Design of Electric Vehicle Intelligent Terminal based on Android

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Abstract

This paper introduces a intelligent terminal for entertainment and monitoring in electric car based on Android. This terminal function is divided into two parts. Firstly, in order to achieve the monitoring of the electric vehicle's running state,the system get the position information through GPS module and get the battery, charger and motor data in real time through CAN network, the data would be stored locally and transmitted through the 3G network after packing. Secondly, the WIFI display sink is designed as an extension of the terminal function, the screen of android mobile phone can be mapped to the intelligent terminal through the WIFI direct, people can easily use the mobile phone's function on the terminal. Finally, the test results show that the terminal can complete the demands of entertainment and monitoring stably and efficiently

Keywords

Android, Electric vehicle, Terminal, Monitoring system, Screen sharing.

1. Introduction

In recent years, with the development of electric vehicles, the vehicle monitoring terminal has also been vigorously developed.Researchers at home and abroad to spend a lot of time researching the design and implementation of electric vehicle intelligent system terminal and have achieved certain results[1][2]. As an bridge between the enterprise or the traffic control department and the electric vehicle, the importance of the terminal is self-evident. With the development of technology, the vehicle terminal developed towards to intelligence, security and digitalization. This paper introduces the hardware and software of the intelligent system terminal for the electric vehicles which based on Android system and identifies two major kinds of requirements: functional requirements and nonfunctional requirements. In the part of functional requirement, the monitoring system can collect the relevant parameters while the electric vehicle is in the state of running and upload the data to the background server, offers a high-efficient and reliable platform for vehicle administrative department or any other users. In the part of nonfunctional requirements, the terminal realize the screen sharing between phone and the terminal by Miracast protocol, the terminal used as client to receive the screen of phone which is equipped with Android system.

2. System hardware design

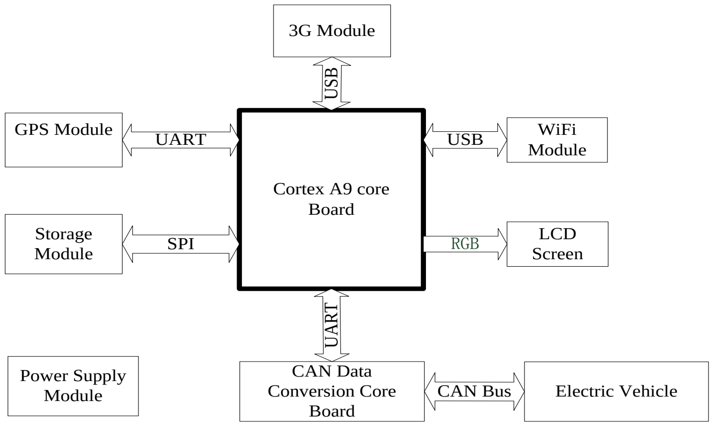

Fig.1 Hardware block-diagram of intelligent vehicle terminal

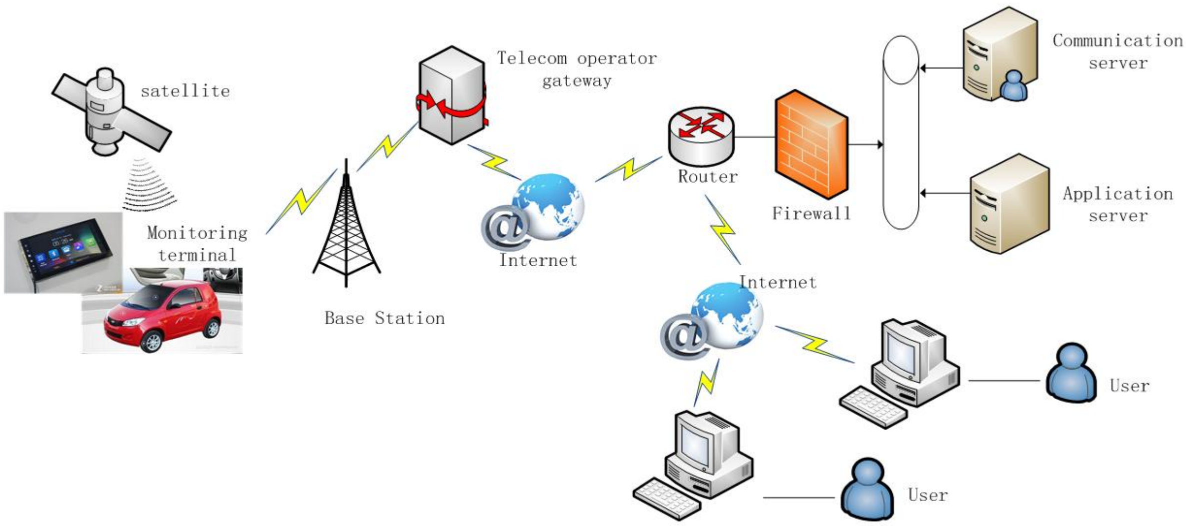

Fig.2 Structure of monitoring and management system for electric vehicle

The hardware system of vehicle remote monitoring terminal as shown in Figure 1.The vehicle terminal hardware mainly include the following modules: ARM Cortex A9 host processor, 3G module, GPS module, the CAN core data acquisition board, Memory module and Power supply module, etc. In this system, the main controller of the intelligent vehicle terminal is PX2, which has a rich peripheral, it is able to requirements of the hardware environment for Android system. The 3G module selects ins slink L303 Mini Pie module, the module uses the USB interface to connect the chip. The uBlox_NEO_6M Positioning module which responsible for obtaining GPS information is adopted. The CAN data acquisition core board which adopt STM32f103RB8 as the core chip can receive the CAN data in the way of real-time. In order to carry out the WIFI connection, the WIFI module uses USB RTL8188EUS W12.

3. Design of wireless monitoring system

3.1 The overall design of the monitoring system

The whole framework of the monitoring system is based on the C/S mode, monitoring system based on terminal equipped with Android systems as the client, in remote PC host based on VC technical data service center. The terminal installed on the vehicle is to collect data through the CAN and GPS module, grouping package according to corresponding communication protocol after the completion of data acquisition and finally uploading data via 3G network. The server would be analyze and record the data uploaded from the vehicle terminal in various ways. The PC client can call the monitoring to view the vehicle’s state such as battery parameter, the fault warning. In this paper, the monitoring terminal based on Android system for electric vehicle is designed.The structure of monitoring and management system for electric vehicle is shown in figure 2.

3.2 Communication protocol

Communication protocol between vehicle terminal and background monitoring server is defined in the vehicle monitoring system. The protocol uses big endian mode of network byte order to pass word and double word, packaged data would be sent to the server through the 3G network in C/S mode. The frame format of the transmitted data packet is shown in Table 1.

Table 1. Frame format of the transmitted data packet

Identification symbol	Message header	Message body	Checking code	Identification symbol

The message format begins with identification symbol, the subsequent including message header, message body and checking code. The start symbol is fixed to the ASCII character ‘xx’, in order to prevent the wrong data package, the protocol need to carry out transformation when the 'xx' appear in the message header, message body or checking code. The message header include the message ID, the terminal ID, message number and the message length. The message body fill with the vehicle data, the information body includes the electric parameters of the power battery, the temperature data of the power battery pack, the fuel cell data and the vehicle data and so on. BCC method was applied in checking code, calibration range start from the first byte of command unit, with one byte XOR, until the previous check code. Checking code takes up one byte.

3.3 The design of monitoring application

The monitoring system is integrated into the vehicle terminal, the monitoring system can be started as a service on the Android system when the electric vehicle starts firing. The system obtain the battery information, energy feedback frequency, motor speed and alarm, monomer voltage information, monomer temperature, time and charge for weeks, charger output information via the CAN node which mounted on CAN network. When the terminal get the CAN data, they would be registered as a broadcast on Android platform. CAN information would be obtained through broadcast receiver in the application. GPS information acquisition mainly use the geographic location services in the framework of the Android system and network to obtain the precise positioning of the electric vehicle. In the monitoring application, open two threads, one thread for GPS information and CAN information collection, and stored in the local SD card, data storage time the first half of the year, over time automatically cleared. Another thread is responsible for establishing the Socket with the server, when the establishment is completed, the terminal obtain the terminal upload frequency from the server and set up the terminal, then group package according to corresponding communication protocol after the completion of data acquisition and finally upload data via 3G network. The server analysis the data after receiving the information sent by the terminal server, and display the running state of the electric vehicle according to the actual needs in the background. Software flow chart of electric vehicle monitoring system is shown in Figure 3.

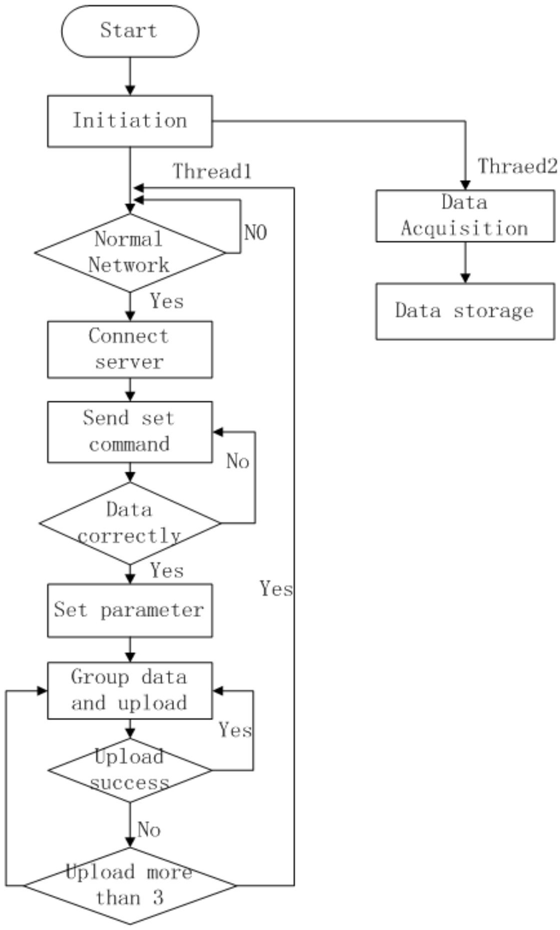

Fig.3 Software flow chart of electric vehicle monitoring system

When the CAN_BUS data is transmitted between the vehicle terminal and the electric vehicle, the interrupt mode is used to receive the data. This way can not only ensure the integrity of the data, but also can ensure CPU work in a state of adequate resources. As shown in Figure 4 of the terminal CAN data processing flow chart.

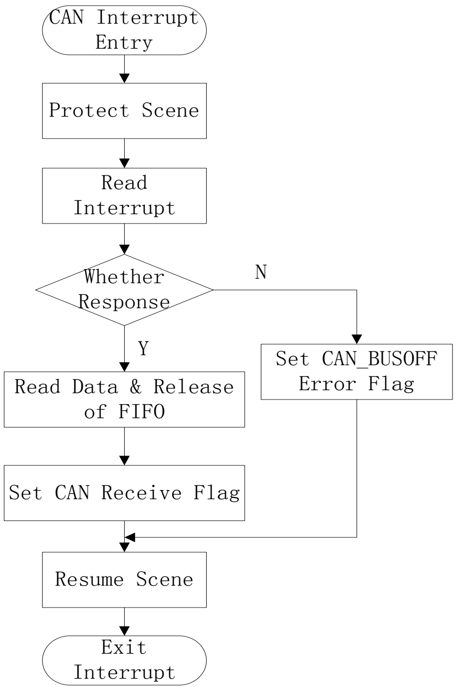

Fig.4 CAN interrupt processing flow chart of the vehicle terminal

4. Design of WIFI display sink

4.1 The design of monitoring application

According to the official definition of WFD and according to the characteristics of the media architecture of the Android system, the overall framework of the WFD sink designed is shown in Figure 5.

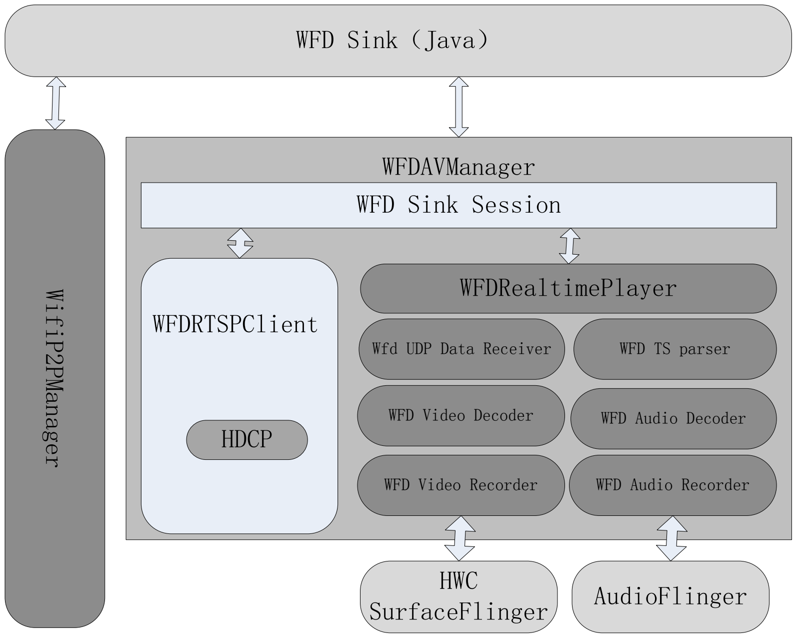

Fig.5 The overall framework of the WFD sink

In the high version of the Android system provides a direct connection to the WIFI support. The devices can be searched to other devices that support WIFI P2P through the WIFIP2PManager.The source (Phone) and sink (terminal) can establish streaming media connection, then the sink would open a thread to create a TCP communication port, wherein establish a session through the RTSP protocol. In the session, the two sides negotiate the parameter they need, including audio and video formats supported, decide the most suitable parameters of channel load, audio and video decoding rate, resolution and determine whether the two sides will support HDCP (High-Bandwidth Digital-content Copy Protection) protocol. The sender (Source) collect the mobile phone or other display device screen pixel data of the original image, high performance H.264 is used to compress coding, and the encoded stream is encapsulated in RTP/RTSP protocol and then transferred to physical layer through WIFI network. The sink side will DE multiplex and decode data, finally rendering them into the Surface Flinger framework in the form of animation drawing pictures to the client.

4.2 RTSP/RTP interaction and data transfer

When the source and sink create the RTSP object. Firstly, the source would call the function sendM1() to send RTSP options request, the response has no error information, that is the status code returned is 200, indicates that the RTSP server provides RTSP methods that are required by the Sink. Next, the sink will call the function sendM2 () to send options request to ensure the whether RTSP could provide RTSP methods that are required by the source, this process be similar to the M1.Thirdly, the source continue to call sendM3 (), source send the GET_PARAMETER method to get the HDCP, video format information, audio encoding format information, RTP client port information supported by sink side. After the completion of the consultation parameters can be carried out RTSP media streaming communication process, such as PLAY, PAUSE and other operations. When the source send command of SETUP, the sink side would start RTP thread to continue the transmission of audio and video data. In the source, the screen data will be collected, decode, and packetize, delivery. The timing diagram of source and sink is shown in Figure 6.

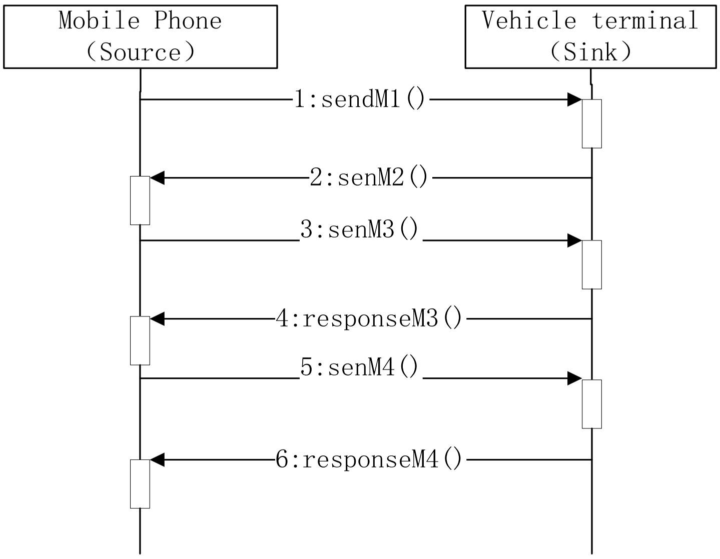

Fig.6 The timing diagram of source and sink

4.3 AV decoder

This system uses FFMEG library to complete the decoding. FFMPEG is an excellent audio and video codec library. It can support a lot of AV coding standard, and its decoding speed is very fast among the open source code. The application call the FFMPEG library through Android JNI technology. In the FFMPEG, the decoder is registered firstly, query the H.264 decoder by acquiring the ID, and continue decoding operation in the decoder. The decoding process is shown in Figure 7.

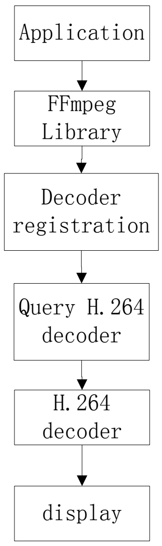

Fig.7 Decoding process using FFMPEG

5. System testing

The intelligent system terminal based on Android can be installed on the general purpose electric vehicle car. When the car started, the terminal is also powered on, and the server can monitor the data sent by the terminal. The experiment is carry out on my own campus. In order to test the reliability and stability of the terminal, the experiment was conducted in a period of half a month, the server can received the complete packet every time and can be analyzed on the map correctly. The data received by the server is shown in Figure 8 and parsed data on the server side is shown in Figure 9.

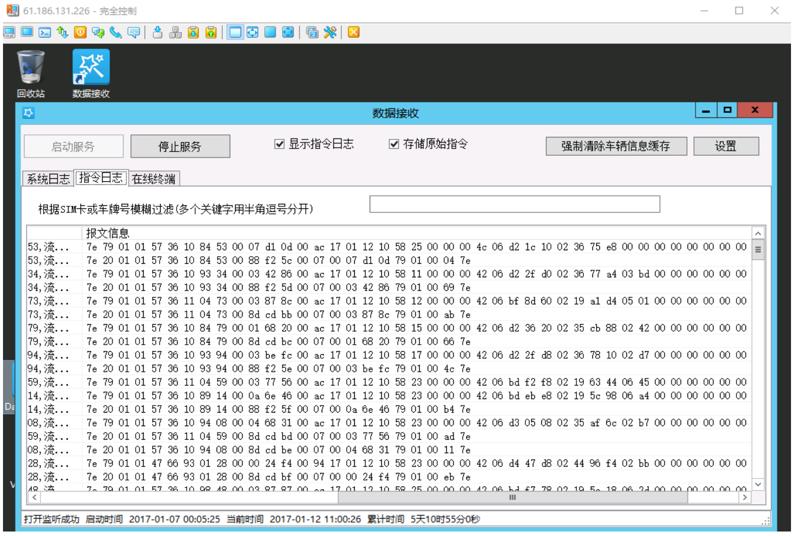

Fig.8 Data received by the server

Fig.9 Parsed data on the server side

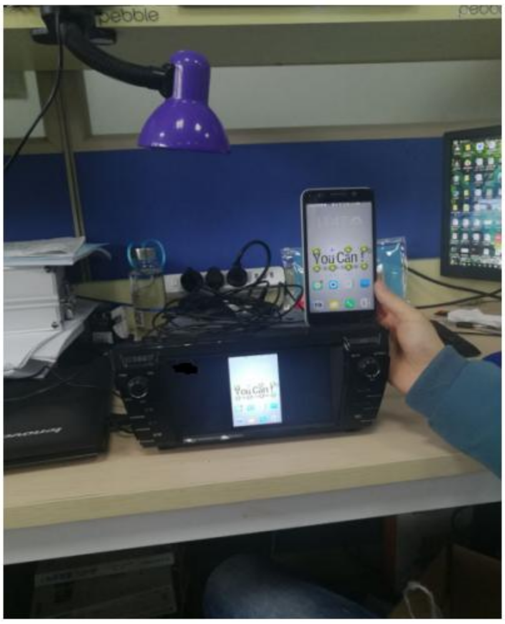

Fig.10 Screen sharing between mobile and terminal

For the screen sharing between mobile phone and terminal, we uses the XIAOMI Note 2 and HUAWEI mobile phone as test object, a total of 100 times of the Wi-Fi direct and sliding mobile phone experiment is carried out, 100 connection success and can successfully achieve screen sharing, the success rate reached 100%.The screen sharing system has low latency, reached the initial design requirements. The screen sharing between mobile and terminal is shown in figure 10.

6. Conclusion

In this paper, the hardware and software design of the intelligent system terminal are designed. The tests proved that the terminal can complete the monitoring function of the electric vehicle in the background efficiently and stably. In addition, the screen of Android mobile phone can be mapped to the terminal, enriching the function of terminal.

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