Wireless Monitoring Terminal for Electric Vehicle

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Abstract

This paper introduces a vehicle remote monitoring terminal, which uses GPS and GPRS technologies. The vehicle terminal not only collect battery, charger and motor running real-time data, but also maintain normal operationt after cut off power supply. In the area where there is no radio frequency signal, the terminal will save the data locally. As soon as the terminal is out of blind area, it restores a stable service.Finally, the test results of the reliability of the vehicle remote monitoring terminal are analyzed.

Keywords

Electric car; GPRS; GPS; Realtime-remote monitoring; CAN message

1. Introduction

In recent years, monitored real-time data including battery data, vehicle state data and fault information plays an important role in the research and development of pure electric vehicles. The data is also necessary for the future development of electric vehicle technology. This paper describes a vehicle remote monitoring terminal based on GPRS technology, which could monitor the vehicle status and position information. Besides, this is a device for the big data research of electric vehicle power assembly and working condition of energy system analysis based on the rich data.

2. General Architecture of Remote Monitoring Terminal for Electric Vehicle

The remote monitoring system is mainly composed of the remote monitoring terminal, server, PC client, GPRS communication and Intel network. The overall architecture of the monitoring system is shown in figure 1.

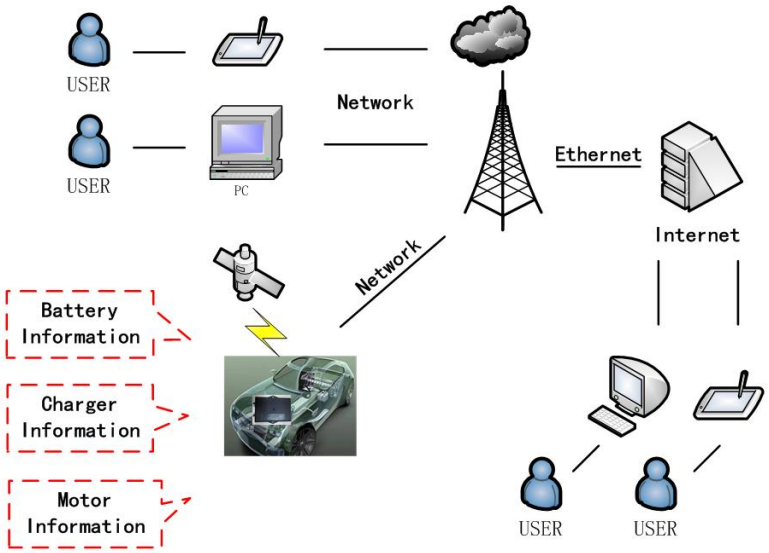


Fig. 1 Structure of vehicle telematics terminal system

The main function of vehicle remote monitoring terminal is collecting data from the vehicle and GPS network, analysis of vehicle agreement, generating message according to network communication protocol and finally uploading data to the server via GPRS/GSM network. After analyzing the data

uploaded by the vehicle terminal, PC client can not only monitor the vehicle's real-time status, but also can analyze the power battery, the fault warning and so on according to the data in sever. This paper mainly introduces the hardware and software design of remote monitoring terminal for vehicle electric vehicles, and the function of the reliability test.

3. Hardware System Design

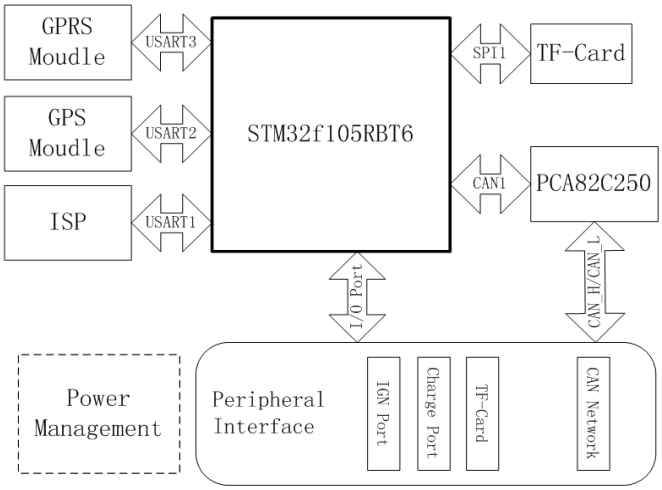


Fig. 2 Hardware frame of vehicle remote monitoring terminal

The hardware system of vehicle remote monitoring terminal as shown in Figure 2, consists of power management, MCU module, GSM/GPRS module, GPS module and CAN module.

The main controller of the vehicle terminal is STM32F105RBT6, which has integrated rich peripheral module. The main controller module is the core of the whole system. The GSM/GPRS module selects the SIM900A module produced by Sim Com Company. The GPS module uses uBlox_NEO_6M that the positioning accuracy of the module is high and the speed of the search star is fast.

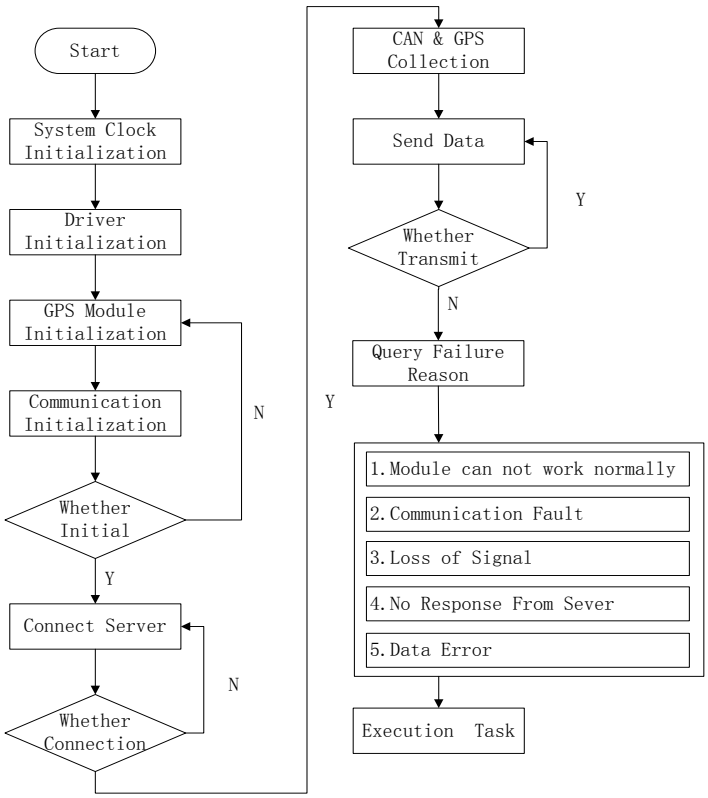


Fig. 3 software structure flow chart of vehicle terminal

4. Software System Design

The software system is designed by modular programming tasks, the system function consists of a main task and multiple sub tasks, and each sub task includes the use of each module. The system software flow chart of the terminal as shown in figure 3.

The software system of remote monitoring terminal is divided into the following parts. First, system initialization program is used to initialize the vehicle terminal, USART1, USART2, USART3 receive interrupt configuration, the timer interrupt configuration, including GPRS network initialization, open the GPS transceiver module and CAN transceiver module, and receive interrupt configuration parameters. Second, the main tasks include data analysis, package, transmission, data storage and so on.

The main tasks consist of network transmission task, GPS data parsing task and CAN-BUS protocol parsing task.

The communication protocol is based on the TCP/IP protocol, and the data collected by the terminal is stored in the local area. When the data communication link is stable, the data is transmitted to the platform at a fixed frequency. Because the transmission mode adopts a non-long connection mode, the platform does not automatically send information to the terminal. So after the end of the upload data, the platform must send a confirmation message. The communication flow of the vehicle terminal is shown in figure 4.

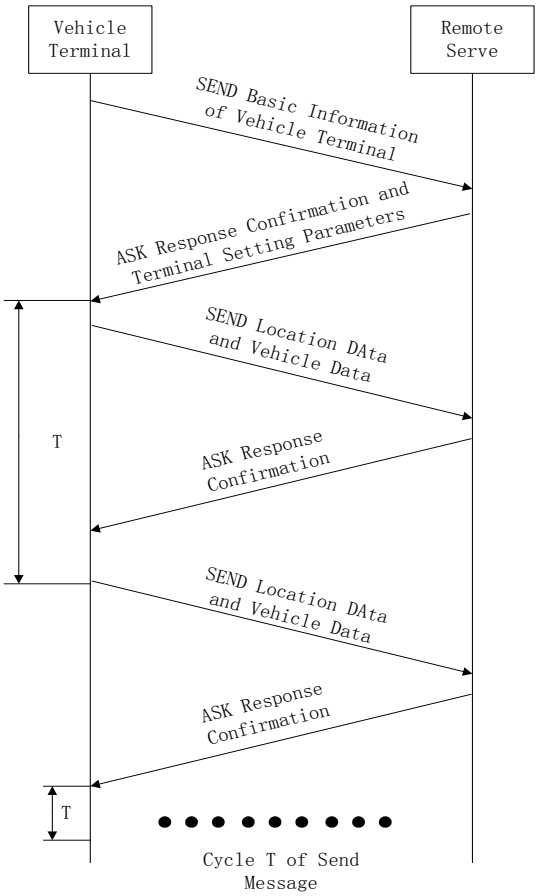


Fig. 4 communication flow between vehicle terminal and background server

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 5 of the terminal CAN data processing flow chart.

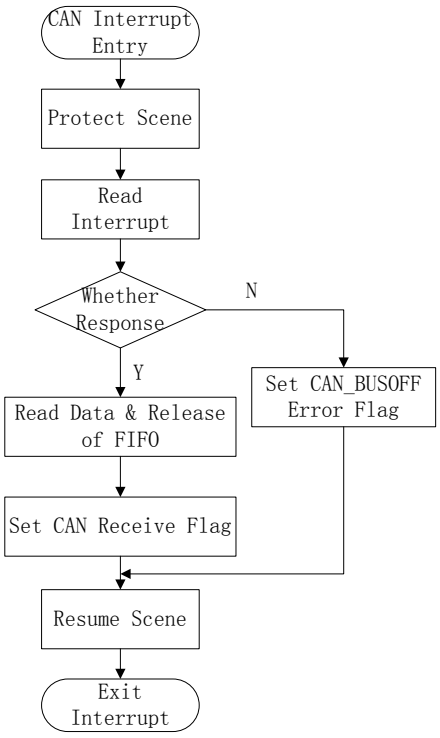


Fig.5 CAN interrupt processing flow chart of the vehicle terminal

5. System Testing

5.1 Performance testing

The environment of the electric vehicle is built on the common fuel vehicle. The test bench using the K60 produced by Freescale Carle simulates the vehicle network environment. When the vehicle terminal is powered up, the device can be viewed on the server. This can query the vehicle terminal upload vehicle data. The packet loss rate in the communication process can also be tested.

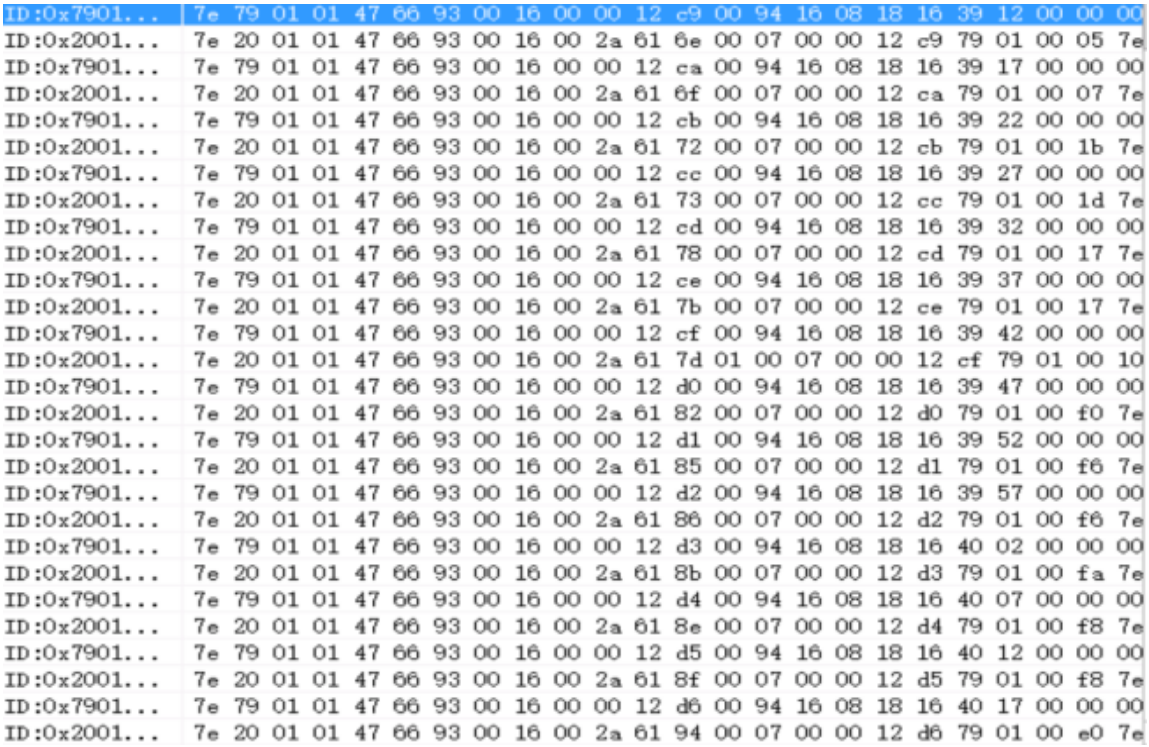
5.1.1 Reliability verification of GPS location

The test method is based on the true position of vehicle remote monitoring terminal location map as the center to draw a 20 meter radius of the circle on the map, and then observe the location information of the vehicle terminal is displayed on the map of the upload. As shown in Figure 6, the graph is the interface of the remote monitoring PC client.

Fig. 6 Vehicle monitoring platform in remote center

5.1.2 Stability verification of wireless network communication

The experiment is carried out in the GPRS network with strong signal and stable power supply. To verify the stability of the communication original data packet collected from the background server. The experiment for 604800 seconds, the server has received a total of 120960 packets, packet success rate reached 100%, the data space is too large, the only part of the data interception.



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ID:0x2001...	7e	20	01	01	47	66	93	00	16	00	2a	61	6e	00	07	00	00	12	c9	79	01	00	05	7e
ID:0x7901...	7e	79	01	01	47	66	93	00	16	00	00	12	ca	00	94	16	08	18	16	39	17	00	00	00
ID:0x2001...	7e	20	01	01	47	66	93	00	16	00	2a	61	6f	00	07	00	00	12	ca	79	01	00	07	7e
ID:0x7901...	7e	79	01	01	47	66	93	00	16	00	00	12	cb	00	94	16	08	18	16	39	22	00	00	00
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ID:0x7901...	7e	79	01	01	47	66	93	00	16	00	00	12	cc	00	94	16	08	18	16	39	27	00	00	00
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ID:0x7901...	7e	79	01	01	47	66	93	00	16	00	00	12	cd	00	94	16	08	18	16	39	32	00	00	00
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ID:0x7901...	7e	79	01	01	47	66	93	00	16	00	00	12	d6	00	94	16	08	18	16	40	17	00	00	00
ID:0x2001...	7e	20	01	01	47	66	93	00	16	00	2a	61	94	00	07	00	00	12	d6	79	01	00	e0	7e

Fig. 9 Some background server data

5.2 Reliability evaluation of radio frequency signal for vehicle terminal

The RF terminal consists of GPS signal and GPRS network signal, the two part plays a decisive role in the realization of the vehicle monitoring. There are special road scenes such as mountain and tunnel in the actual operation of the vehicle; the RF signal is too weak to signal easily lost. Once cars are out of the way, the vehicle terminal must recover the RF data quickly. Therefore, the real-time road test is needed.

First, the cold start mode was tested. In this scenario, the RF signal is not blocked. Each time the vehicle terminal is completely out of power, and then re-power. Test results are shown in Table 2.

Table 2. Cold start mode

Number	Location Time(s)	Number of Satellites
1	88s	9
2	94s	8
3	86s	9
4	103s	7
5	83s	9
6	92s	9
7	105s	7
8	97s	9

Second, the performance of the hot start of the vehicle terminal is tested. The test scene is vehicles pulled out of a tunnel, and then measure the length of time for GPS signal recovery. Test results are shown in Table 3.

Table 3. Hot start mode

Number	Location Time out of the Tunnel
1	4s
2	3s
3	4s
4	6s
5	9s
6	3s
7	8s
8	4s

After experimental verification, in the cold start state, the terminal can successfully locate within 120s; in the hot start condition, the terminal can successfully localize within 10s.

6. Conclusion

In this paper, the hardware and software design of the electric vehicle remote monitoring terminal are described and the terminal reliability has been verified and tested. The vehicle terminal built a communication bridge between cars and external networks and it enhances security related features for drivers. It also creates conditions for large data analysis.

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