Design and Implementation of Smart Travel System Based on Android

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Abstract: With the rapid development of the mobile GIS, LBS and its extended application bring lots of convenience to people's life. Under such circumstances, using LBS mobile applications to do travel itinerary planning has become a popular new trend. However, existing LBS systems can only mechanically recommend one kind of tourist attractions at the same time and do route planning from one attraction to the next, which is very inconvenient and cumbersome. To revise this defect, this paper develops a smart travel mobile electronic map system based on android. Besides the traditional functions such as real-time positioning, this system can intelligently recommend the tourist attractions which the users may be interested in due to the relevant information input by the users. At the same time, it can also provide the overall route planning among these attractions, as well as the weather conditions during the tour, which realize the intelligent planning of travel itinerary.

Key words: Location-based services, mobile GIS, overall route planning, travel itinerary planning.

1. Introduction

With the development of mobile Internet technology, people's travel is increasingly dependent on Google map and other mobile electronic maps. In the meantime, with the rapid development in wireless communications and spatial positioning technologies, the location-based services (referred to LBS) has become a "killer application" in mobile data services [1]. In this context, various types of mobile GIS services based on LBS came into being.

Path navigation and route planning is the most widely used function in LBS - based mobile GIS service. Users usually only need to input their destination, and the relevant system can automatically generate an optimal route planning for them, which is convenient and quick. However, when the user is in an unfamiliar region, such existing single route planning from the current location of the user to the target location is cumbersome and very hard to control.

For example, when the user is traveling, his target location is often unknow and it's hard to make a choice. In this case, users need to spend lots of time choosing their destination and doing a reasonable route planning, which means they need to use the traditional single route planning service time and time again and never get a nice user experience. Beyond that, obtaining more real information of tourism destination is one of most concern for tourists [2]. So, in a mobile travel system, data acquisition, integration and display are also very important and need improving.

The current trip planning practices apparently lack the integration of location information of various aspects of the trip [3] and due to that this paper developed a smart travel mobile electronic map system based on Android, which realizes the intelligent tourist attractions recommendation and the overall route planning. The main interface of the system can be viewed simply as a tourist map, which can be dynamically generated according to a wider range of variables from user preferences and interests [4]. Compared with previous methods, this system not only solves the cumbersome problem of traditional "point-to-point" route planning in multi-point case, but also improves the acquisition, integration and display of multi-source data, which greatly enhances the use experience of travelers.

Next, we will introduce this system in the following order. We will discuss the comprehensive analysis of this application in Part 2. Then we go to Part 3 to introduce the specific implementation method of each part of the whole system in detail. In Part 4, we summarize the research work of this paper and look forward to the future research.

2. Application Analysis

This paper focuses on related data crawling, data analysis and display and smart attractions recommendation and overall route planning.

2.1. Development Model

The software uses the Java language implementation, calls the Amap API to build the application framework, and uses Android Studio as the developed IDE. It can provide the smart attractions recommendation and overall route planning service based on the geographic information and location services.

Android mobile operating system is based on the Linux kernel and is developed by Google. This operating system is one of the most widely used mobile Operating System these days [5], and Android Studio is the official integrated development environment (IDE) for Google's Android operating system ,built on JetBrains' IntelliJ IDEA software and designed specifically for Android development [6].

Amap open platform provides a large number of SDK development kits, including map SDK, positioning SDK, navigation SDK and so on. Developers can freely choose and use a variety of API interfaces in these SDK environments to easily implement various LBS.

2.2. Research Content

2.2.1. Experimental data acquisition

The software involves a large amount of data and a large number of data types, which can be divided into two main categories, the map data and other relevant data. Specific include the geographic information data of tourist attractions, travel route data, tourist information data of attractions and weather data. The geographic information data of tourist attractions and the travel route data come from the Amap online resources. The tourist information data of attractions is gained from TripAdvisor by Jsoup, and the weather data is mainly JSON data from the network. In the meanwhile, our software can automatically locate the starting point of the overall route planning and move the center of the screen to this point, which ensures the best user experience.

2.2.2. Acquisition of weather information

As a new LBS mobile application whose main function is travel itinerary planning, it's necessary to take the daily weather conditions during the trip into account. After all, no one will like to travel in bad weather. Nowadays, weather forecasting is no longer a sophisticated technology, and the weather data available online is rich, varied and accurate, so what we need to do is find the API on the internet and get the target city's city number. In this paper, we have gained the weather's JSON data by the method described above, and analyze it by its format, which can give us plenty of weather information. Now it's time to think about how to display weather condition in a reasonable way. To solve this question, we decided to work on the layout of this application, place a small weather icon at the top right of the map interface, which is small enough that will not block the main information displayed on the map and also big enough that can give users eye-catching reminder. This method makes a combination of weather data and the base map, and enables the organic integration of multivariate data.

2.2.3. Smart attractions recommendation

As a smart travel mobile electronic map system, this paper provides the users with intelligent recommendation of the tourist attractions due to the information input by the users. Users don't need to make any effort to get familiar with the tourist destination, and what they should do is just consider their favorite attractions' type and tell us through the input. Afterwards, we will give them what they want.

According to the users' input information such as travel destinations and attractions preferences, we can do the next series of operations. First of all, we crawl the target city's city number through Jsoup, which can give us the unique identification of the target city. Secondly, according to the city number, the days of travel and the users' attractions preference, we can get the recommended attractions through the crawler technique and evaluation screening. Finally, based on the above information, we can make intelligent planning for users' daily travel arrangements, including the attractions' information and the overall route planning. In the best of circumstances, the users will be arranged to visit as many attractions as possible, which can ensure the users have the best travel experience. In the meanwhile, users can make their own specific travel plans more easily according to our arrangement.

2.2.4. The overall route planning service

With the rapid development of the LBS technique and the increasing demand of people, route planning service has become an indispensable function of mobile GIS system for people's travel itinerary planning. However, the existing LBS systems can only do a single route planning, which means when you have multiple locations on your route, this kind of system can't provide a convenient enough service. To correct this defect, we provide our users with the overall route planning service on the basis of the intelligently recommended attractions' geographical information data we discuss in the section 2.2.3. According to the attractions' geographical information data and the starting and ending points users have input, we can analyze and gain their location information such as longitude and latitude and mark them on the map by some intuitive symbols and the path sequence number will also be shown. Then we use the corresponding route planning algorithm for the overall route planning among these target points. The results of overall path planning are marked in the map with lines in different colors between different tourist attractions, which is very clear and intuitive. Considering that the information shown on the map is not specific and detailed enough, we also use the text to show each step of our travel arrangements, which realizes the combination of intuition and concreteness. This overall route planning service is the core of this paper.

3. System Design and Implementation

3.1. Systematic Architecture Design

Model View Controller (MVC) is applied to design this system. The system consists of one MVC mode, called system overall mode. Controller Accepts input and converts it to commands for the model or view [7]. In addition to dividing the application into these components, the model–view–controller design defines the interactions between them [8].

The View consists of one table and a listview, the map view and the table view. The map view is used to display the the map and route among labelled attractions. The table view is responsible for enumerating the public transport information. ListView is a class in Android, and MapView is a class in the Amap API.

Model is the central component of the pattern. It is the application's dynamic data structure, independent of the user interface [9]. The Model is formed by two main models, namely SRArray and TIArray. SRArray stores the recommended attractions and route information among the attractions. TIArray stores the Bus information between scenic spots, which includes starting station, destination and the number of the bus.

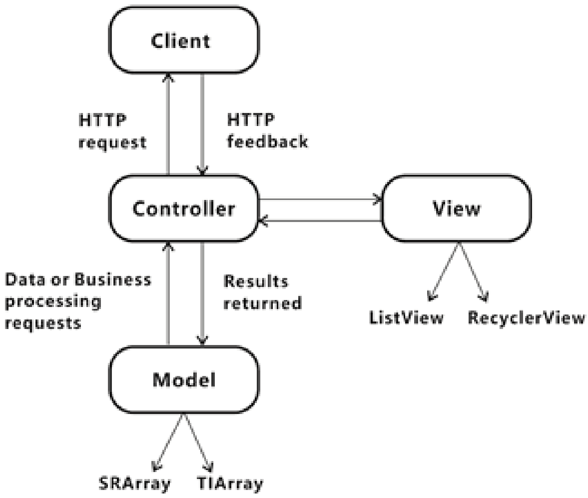

Fig. 1. system architecture.

3.2. Requirement Analysis

Today's electronic applications are user-oriented, serving people everywhere, known as Egocentric. Therefore, the development of a new tourism planning software is widely expected. People don't want to make inquiries about the attractions nor the weather. At the same time, they do not want to plan the route between the tourist attractions, either. Therefore, based on the requirement, we have developed the system in this article.

3.3. Logical Design

The mobile GIS system focuses on four parts, data acquirement, data organization, data analysis and data visualization. So, the whole system can mainly be divided into the above four logical parts. The data acquirement is the cornerstone, which means without this part there is no subsequent part. The second part is about the data organization. Due to the fact that this system involves a large amount of data and a large number of data type, an excellent data organization will greatly increase the subsequent processing speed. Data analysis and processing is the third part of logical design and the most core part of a mobile GIS system. This part is mainly about how to use the preprocessed data reasonably and effectively. Based on such data, what analysis can the system perform and what functions can it achieve directly determines the level of the system. Data visualization, the last part, is about how to present the processed data in an intuitive way, which directly affects the user experience.

3.4. Data Design

3.4.1. Data acquisition

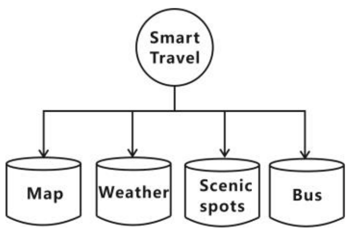

Fig. 2. Data overall organization.

In computing, JavaScript Object Notation (JSON) is an open-standard file format that uses human-readable text to transmit data objects consisting of attribute–value pairs and array data types (or any other serializable value) [10]. The weather data used in this article is the JSON weather data imported from the Internet. After obtaining the URL of the weather data, it is necessary to establish relative classes and attributes according to the format of the acquired JSON data, and use class jsonObject and Java library function Gson() to parse the data. Finally, we obtain the weather data.

The map SDK of Amap provides 2D and 3D map data, which can be freely selected by developers according to their needs. This article USES the developer package for 3D map V6.8.0. After downloading the SDK on the Amap official website, we first introduce the package in the IDE, then establish the libs folder in the app directory, and introduce the. Jar package into it. Next, we create a new jniLibs folder in the Java directory, and introduce the. So, file into it. Finally, click Sync button to register it and complete the introduction of map development kit.

Jsoup is an open-source Java library designed to parse, extract, and manipulate data stored in HTML documents. After retrieving the URL of different cities, Jsoup can be used to crawl the content of the web page. The connect() function is used to establish a connection with the city URL, and then select() and getElementsByClass() are used to get various Elements objects of different types. Finally, the properties of the Elements object are parsed to get the final scenic data.

3.4.2. Data organization

This paper covers three sets of data, the weather data, the tourist information data of attractions and the bus route data.

Because the weather data's type is JSON. In the associated JSON file, it already has a nice data structure. So, we simply followed the data structure of its own JSON file in the process of class definition.

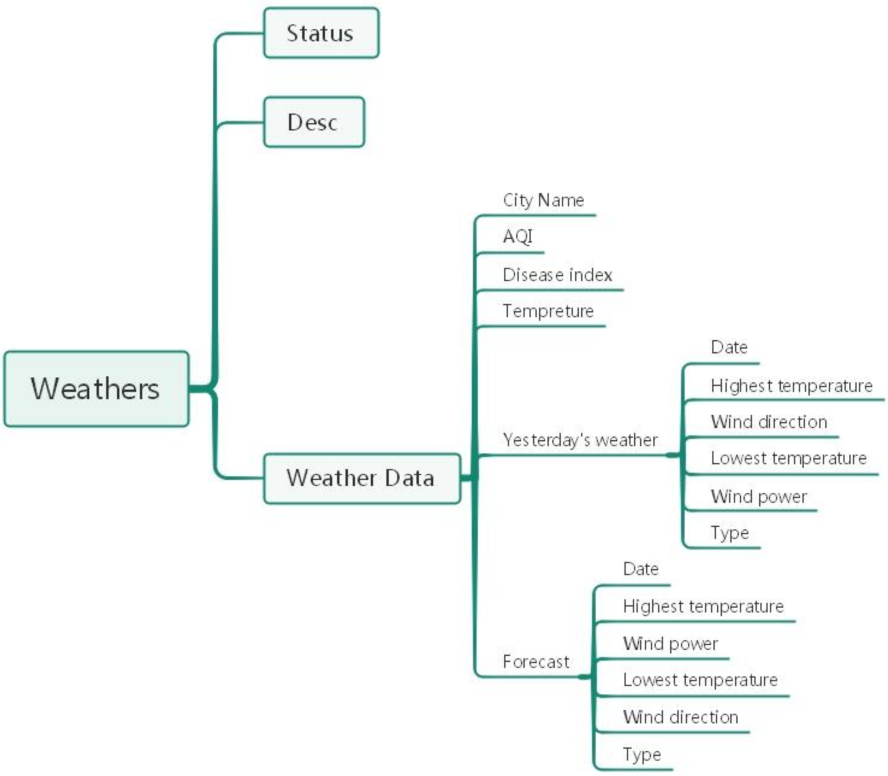

Fig. 3. Structure of weather data.

Considering the subsequent analysis and visualization, we organized the data of tourist attractions as follows. A single tourist attraction is a Scenic object, and one object contains all necessary data and operations. In addition, scenic, city name and travel time are attributes of the city.

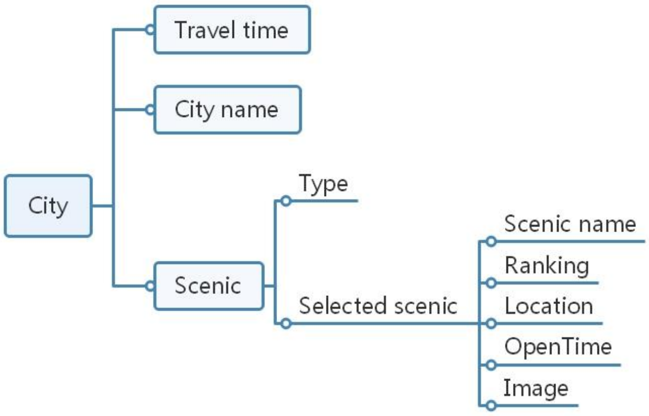

Fig. 4. Structure of scenic data.

The processing of bus information is particularly important in the realization of this system, so we designed the following structure to store it. First, we use the class Route to store the basic bus information, which contains the starting station name, the ending station name and the bus route. Because sometimes one bus can't go straight to the destination, we build the class RouteSet, which contains an array containing the class Route. This structure can complete the encapsulation of bus information from one point to the next. Finally, we build an ArrayList in the main class and complete the organization of all route data.

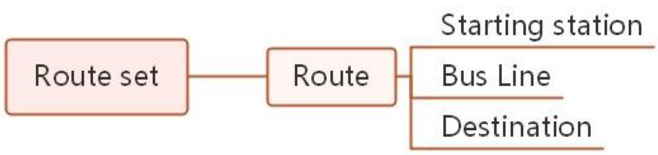

Fig. 5. Structure of bus line data.

3.5. Functional Design

Mobile GIS system mainly contains five levels of functions. Each level deepens the functions of the previous level, which can be regarded as a functional leap. These five levels of function are: browsing, querying, Labeling, analyzing and modeling. The system developed in this paper covers the first four functions, and the whole system framework is also built around these four functions. Next, we will introduce the specific embodiment and implementation of these four functions in this system.

3.5.1. Browsing

Browsing is the most basic function in the system, there is no mobile GIS system without map browsing. Since the map data has already been acquired in the data acquisition stage, the next step is just to display the map data in the package. The specific steps are instantiating the Amap in class MainActivity, and add the map control to the XML file to match specific objects. Then we call the function getMap(), which can complete the map browsing function.

3.5.2. Querying

Querying and browsing are both basic functions of mobile GIS system, but querying is one level higher than browsing. In this paper, the system querying function includes real-time positioning query and the keyword query, which actually refers to querying the longitude and latitude coordinates of the tourist attractions and the real-time position of the users. It is mainly implemented by the API interface of Amap, called GeocodeSearch. According to the string of the location input by the user, the longitude and latitude coordinates of the corresponding location can be obtained to facilitate subsequent positioning and path planning. First we instantiate the class GeocodeSearch and set its Listeners. Afterwards, instantiating the class GeocodeQuery and calling its function getFromLocationNameAsyn(), which inputs the query as a parameter. Finally, we complete the analysis of the response result in class onGeocodeSearched, and obtain the longitude and latitude coordinates of the starting point, ending point and tourist attractions.

3.5.3. Labeling

Labeling is a special function in mobile GIS system. The labeling function of this paper is mainly to mark the starting point, ending point and tourist attractions in the map, which is convenient for users to view and provides better visual experience, and the implementation of such function uses the API provided by the Amap open platform. To be specific, inputting the points' geographic information and the related map symbols as the parameters, we can realize the visualization of map labeling.

3.5.4. Analysis

Analysis belongs to a higher level in the thematic function of mobile GIS system, and generally also belongs to the absolute core function in the system. The analysis function of this paper is mainly reflected in the following aspect: using intelligently recommended tourist attractions data to make an overall route planning. This service's implementation also uses the API provided by the Amap open platform, and mainly includes the following steps. First instantiate the class mRouteSearch and set the listener. Then input the starting and ending points' coordinate information as parameters to the class BusRouteQuery and call the function calculateBusRouteAsyn() to startup the route calculation. Finally, we can gain the route calculation result through the object of onBusRouteSearched and finish the overall route planning.

3.6. User Interface Design

As the system developed in this paper is mainly intended for academic research and innovation, it has no commercial use for now. So, we don't have a sophisticated user interface design, what you see is all test version of this system. We have three main user interfaces in this system, the first is used to gain the user's basic travel information such as the time, tourist destination and the type of attractions they may like. The second is used to gain the geographic information of the starting and ending points, combined with the recommended tourist attractions information for the overall route planning. You can also gain the weather information from this interface and prepare beforehand. The third interface is about the detail of our overall route planning so that you can make your own arrangement quickly according to our service.

3.7. Functional Demonstration

According to the above description of functional design and implementation methods, we complete the development of this APP and implement most of the functions. We will follow the steps below to demonstrate our APP.

3.7.1. Get basic information

In the first user interface, users can input the basic information about their trip, such as the time, the destination and what kinds of tourist attractions they may like. The interface is shown in Fig. 6 below.

Fig. 6. Get basic information.

3.7.2. Overall route planning function

After the users input their basic information and click on the button "FINISH", they can enter into the second user interface, where they can gain their current location. Then they can input their starting point and ending point and push the button "START PLANNING", the system will start the overall route planning service among tourist attractions recommended intelligently. Figure. 7 is a demonstration of the service results.

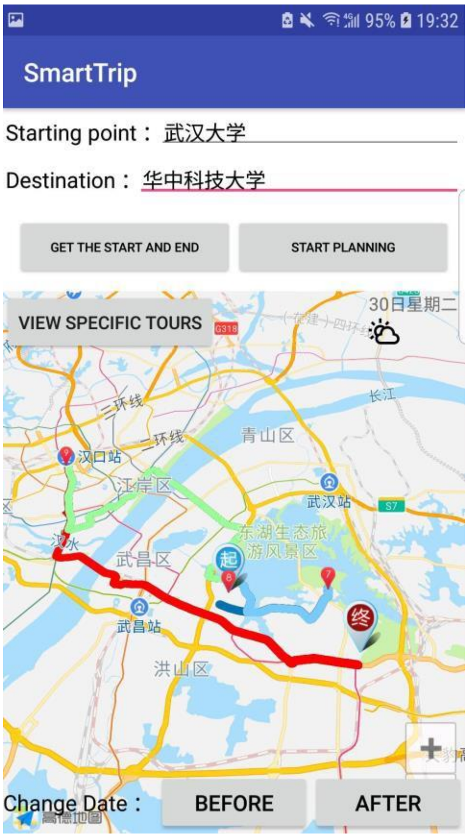

Fig. 7. Overall route planning.

If you want to get a preview of the schedule for the next few days, you can click on the button “AFTER”. The system will dynamically generate your next schedule.

3.7.3. Display in detail

The above interface may not be intuitive enough, then you can enter into the third interface by click on the button “VIEW SPECIFIC TOURS” and you will gain the details of our route planning results. As is shown in Fig.8. It displays all the necessary information, including the travel time, transportation routes and so on.

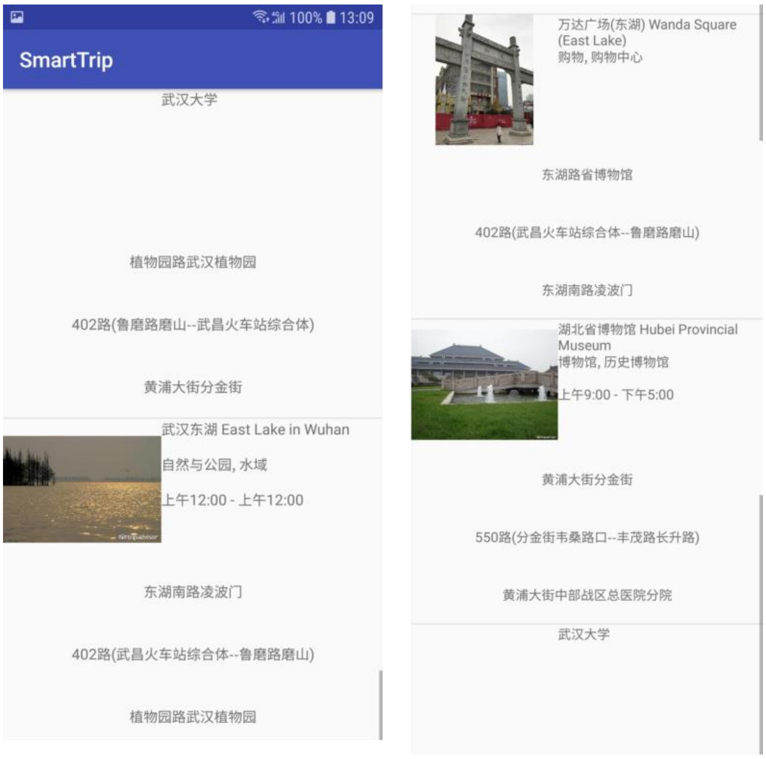

Fig. 8. Display in detail.

4. Conclusion

The system uses Jsoup crawler technology, combined with the Amap map development kit, using Android Studio 2.2 as a development tool using Java language, which can realize the smart recommendation and intelligent route planning application system. The system in this paper is on trial and updates, which improves the ability of data acquisition by using Big Data Technology combined with Artificial neural Network Technology and Data mining Technology, which makes it more in line with the user's preferences. Real-time route planning combined with AR technology provides users with more excellent real-time route.

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