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Design of Remote Data Communication Gateway Based on Onenet

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Abstract

With the improvement of the quality of life, people increasingly pursue comfort and safety for cars. A kind of remote data communication gateway system including master node and slave node is designed to collect and transmit information in real-time. The information data is transmitted using CAN bus from slave node to master node. Data also be sended to OneNET cloud platform. With the design of application, real-time data can be monitored remotely. The design is meaningful to realize intelligent automobile.

Keywords

CAN bus; OneNET cloud platform; Vehicle gateway; Condition monitoring.

1. Introduction

With the development of automobile, it becomes more and more intelligent. What people pursue is not only the driving function, but also driving experience, vehicle safety and etc. To achieve these goals, the first thing is to monitor the running state of the vehicle. Fieldbus is the most widely used method to transmit information in automobile, which is mainly used for monitoring the overall operation parameters of automobile internal control and data communication with control equipment. CAN bus is one of the most used Fieldbus in automobile [1, 2]. However, simple point-to-point data communication between sensors and ECU can not meet people's increasing demand for automobiles. This kind of closed data communication network is easy to lead to some abnormal equipment of vehicles, such as carbon canister blockage, abnormal engine cooling and so on, which are hard to be found in time. At present, the automobile repair shop or 4S shop mainly uses the external facilities link mode to extract the vehicle network data, which also causes the disadvantage of data monitoring is not timely, and the simple problems that can be found and solved by real-time monitoring become complicated. Therefore, it is significant to design a remote data communication gateway system based on onenet to solve the problem of untimely monitoring [3]. A gateway interface is put forward based on PDU router, which is designed for the network bus like FlexRay, LIN, CAN. It can also be understood that the collection of early vehicle information is the conversion and acquisition of can data and COM module data through the protocol layer [4]. With the development of big data and cloud computing technology, vehicle LAN and cloud platform have been well integrated. In 2020, ST company launched the cloud smart gateway SGP, which extends the computing processing capacity of the platform and the throughput capacity of vehicle network transmission to a certain extent.

To realize the remote data communication between vehicle network and Internet platform, real-time data transmission is essential. Traditional 2.4G wireless technology has the problems of high packet loss rate and large interference in the complex road environment [5]. The new generation of NB-IOT technology has the limitation of small amount of data transmission [6]. Therefore, 4G mobile communication technology with strong signal ability, fast transmission speed and high intelligence is more suitable for many and complex vehicle driving environment.

To monitoring the running state of the vehicle, a data communication gateway is designed, which include CAN master node and slave node. Slave node is used to collect real-time speed

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and temperature of automobile engine. Master node is used to collect data and transmit it to the cloud.

2. Hardware Structure Design

2.1. Overall Design

Figure 1 shows the overall block diagram of the system.

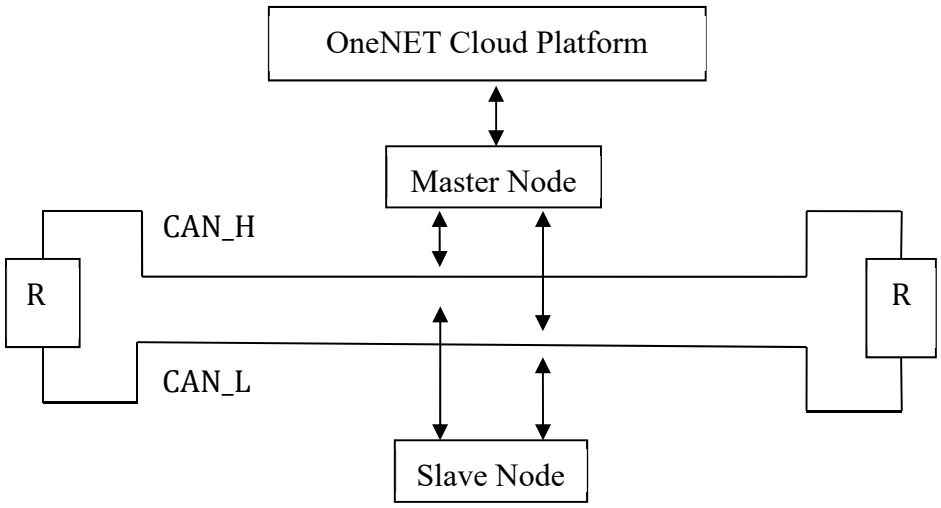

Figure 1. System structure diagram

It shows the implementation scheme of remote data communication gateway system. The system includes master and slave nodes. They are connected through CAN_ H and CAN_ L. These two differential signal lines constitute the CAN bus local area network. The slave node is used to collect information. Signal from slave nodes will converge to the host node, which is used as information transmission hub. Finally, information will be upload to onenet cloud platform and be monitored remotely.

2.2. Design of Master Node

Figure 2 gives the diagram of the master node. The node mainly includes STM32F103 MCU, CAN transceiver module, 4G module, display module, buzzer, key and etc. Master node is the core of the gateway system and used to control information display, signal transmission, signal uploading, and driving functions of the actuator elements of slave node. When the master node successfully connects to the network, it can process the data, which is received from the slave node. The processed data can be refreshed and displayed in real time. At the same time, the threshold can be set by the key. When the values exceeds the threshold, the buzzer will work. The slave node equipment can also be controlled using the key.

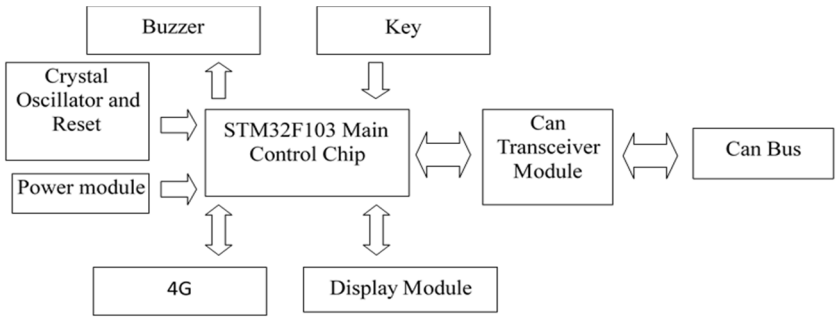

Figure 2. Structure diagram of master node

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2.3. Design of Slave Node

Figure 3 gives the diagram of the slave node.

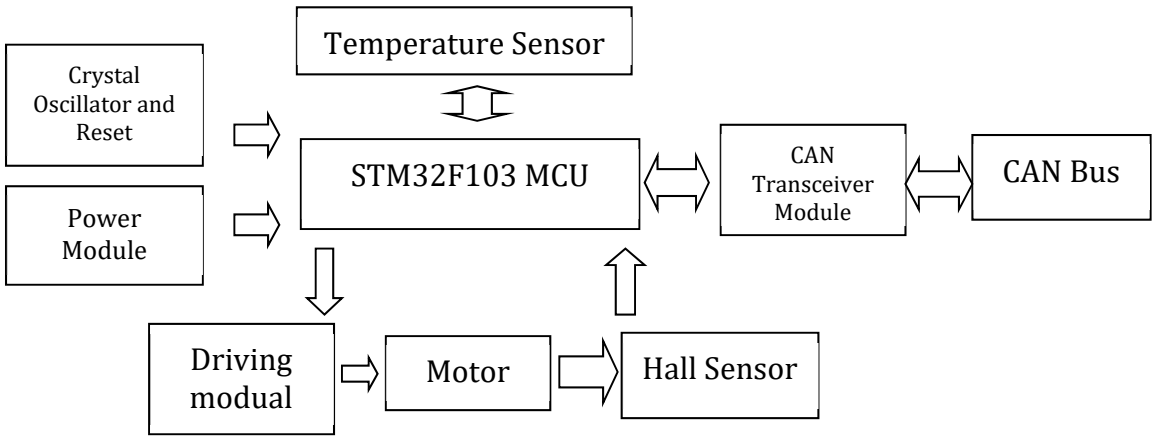

Figure 3. Structure diagram of slave node

The slave node mainly includes STM32F103 MCU, CAN transceiver module, sensors, actuator and etc. In this system, the node is used to collect the speed and temperature of motor, which is significant to predict the status of motor. The motor temperature is collected by the temperature acquisition module, and the motor speed is collected by the hall sensor. On the other hand, the motor can be controlled by the master node to realize the control of speed and steering.

2.4. CAN Bus

CAN is a kind of multi host LAN in automobile application field, which is mainly used for automobile monitoring and control. Traditional end-to-end connection mode has the disadvantages of complexity, high cost, and it is difficult to solve the problems in practical application scenarios. The performance of the design scheme based on CAN bus is better than the traditional scheme. The advantages are mainly reflected in the following aspects. CAN bus can efficiently control the distributed control system and the real-time serial communication network. The CAN bus encapsulation protocol of communication interface can further optimize the frame processing of communication data. The communication data is processed and coded in blocks. It is connected to the outside through CAN_ H and CAN_ L, and can realize error detection and fault closure.

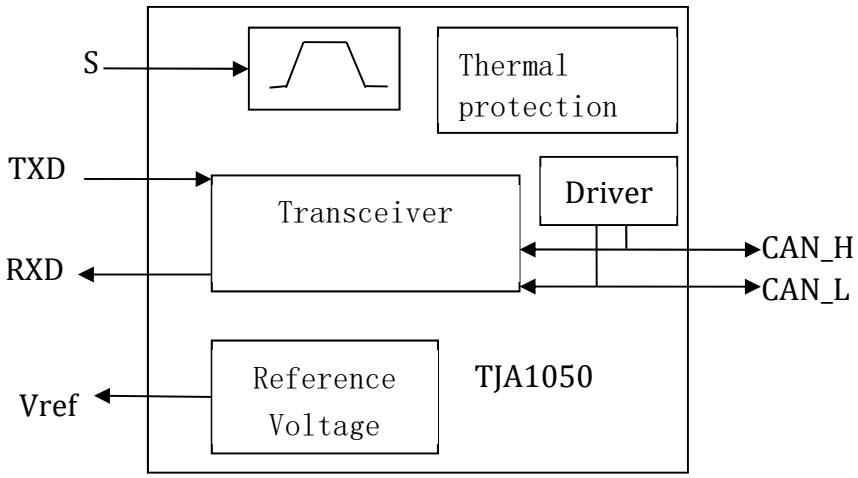

Figure 4. TJA1050 CAN transceiver module

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This design selects TJA1050 CAN transceiver module. The structure chart is shown in Figure 4. The bus votage is the difference of the voltage of CAN_ H and CAN_L. The bus level is divided into dominant level (corresponding to logic 0) and invisible level (for logic 1), which is used to convert data into physical information on CAN bus for transmission. Since there is echo reflection in the actual transmission process, 120 Ω terminal resistance should be added to the initial section of CAN bus to balance the impedance effect.

3. Software Design

The software includes two part, which can control the master node and slave node respectively.

3.1. Master Node

The specific working process of the master node software is shown in Figure 5.

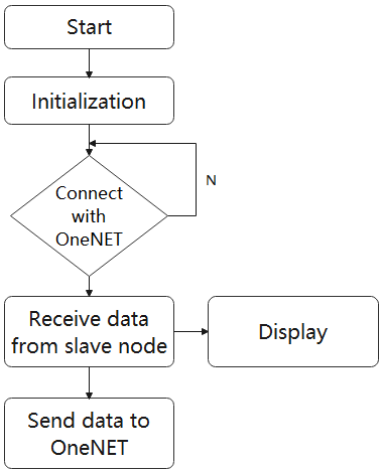

Figure 5. Software flow chart of master node

After initialization, the master node establishes a connection with OneNET. If it fails, the connection estabilishment will be continued. If the connection is successful to be made, the data will be received from the slave node. The data will be displayed on the display screen. At the same time, the data will be sent to the cloud platform.

3.2. Slave Node

The specific working process of the slave node software is shown in Figure 6.

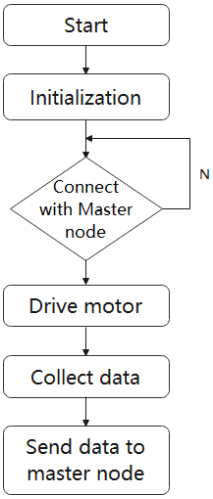

Figure 6. Software flow chart of slave node

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After initialization, the slave node establishes a connection with the master node. If the connection is successfully made, the information of motor will be collected by sensors. The data will be send to the master node.

4. Application Design

TCP transparent transmission protocol is used to analysis the data from the master node. The protocal can be defined by users. It is usually written in Lua scripts. The scripts can be defined as following:

```
function device_data_analyze(dev)
    local t = {}    --define data-flow
    local a = 0
    local s = dev:size()    -- Get uploading data length
    add_val(t,"ds_id",a,dev:bytes(1,s)) -- Add to the data-flow “ds_id”
    dev:response()      -- Send response
    dev:send("received")  -- Send "received"
    return s,to_json(t)   --Save data
end
```

When the cloud platform receives the data from master node, an information of “received“ will be send back to master node. The data will be added to the data-flow “ds_id“.

Using the API interface provided by the platform, an application can be created easily. After an account of onenet cloud platform is registered, the visualization function of device data on the onenet platform can be easily completed through the application editor on the basis of API. The interface is designed as following. Real-time temperature and speed data can be displayed. Data over a period of time can also be recorded.

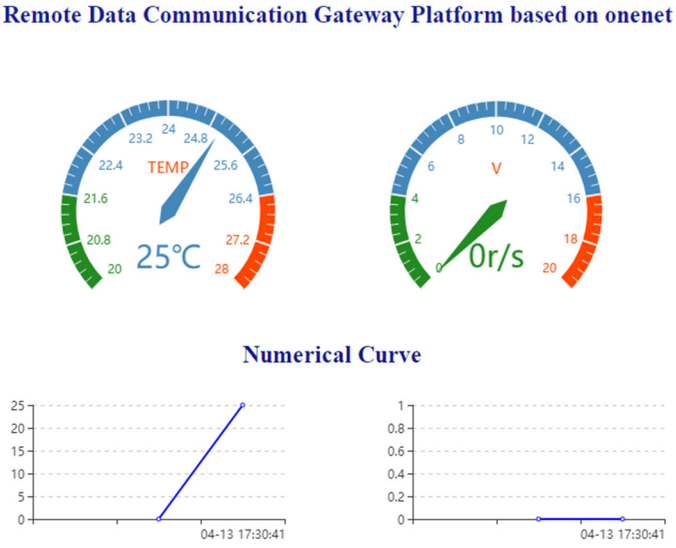

Figure 7. Interface of the application

5. Conclusions

Using CAN bus and onenet cloud platform, a network gateway is designed. The system includes master node, slave node. Running data transmission can be realized conveniently between automobile and cloud platform. The information between cloud platform and CAN LAN is analyzed by using TCP transparent transmission protocol. A web application program is

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designed to monitor the information collected from CAN local area network. Compared with other systems, the vehicle running data can be monitored remotely in real time, which is significant for improving automobile safety.

Acknowledgments

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