Research on Location Method of Vehicle Trajectory based on Intelligent Terminal

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Abstract: With of people's living standards improving, small cars have gradually become the first choice. However, the consequent traffic problems restrict the development of our society. Based on Android OS and combined with GPS positioning and smart phone sensor components, this paper develops a software for real-time monitoring of vehicle speed and trajectory. The position, speed, acceleration and trajectory of cars are collected and monitored, and the processed data are uploaded to the mobile client through the network of the mobile phone, and the driving status of the vehicle is monitored in real time through the Android client. In order to ensure the accuracy of data recording, the minimum distance of GPS and refresh time interval (refresh once in a second, if the distance exceeds 0.3m compared with the historical location, the monitoring data will be written into the file). To ensure the real-time performance of acceleration data and GPS data, the refresh time interval of the body sensor is set to 0.5 s.

1 INTRODUCTION

With the development of human society, there are more and more automobiles. Though it brings great convenience to human beings, traffic problems are becoming more and more serious. According to the survey, a large part of traffic problems is caused by malfunction of automobiles. However, no malfunction occurs abruptly. It can be predicted in advance by monitoring the state of automobiles, which can largely alleviate traffic problems. Therefore, real-time monitoring of the running state of automobiles is of great importance (LUO Bing-Yang, et.al, 2016). There are two main characteristics of great mobility and wide range in automobile industry. Therefore, for real-time monitoring of automobiles, there is a high demand for real-time interaction of information. So it is necessary to establish an informationalized, graphical and online application platform (Huang Aqiong, Gu Yunhui, Fu Li, 2013) so as to meet the real-time monitoring of trajectory and speed of cars. GPS and 4G network are used to transmit the real-time running state of cars to the mobile phone to achieve real-time monitoring, the mobile phone can acquire the driving state of the car in.

With the advancement of scientific information technology, computer technology and network technology have been greatly improved, and on this basis, remote management monitoring technology (Ma Jian, 2016) has been realized. In recent years, Web-based vehicle monitoring has been continuously studied and applied, and develops rapidly in many fields, for example, remote monitoring and network management technology has been widely used in vehicle management system (Han J W, Kamber M, 2001).At present, wireless data communication module, sensor module and satellite positioning module have been applied to the information monitoring system like vehicle positioning, vehicle operation status and so on at home and abroad (Moridong, Luo, et.al, 2016). Now the popularity of mobile phones with Android OS enables us to achieve a real-time monitoring of vehicle operation status in a more economical and convenient way, namely, monitoring vehicle operation combining Android with GPS and mobile phone's sensor components in real-time.

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2 APPLICATION DESIGN

The purpose of this application is to develop a software based on Smartphone (Android version 6.0 or above and pre-installed Google GPS system services and body sensor components), which can automatically record the speed and trajectory of the vehicle in the background and generate a record file.

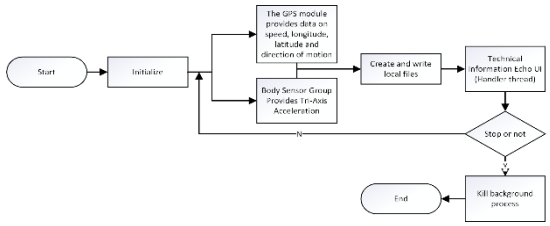

Figure 1. Flow chart of the program.

2.1 Relevant Technologies

This application is developed on Android platform by combining GPS module of Google system service, body sensor module of mobile phone and Baidu Map SDK. Main technologies used are as follows:

2.1.1 About Android System

This application development is based on Android version 6.0 or above. Android version 6.0 or above has changed its permission control mechanism, meaning the app needs to be granted with the permission declaration by the system (Yang Jun, 2015). And the time to be granted is when the user installs APP. The implementation method is to add permission application in Manifest file. And the permission is divided into four levels:

Normal: Low-risk permissions, user's confirmation is not required for installation

Dangerous: High-risk permissions. User's confirmation is required for installation.

Signature: The permission can only be granted if the digital signature of the application applying for the permission is the same as that of the application declaring the permission.

SignatureOrSystem: The application with the same signature or application permission is a system application (in system image), which is similar to Signature. Try not to use this option, Signature is suitable in most situations.

2.1.2 GPS Module

The GPS service component obtains four sets of data, [Position 1, d1] [Position 2, d2] [Position 2, d2] [Position 3, d3], which are mainly (satellite position and distance from signal receiver) (Fang Xingbo, Tao Tingye, Gao Fei, 2017). After many high frequency measurements of positioning points, the speed and direction of the GPS signal receiver are obtained, which is fed back to the "Location" variable through the monitor for users to use.

2.2 Realization of Main Functions

There are three main modules in this software: GPS information acquisition module, acceleration information acquisition module and writing in local SD card module.

2.2.1 GPS Information Acquisition Module

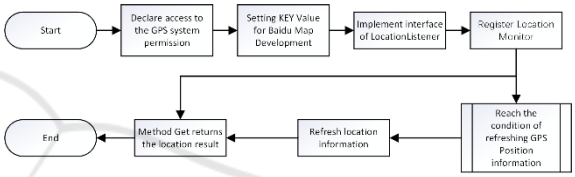

Figure 2. Flow chart of acquisition of GPS information module.

Two tools are needed in this module: GPS module embedded in mobile phone and Baidu map development tool.

1. Configuration Information Description File

Step 1: Declare the permission for accessing to GPS Declare service component

Step 2: Set the KEY value for developing Baidu Map;

Step 3: Implement Location Listener positioning interface

Step 4: Set Location Source (this); Register positioning monitor

Positioning parameters: Longitude, Latitude, Speed, Direction setting

Display the positioning layer and trigger the positioning.

Step 5: get method returns positioning result

2.2.2 Acceleration Information Acquisition Module

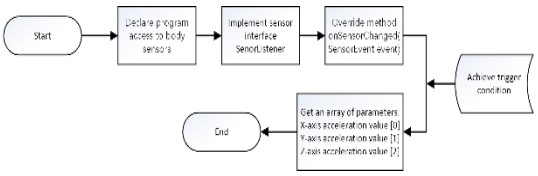

Figure 3. Flow chart of acquisition of acceleration information module.

Step 1: Declare the permission for the program to access to body sensors in Mainfiest.XML

Step 2: Implement sensor interface EventListener

Step 3: Rewrite the onSensorEvent Changed (SensorEvent event) method and return the result of the acceleration of the positioning direction. (Values [0]: X-axis acceleration Values (LUO Bing-Yang, et.al, 2016): Y-axis acceleration Values (Huang Aqiong, Gu Yunhui, Fu Li, 2013): z-axis acceleration)

2.2.3 Write to Local File Module

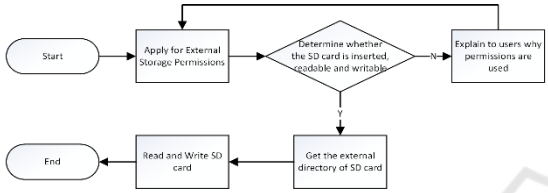

Figure 4. Flow chart of write file module.

Step 1: Declare the permission for the program to access to GPS in configuration information description file

Step 2: Judge whether SD cards exist

Step 3: Get the root directory of the SD card: Environment.getExternalStorageDirectory().getAbsolutePath()

Step 4: Get the default file storage path: FILE. getAbsolutePath ();

Step 5: Read files using BufferReader

Write in files using BufferWriter (in append mode).

3 ANALYSIS OF THE ACQUIRED MONITORING DATA

Test environment: (This test only aims at the purpose of testing whether the software can monitor the speed and trajectory of vehicle)

This test data is based on the data obtained from the track and field sports test in South Campus of Jilin University, at 7:30 pm, on July 6, 2019. Fig. 7. is the complete motion path map, and Fig. 5and 8. are the velocity and acceleration data segments obtained by random detection.

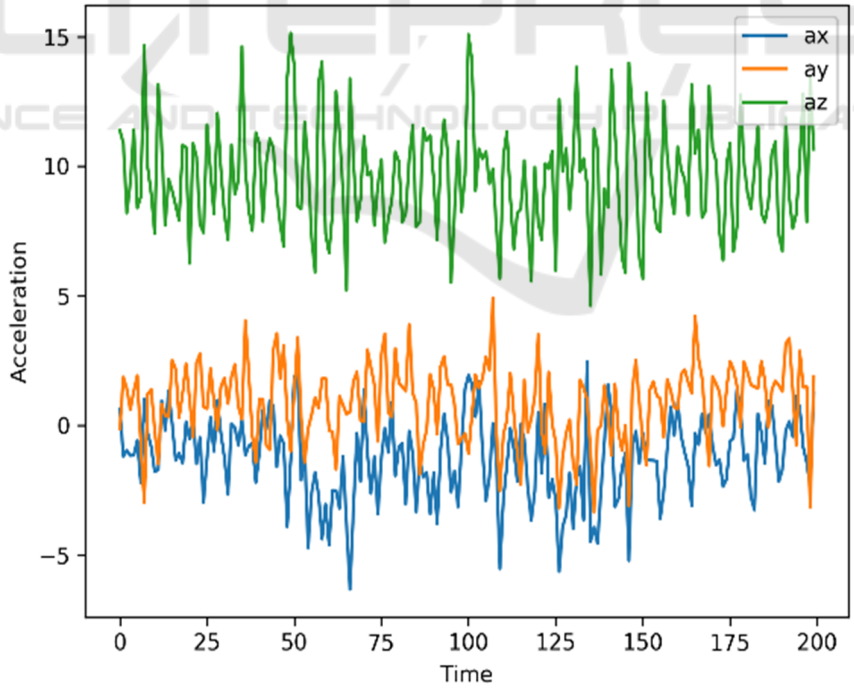

Figure 5. Acceleration curve diagram (part).

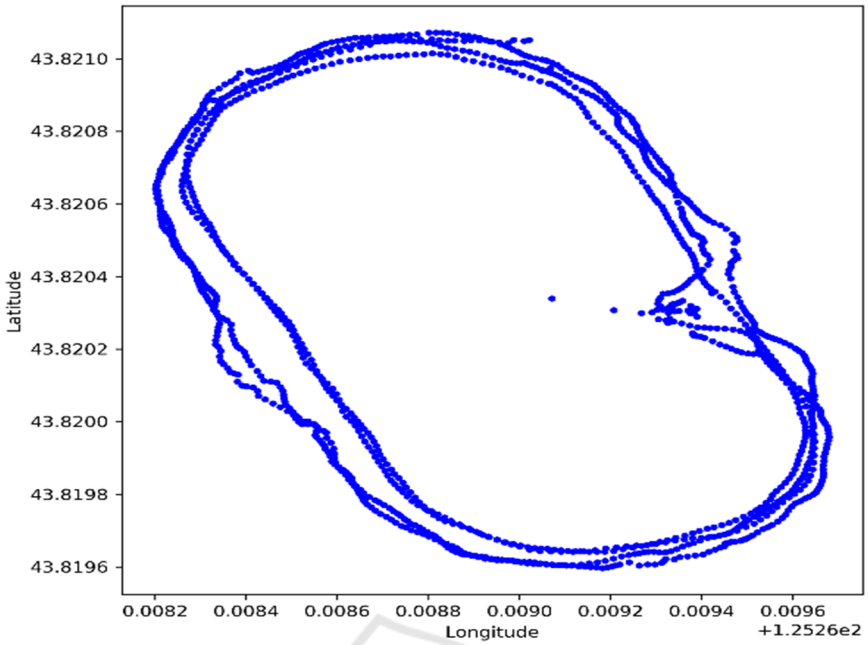

Figure 6. Scattered positioning points diagram.

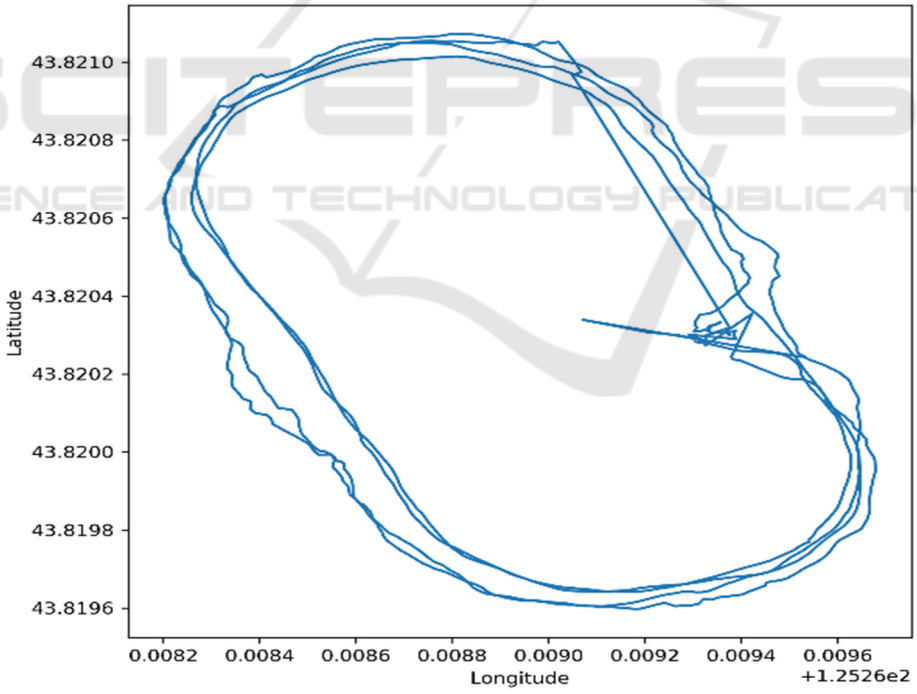

Figure 7. Travel trajectory diagram.

The test results may be slightly different in different test equipment due to hardware factors such as different mobile phone models and sensor models. The results of the monitoring data reflect the movement status of every second in the testing process, and the complete trajectory through the positioning point and the direction of movement is obtained, which can achieve the expected purpose of monitoring the speed and trajectory of the vehicle.

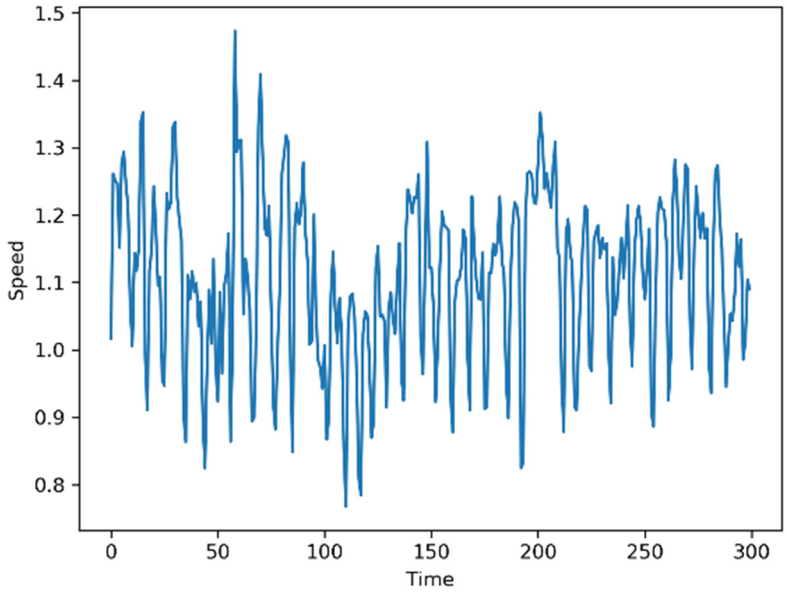

Figure 8. Velocity curve diagram (part).

4 CONCLUSIONS

In this paper, a set of application software is developed on Android platform using GPS positioning service component and sensor component on the mobile phone, which can monitor the vehicle's transportation speed, trajectory and record in real time. The software meets the demands of middle and low-end mobile phone users for fast operating speed and less memory, and can adapt to the latest Android system.

Test the operating environment: The software runs normally in many mobile phones with Android 6.0 or above operational systems. The accuracy of positioning and monitoring data is in 5-10m, which meets the accuracy requirements of monitoring and collecting motion data and is consistent with the expected results.

Module expansion application: The location information module and acceleration acquisition module in the program can also be widely used in other positioning or motion monitoring software.

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