Design and Implementation of Location Analysis System for Mobile Devices

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Abstract. With the rapid development of Internet technology and the rapid spread of mobile devices, mobile devices have become an indispensable tool for people today and store a large amount of user's private information. The use of mobile devices for fraud, illegal transactions, dissemination of rumors, and the spread of Trojan horse crimes and other criminal activities are increasing, which has a serious impact on social stability. Therefore, how to locate the suspect's geographical position and narrow the scope of arrest become particularly important. Based on the principles of mobile digital forensics, this paper studies and designs a complete location analysis system for mobile terminal device from the perspective of data visualization.

Keywords: Mobile device · Digital forensics · Geolocation
Data visualization

1 Introduction

Foreign digital forensic research began in the 1970s and continued to develop in the 1990s and then became mature. Relative to the progress of foreign research, the research on domestic mobile digital forensics technology started late and is still in the development stage. For the time being, there are no standardized forensic procedures and scientific forensics systems, and there are no comprehensive laws and regulations on digital evidence forensics. In recent years, with the continuous improvement in the status of electronic evidence in the judiciary, some domestic government research departments, university research institutes, and corporate research departments have begun research on smart mobile terminal forensics-related technologies, and the number of people investing in research has also rapidly increased.

With the memory capacity of smart mobile terminals is getting larger, more and more applications are installed, and the types of data formats are also increasing. This causes an increase in the workload of traditionally relying on manual search for digital evidence. Therefore, it is very important to develop effective mobile digital forensics tools. Mobile terminal equipment will generate a large amount of geographical location information in daily use. In digital forensics, the locational information can well reflect the trajectory of the behavior of suspects, and play a very important role in determining

and narrowing the range of activities of suspects and can provide important clues for forensic personnel.

2   System Related Technologies

2.1   NodeJS

NodeJS is an open source, cross-platform JavaScript runtime environment that can run JavaScript on the server side. As we know, JavaScript is the only standard for front-end development. NodeJS brings JavaScript to the development of back-end servers. Its greatest advantage is the use of JavaScript's inherent event-driven mechanism plus the V8 high-performance engine, making write a high-performance Web service easily. With the increasing popularity of NodeJS, NPM was born. NPM is a Node package management tool. It is the largest software registry in the world, with approximately 3 billion downloads per week and over 600,000 packages. Allowing users to download third-party packages written by others from the NPM server for local use, therefore NodeJS can greatly accelerates the efficiency of development.

2.2   Bootstrap

Bootstrap is an open source toolkit for front-end development designed by Twitter. It can help us quickly build the interface. Providing rich font icons, drop-down menus, buttons, navigation, carousels, and other various components designed to make the development of dynamic web pages and web applications easier. Its unique grid system allows Web pages to adapt to different resolution devices.

2.3   Tencent Map API

The Tencent Map open platform provides locational services and solutions for various developers. It provides components such as location display, route planning, and map selection points, markers can be displayed on the map by latitude and longitude information. By marking on the map, it is possible to display the suspect's geographic information.

3   Design and Implementation of Geographical Analysis System of Mobile Terminal Equipment

The geographical analysis system of the mobile device can be divided into two parts: data collection and data analysis. The collection client can collect data of mainstream mobile devices on the market, and the data analysis client can analysis data, filter data and visual data. Through the data acquisition equipment, the positioning data in each application can be obtained. The system only needs to visualize the position, latitude and longitude, and time stamp data in the positioning information table in the analysis system interface.

The system does not display all the data of the database directly, but needs to filter and classify the data in the database, such as the scope of activities for a specific time period, the visual display of geographical information of a specific App, and then visually shows the target suspect's detailed information for locating or navigating with an App during a certain period of time. The system uses Tencent map to display the suspect's mark. The overall process design of the system is shown in Fig. 1.
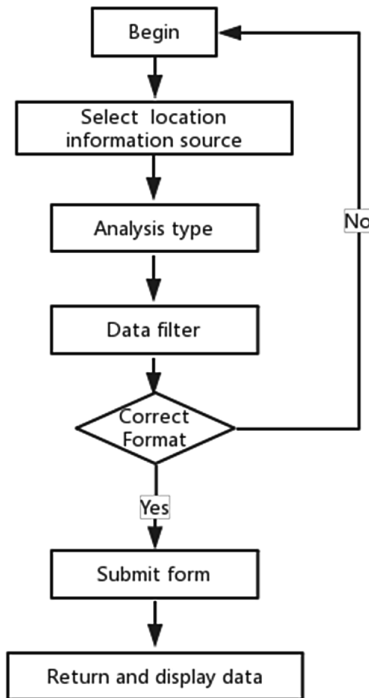
Fig. 1. Geographic analysis system process

The geographic location analysis system is mainly composed of client and server. The client needs to provide the selection of the geographical location information data source, statistical types, and data screening conditions to filter the data as follows:

– Choose geographical location information data source: Include some apps that can generate geographic location information. Baidu map, Gaode map, Tencent map, location information in Taobao, location information of photos are included in this system.
– Statistics Type: Contains navigation type and location type. The navigation type is displayed in the Tencent map as a line segment containing the start and end points. The location type is displayed as a marked point on the Tencent map.
– Start and end time: You can filter geographical location information according to start time and end time, and then display it through Tencent map.

The data submitted by the client is sent to the server via ajax. The server processes the data in the database and then returns data to the client for displaying. System function module diagram shown in Fig. 2:
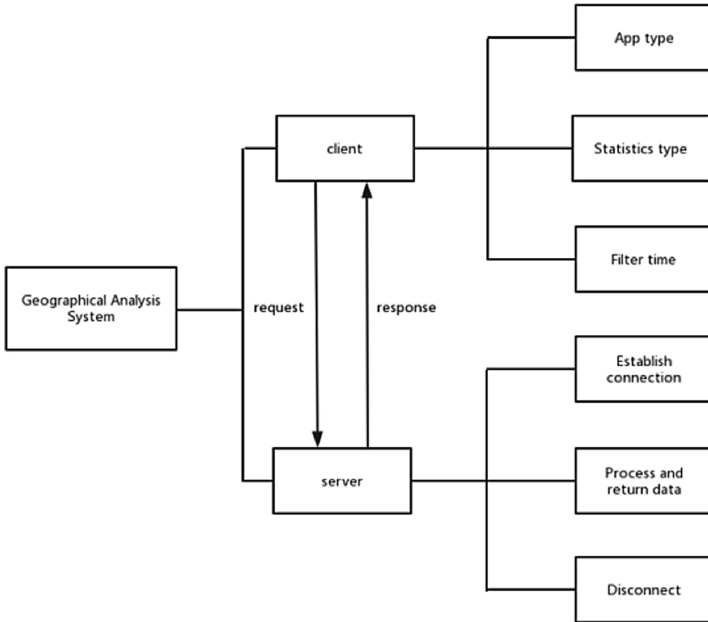

Fig. 2. System function module diagram

3.1 System Front-End Interface Design and Implementation

The web interface design of this system mainly uses the bootstrap framework. First, jQuery must be introduced before the introduction of bootstrap, because all javascript plugins of bootstrap rely on jQuery, and then introduce bootstrap through the free CDN acceleration service. According to the above functional analysis, the entire page is designed as a two-column layout: the bootstrap grid system divides the entire browser viewport into 12 columns, and it can scale the devices with different rates, which can be well performed on different devices. Run, the system uses the left 3 columns of the browser viewport as a conditional filter layout, from top to bottom as follows:

– Select tag creates a selection list with options. The selection list includes the data source and the type of statistics that generated the geographic location information.
– The DateTimepicker time selection control of bootstrap filters the data generated by the geographic location information in time.
– Button tag is used to submit form data to the server.

A set of buttons for manipulating the suspect's mark: including location query, display location, hide and clear tags.

The remaining 9 columns on the right are used to display detailed geographic information and Tencent map markers as follows:

– Datatables plugin of bootstrap is used to store the data returned by the filtered server. The table plugin contains the search box and sorting functions.
– The page loads the Tencent map by embedding the iframe and marks the suspect's geographical information.

The operational effect of the system is shown in Fig. 3:

Fig. 3. System operation result graph

3.2 Design and Implementation of System Front-End Logical Functions

The front-end logic functions of this system mainly include.

When the form is submitted, the selected conditions are recorded and the data is submitted to the server via ajax: The value of the select list can be obtained by setting the value, obtaining the start and end time of the DateTimepicker control, and submitting the data to the server. Then submit to the server through jQuery's $.ajax method and request the processed data, and convert the data into JSON format.

After the data submitted to the server is filtered, the data matching the conditions is returned to the front end, and the data is inserted into the Datatables table plugin. Then the data binding event for each row in the table, when the lines in table are clicked, the position information can be obtained such as latitude and longitude, the latitude and longitude information is passed as an argument to the Tencent map api, and the marker or the route is displayed on the map. In addition, even if there is no latitude and longitude information can use the place name to search for places. Here are the Tencent map APIs used by this system as follows:

– CityService: According to the city name, latitude and longitude, IP address, telephone area code to obtain city information. This function sends the request

parameters to the server asynchronously and returns the result through a customized callback function.

- Geocoder: The address resolution class is used to translate between addresses and latitude and longitude. This function sends the retrieval condition asynchronously to the server and returns the result via a custom callback function.
- Add custom controls: Add custom controls to the map by generating a qq.maps. Control instance. This control requires initialization of the options parameter, where the content attribute specifies the DOM node element or HTML string that the custom control presents in the page.
- Navigation route display: The line segments connecting the start and end points are displayed on the map by obtaining the values of the start and end latitude and longitude. Concrete implementation: Add a polyline to the map by generating an instance of the class maps.polyline. This class requires initialization of the options parameter, where path is a set of coordinates on the map and the coordinates correspond to the inflection point of the polyline. Then add polyline to the corresponding map object by setting the map property.

3.3 The Backend Logic Function of This System is Realized Through NodeJS

- Create a server: The Http protocol is a generic application layer protocol that creates a http server through the http module of Node.js and listens for client requests. Because Node.js is single-threaded, we must ensure the stability of the system. Otherwise, once the program error occurs, it will cause the entire server to crash. Therefore, the system uses a third-party package of NPM: Log4js log module, which has a log, daemons and exception capture and other functions.
- Listen to the request sent by the client and operate the database according to the parameters passed to the server. Node.js and MySQL database connection there are many ways, this system is selected in the NPM installation mysql package, and then in the server require ('mysql'), and then the parameters passed to the client, and finally execute MySQL Query the statement and return the data to the front end.

4 Conclusion

This paper introduces the design and implementation of a mobile terminal device geographic location analysis system. The advantage of this system lies in the display of geographical location information through data visualization technology. At the same time, different applications and positioning time can be screened to narrow the scope of activities of criminal suspects under certain circumstances, providing new ideas for the geographical location of mobile devices.

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