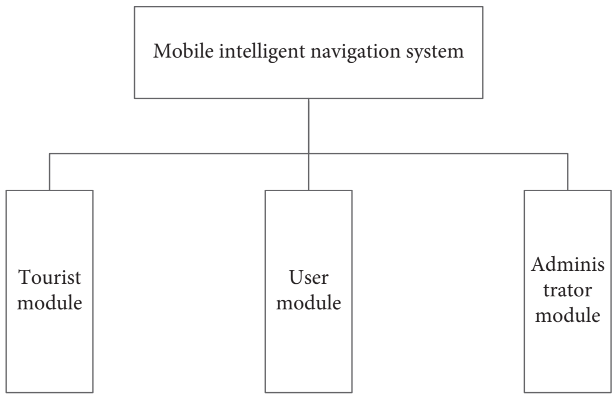

Figure 1: System role module.

3. Overall Design of the System

3.1. Overall Technical Architecture. The smart navigation system adopts the three-tier architecture, where the whole business is divided into the user interface layer, business logic layer, and data access layer. The purpose of hierarchy classification is for the idea of "high cohesion and low coupling." The three-tier architecture model can promote standardized development, improve the reuse of logic in the hierarchy, make the structure clearer, and greatly reduce the maintenance cost and maintenance time during the later maintenance [8].

From the perspective of software structure hierarchy, referring to the three-tier architecture idea, the overall architecture of the mobile intelligent navigation system can be divided into the basic platform, data layer, logic control layer, and user interaction layer from bottom to top, whose overall framework is shown in Figure 2.

As shown in Figure 2, the mobile intelligent navigation system studied in this study mainly includes four levels [9]:

(1) The basic platform mainly provides the support of the underlying physical environmental platform for the system;
(2) The database system provides good conditions for data information management of scenic spot data;
(3) The logic management layer provides the logic application and realization of the four basic functional modules in the system;
(4) The visual interface is the concrete realization of the view layer, which is a convenient operation interface for users. In addition, the standards and norms of systematic security provide safety-related guiding principles for systematic design. According to specific business requirements, it is clear that the main modules of the mobile intelligent navigation system include user management, information browsing, recommendation of scenic spot, management of scenic spot, and background management.

3.2. Design of Functional Structure. The smart navigation system receives travel information from travel agencies, tourist attractions, tourists, and other travel agencies or individuals through the internet, and combines and classifies the received information from other departments such as hotels for information data processing. Therefore, it can provide services for relevant departments of tourism. The smart navigation system should include all related tourism industries with many aspects. For example, a tourist district should provide regional information and manage this information accordingly. Moreover, travel agencies must provide tourists with relevant information such as tourist hotels and update these data in time to ensure that the relevant information is updated in real time. On the whole, the overall functional structure of the mobile intelligent navigation system is shown in Figure 3.

4. Design of the Mobile Intelligent Navigation System

4.1. Design of the Registration and Login Module. The design of registration and login makes users obtain independent identity authentication in the mobile intelligent navigation system. User registration and login mainly have the following basic functions:

(1) All users need to register with their user names and passwords first, the system administrator will audit the user information, and the user names and passwords will be automatically saved after the approval. During the registration process, they need to enter your real user name and mobile phone number;
(2) After successful registration, the users can log in to the system by entering the user name and password, and the password can be modified and saved. In the process of password modification, the new password is mainly modified by inputting the registered mobile phone number and SMS verification.

The process of judging the legitimacy includes two steps: step one, checking the correctness of the input data after users input the account number and password, which cannot be empty or contain specified characters; if the initial data are checked, the second step proceeds, where the system will call the database to find all user tables, and check whether the ID account exists and whether the passwords are consistent. After the system is opened, the login window page is loaded on the homepage, and the system calls the designed CSS, JS, images, and other files to make the overall layout of the page and create the form of the login window. After sending the login request on the login.jsp page, the system calls the doPost of the mainCtrl class under src to verify it [10, 11]. When the system determines that the accounts and passwords are correct, the system will jump to the home page. The flowchart of login is shown in Figure 4.

4.2. Design of the User Management Module. This module is divided into the background information management service module and the front register service module, which provides the function of assigning permissions to different users. The register service module is further subdivided into

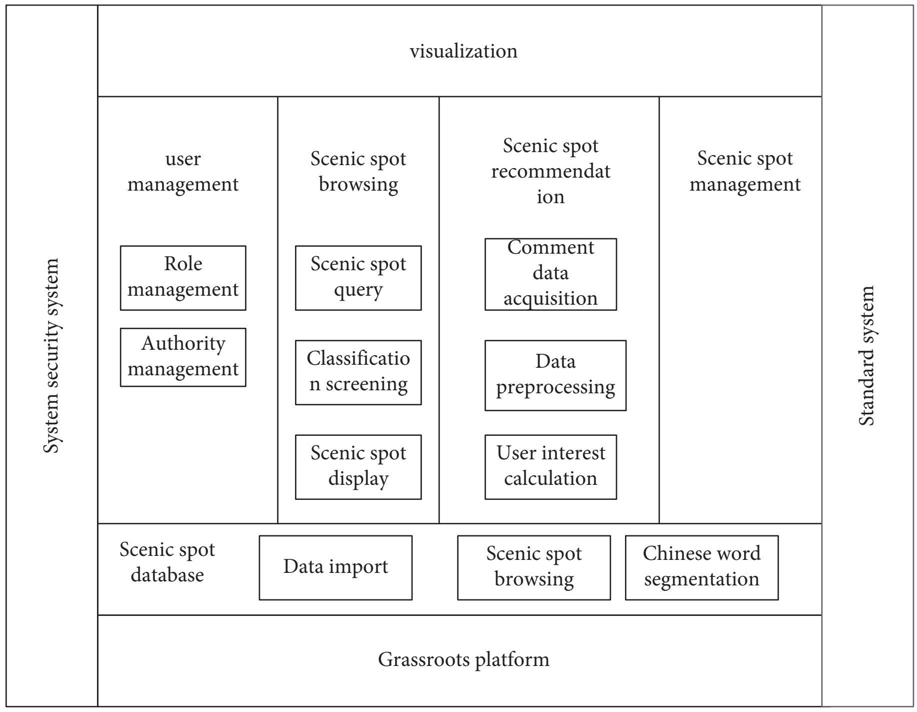

Figure 2: Overall framework of the mobile smart navigation system.

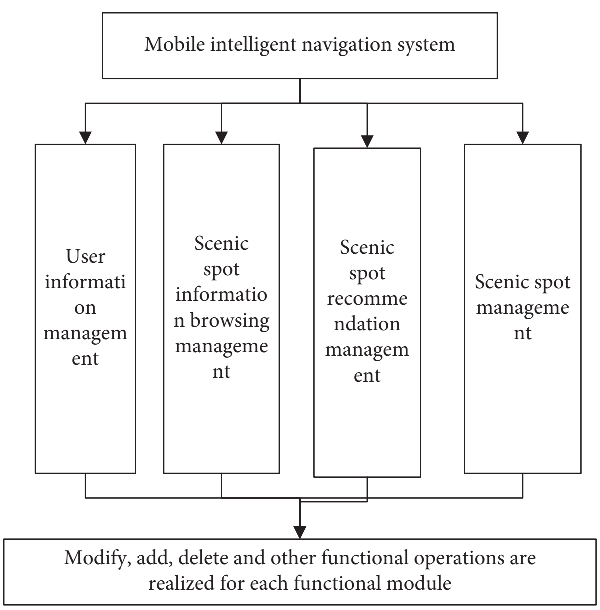

Figure 3: Overall functional structure of the system.

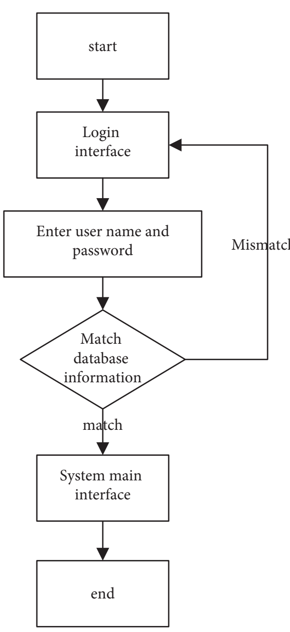

Figure 4: Flowchart of the login module.

subfunctions of service-registered user information and service administrator. The information service of the registered users can complete the search and processing of tourism information registered in the front system, while the information service of administrators can be realized in the functions of adding administrators, modifying, and deleting management in the background. As shown in Figure 5, when the system runs, it will determine the user's role and the user's authority according to the user information logged into the system.

When the users input the correct accounts and passwords, they will enter the background system where the main interface displays the current registered users and provides the function of "Change Password" to help users change their login password.

4.3. Design of the Scenic Spot Information Browsing Module. Considering the congestion of scenic spots caused by the large tourist flow during the peak season, tourists may be

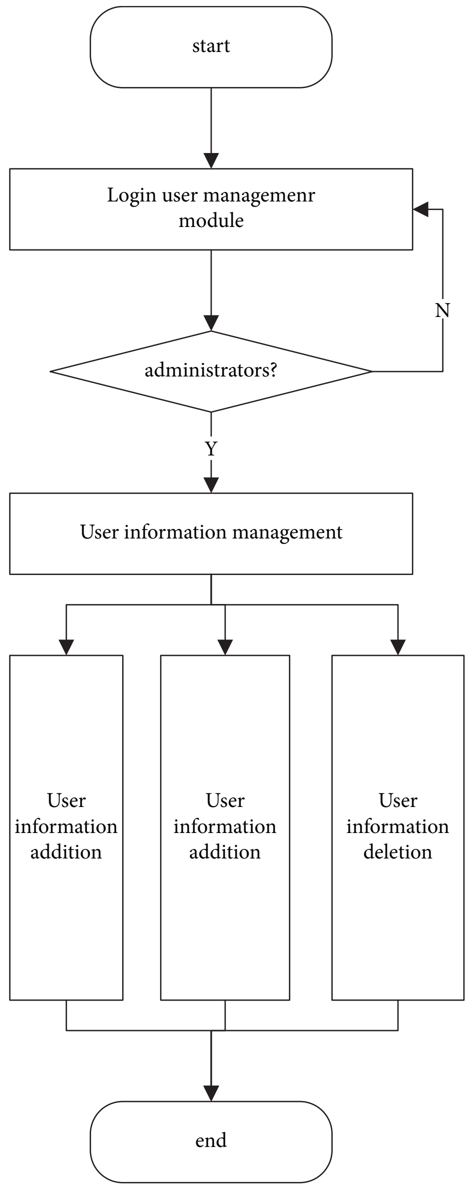

Figure 5: User information management module structure.

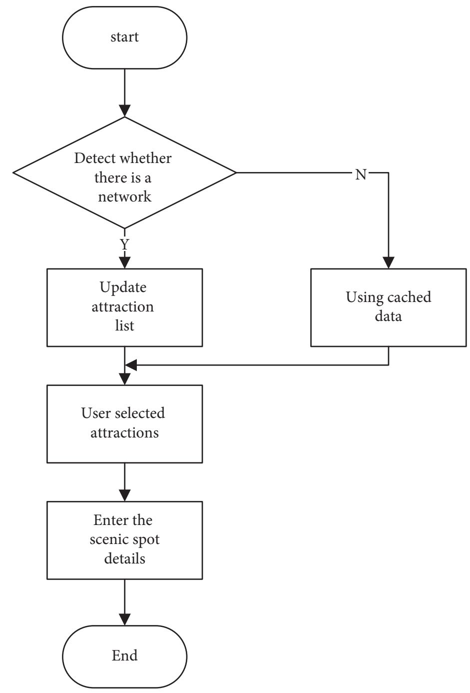

Figure 6: Flowchart of scenic spot browsing.

unfamiliar with the scenic spots. Through the location service of scenic spots, tourists can be clear about their current location and the distance from the target scenic spots. Moreover, the system can also provide information on the nearby scenic spots according to the current geographic location of users. After selecting the attraction and route, users can use the navigation function to reach the destination.

The basic flow of scenic spot browsing is shown in Figure 6.

(1) After the mobile intelligent navigation system is started, it automatically detects whether there is a network
(2) The mobile intelligent navigation system updates the scenic spot information resources according to the user's network situation (automatically cache scenic spot resources under Wi-Fi network and update in real time under 3 G/4G network)
(3) After selecting the target scenic spot, the user will enter the page with a detailed introduction of the scenic spot

When the user enters the map interface, that is, after the Maps Activity is started, the system will automatically load scenic spot information and add layers to the map as scenic spot marks. The main steps of this process are as follows:

(1) We start the get Spot thread to automatically load the scenic spot layer.
(2) We call the get Spot Geo () method to query the coordinate information of all scenic spots in the scenic spot where the user is located, and then, the server returns the result of the coordinate position.
(3) We call the add Spot Layer () method and load the scenic spot layer on the map with the position coordinates obtained in the previous step as parameters, that is, add a marker to the map for each scenic spot, and add Spot Layer () to return the center position of the map.
(4) We display in the client map interface, and the process of obtaining scenic spot information ends. At the same time, when the user turns on the GPS switch, in order to ensure that the system can get the user's location in time, the system sets to capture the user's location information every 10S. The city Timer Task is a timer class for obtaining coordinates, and the geographic location information of users will be obtained once every 10S from the 1S start-up delay of the app [12].

The main codes are as follows:

```
timer = new Timer();
timer.schedule(new city Timer Task(),1000, 10000);// Once every 10 1
```

4.4. Design of the Scenic Spot Recommendation Module

4.4.1. Process of Recommendation. According to the above analysis, the scenic spot recommendation module is the core module of this system, which is used to calculate the user interest vector and generate the list of scenic spot recommendations for users according to the user interest vector. As can be seen from Figure 7, first, we read the user evaluation records of tourist attractions in the database. If the browsing record is blank, a list of scenic spot recommendations is generated for the user according to the scenic spot popularity; while if the browsing record is not empty, the evaluation record and browsing record are segmented, the user's interest words are extracted from the comments, and the user's interest vector is calculated by using the interest words. Subsequently, the vector is input into the recommendation model to get the recommendation probability of each scenic spot. Finally, the scenic spots are sorted according to the recommendation probability to generate a recommendation list. The process of the scenic spot recommendation module is as follows:

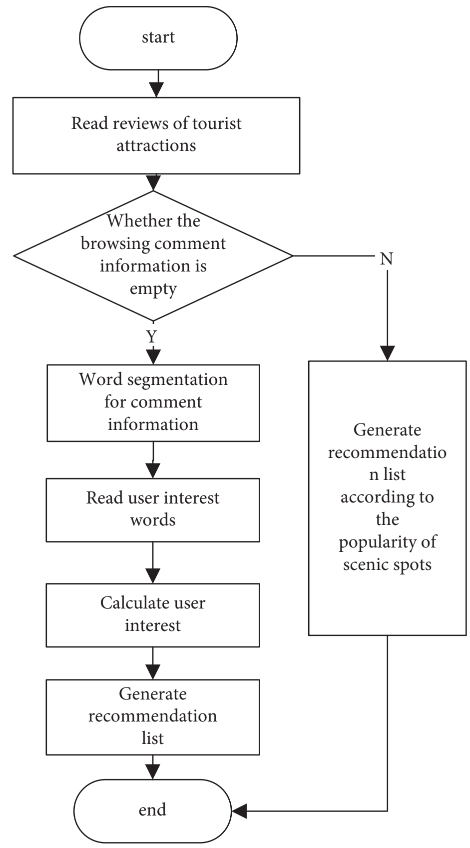

Figure 7: Flowchart of scenic spot recommendation.

4.4.2. Construction of the Recommendation Model. A tourism information recommendation module is designed for tourists, which mainly combines the relevant comment information of tourism websites, and a tourism recommendation algorithm is put forward based on user interest and deep learning from two angles of user rating and comments, so as to formulate a reasonable personalized recommendation for tourists' travel and provide a reference for their selection.

By preprocessing the data, various vectors are obtained. As the input of the network, these vectors can be regarded as various information representations of users and tourism services. After calculation, each part will output a set of low-dimensional dense spatial vectors, which can be regarded as further abstract descriptions after feature extraction. In order to make the features extracted from the three parts, an interaction layer at the top of the three part networks is added to combine the features extracted from the three parts to make the final score prediction. In this study, the factor decomposition technology is used to construct the model function, and the items are scored and predicted on the interaction layer. The interactions between various vectors need to be learned, and they can be used to predict scores for target items; therefore, a factorization machine is selected to manage it. Figure 8 shows the structure of the recommendation model constructed in this study.

This method is based on the interest word set, and combined with the lexical vector model, the average vector can be obtained by calculating the user interest vector. Then, the user interest vector is transferred to the convolution layer to extract features, because the user interest vector is a one-dimensional numerical vector, and the convolution operation here is one-dimensional convolution, which is shown in the following formula:

$$c_i = f\left(w \cdot X_{i,i+h-1} + b\right). \quad (1)$$

where Ci is the ith characteristic value in the characteristic graph; f is convolution kernel function; $w \in R^h$ is a filter with sliding window width h; B is the offset value; and $X_{i,i+h-1}$ represents the local feature vector composed of i to $i+h-1$ columns. Therefore, the obtained feature vector C is as follows:

$$C = \left[c_1, c_2, \ldots c_{n-h+1}\right]. \quad (2)$$

As shown in Figure 8, the f factor decomposition model introduced earlier connects the networks of three parts through a so-called interaction layer, and the features extracted from the networks of the three parts are sent to the interaction layer. In this process, the factor resolver further calculates the three parts, thus completing the score prediction. Similar to the second-order f factor decomposition, the obtained function is shown in the following formula:

$$y = \widehat{w_0} + \sum_{i=1}^{|\widehat{z}|} \widehat{w}_i \widehat{z}_j + \sum_{j=i+1}^{|\widehat{z}|} \langle \widehat{v}_i, \widehat{v}_j \rangle \widehat{z}_i \widehat{z}_j. \quad (3)$$

Here, the feature vector x_u obtained through the user comment, the feature vector x_i obtained through the tourism

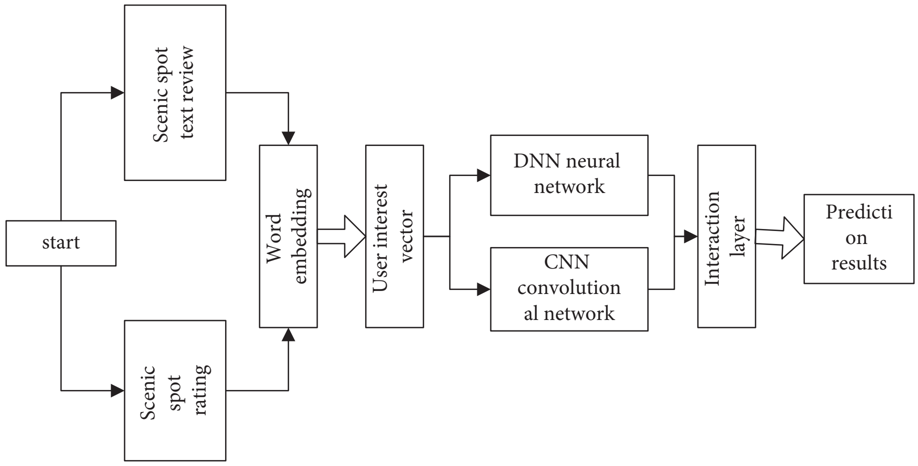

Figure 8: Structure of the recommended model.

service item comment, and the feature x_0 obtained through other information networks are linked to form a single vector, which is recorded as $\hat{z} = (x_u, x_i, x_0)$.

On this basis, the structure of the depth prediction model is proposed, that is, a multinetwork coupled neural network model. When the whole model propagates forward, the predicted value of the output can be obtained. In order to further analyze how the model updates the network parameters according to the error between the predicted values of the nodes and the values of the standard output, it is necessary to introduce the objective function of the model.

Through formula (3), it can be seen that the output of the model is a real numerical value, which represents the predicted value of the user's rating on the tourism service items. y is set as the standard output, which indicates the user's true score of the project; at the same time, $\hat{y}$ is set as forecast output, the user's rating is predicted, and then, the error is calculated by $\hat{y} - y$, so a single sample can be defined with the following loss function:

$$L(\hat{y}(x), y) = \frac{1}{2}(\hat{y} - y)^2. \quad (4)$$

The purpose of adding 1/2 is to simplify the gradient form of the objective function. For the whole training set, after adding regular terms, the objective function is set as follows:

$$E_N = \frac{1}{N}\sum_{i=1}^{N} L_i(\hat{y}(x), y) + \frac{1}{2}\sum_{\theta\varepsilon\Theta}\lambda_\theta\theta^2. \quad (5)$$

Therefore, the optimization is transformed into a solution of $\Theta^* = \text{argmin}_\theta E_A$, that is, finding the solution Θ^* in the parameter space, so as to minimize the overall objective function.

After training the network model with the optimization algorithm above, the vector information of tourism service items and users can be input into the network model, and the trained network model can get the predicted scores of users for the tourism service items and sort them according to the scores. Afterward, the top N tourism service items with higher scores are recommended to users, which generate personalized recommendation lists and complete the recommendation.

4.5. Design of the Scenic Area Management Module. The scenic spot management module can manage the information of the local scenic spot, the foreground can query and view the information of the scenic spot, and the background can query, add, modify, and delete the information. The specific structure is shown in Figure 9.

The application value of the scenic spot management module is that when managing the information of tourist attractions, it can quickly add the information system about tourist attractions, at the same time, manage the relevant information, and contact the database. The information about tourist attractions is stored in the time information database where users from external systems can view the information of tourist attractions that is timely and conveniently added and updated by the second-level administrators.

The function of adding information about scenic spots is also a function in the background system, which is operated by tourism practitioners with administrator authority. The operation flow is shown in Figure 10. First, users need to fill in the name of the scenic spot where the primary key is in the database, and no duplicates are allowed. When the scenic spot information is verified, they can fill in the information about scenic spots such as introduction and location. Subsequently, the information is saved, and the newly added related information about the scenic spot will be stored in the database. Visitors can query the information through the foreground interface of the tourism information management system.

The scenic spot management module mainly introduces the various tourist attractions in detail. The scenic spot introduction module mainly includes the following parts: adding scenic spots, replacing scenic spots, and removing scenic spots. The display of the scenic spot module should include the list of scenic spots and the display of scenic spot objects. After selecting the attraction resource management menu, the current attraction information list will be

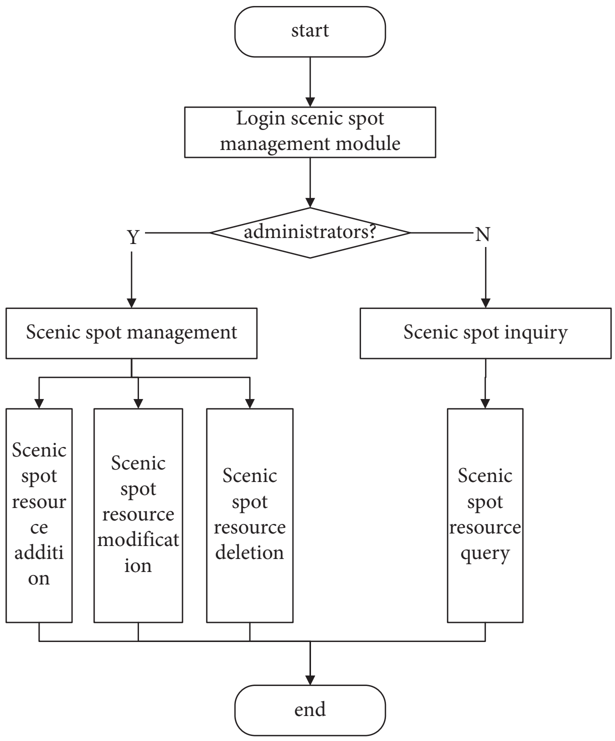

Figure 9: Structure of the scenic spot management module.

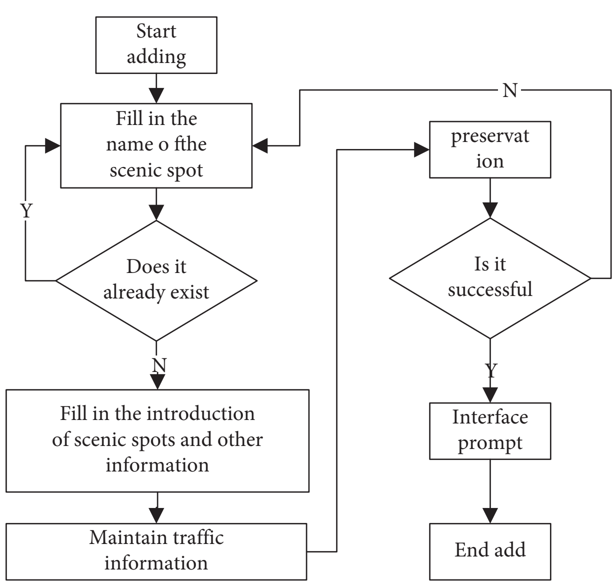

Figure 10: Flowchart of adding scenic spot information.

displayed. Users can add new scenic spot information, or modify or delete existing information.

In addition, the scenic spot management module mainly displays the information to be stored in the scenic spot, including the name, location, contact number, painting level, theme, opening hours, information of scenic spot, and so on. The system completes filling in the location information of the scenic spot, and saves it after adding a new location or changing the existing information. If the saving is successful, they will be prompted "XXX scenic spot information has been saved successfully!"; otherwise, if saving fails, they will be prompted with "Failed to save XXX scenic spot information!". The saved information about scenic spots will be stored in the systematic database.

5. Conclusions

With the rapid development of computer and network technology, more and more industries have adopted advanced information technology to manage industrial information. In this study, Xi'an Qinling Wildlife Park is taken as an example, and the mobile intelligent navigation system of Xi'an Qinling Wildlife Park is designed and implemented, which is realized under B/S mode, and has excellent practicability and operability. Moreover, it can not only improve the management efficiency of tourism management departments but also advance the operation efficiency of tourists, thus promoting the development of tourism in Xi'an Qinling Wildlife Park.

Data Availability

The dataset can be accessed upon request to the author.

Conflicts of Interest

The author declares that there are no conflicts of interest regarding the publication of this paper.

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