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Design of Automobile Bus Communication Platform

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Abstract

With the development of intelligent automobile, more and more information needs to be processed by automobile. In order to facilitate the transmission and use of these information, automobile bus came into being. However, automobile bus is very abstract and the information transmitted on the bus is difficult to understand. In order to better help automobile employees learn and master automobile bus, an automobile bus communication platform is designed,This platform can simulate the communication bus on the car in real time. Through this platform, you can master the car bus well.

Keywords

Bus Design; Bus Communication; CAN Bus.

1. Introduction

The development direction of modern automobile is intelligence. The development of intelligent automobile is inseparable from intelligent equipment. Since it is an intelligent equipment, it must have the ability to process information independently. This is the familiar microcontroller or microprocessor.If the microcontroller or microprocessor needs to process information, the information must have a source. For example, you need to process the speed. To be precise, it is not processing. It is to make further speed adjustment or make the next speed control strategy according to the current speed information data.To process the speed information, we need to know the current speed. This requires the speed sensor to collect the speed. The speed sensor collects the speed, and the processor makes the whole speed control scheme according to the current speed.

In this process, we will find a problem. The sensor collects a set of data. Many times, several or more modules of the car need this data. At this time, the processor needs to transmit these data to these modules respectively, which requires many transmission lines. There will be thousands of data to be collected on the whole vehicle. After collection, it needs several or more times of transmission lines to transmit data, which not only greatly increases the number of transmission lines, but also greatly increases the difficulty of vehicle repairing. This is a great challenge for vehicle reliability and maintenance. In order to deal with this problem, the world's well-known automobile manufacturers have formulated bus protocols.

2. Overall Design of Bus Communication System Platform

The principle of automobile bus is as follows: after the data of a sensor is collected, a processor packages the data according to the corresponding automobile bus protocol, and then sends it to the bus. The data has a unique number. All modules that need the data can receive the required data according to the number.Such a processing architecture can greatly reduce the data transmission lines.With the continuous development and maturity of bus technology, automobile information is divided into several categories according to the characteristics, function and transmission speed of

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data, such as power bus, comfort bus, diagnosis bus and so on.The information transmitted on the power bus is mainly the information on the main control module, transmission module and ABS module. The information on these modules requires high transmission speed;The information transmitted on the comfort bus is mainly four door controller modules and comfort system controller modules, and the transmission speed of these information is relatively low;The diagnostic module is mainly responsible for vehicle diagnosis. This kind of information needs special messages and should cooperate with the diagnostic instrument.These types of buses have different speeds, but if these types of buses need to exchange data, they also need a module, which is the gateway. The function of the gateway is to convert the information of different systems, so that the data can be transmitted between the bus systems that need to interact.

The automobile bus communication system designed on this platform mainly includes four parts: automobile power bus system, automobile comfort bus system, automobile diagnosis bus system and automobile display system. It mainly covers five modules of automobile comfort system, three modules of automobile power bus system, plus diagnosis module and large LCD system, a total of 10 modules.The main protocols include CAN bus communication protocol, LIN bus communication protocol, diagnosis bus protocol and display system transmission protocol.

The specific design block diagram is as follows:

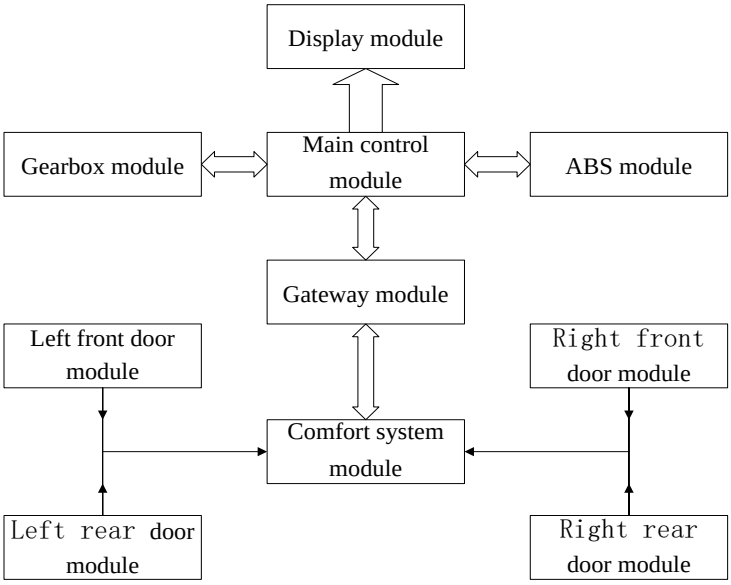

Figure 1. Block diagram of automobile network communication platform

3. Protocol Introduction of Automobile Network Communication Platform

At present, there are many kinds of automobile communication protocols. Many regions and automobile manufacturers have launched their own automobile buses. They have their own characteristics. Each bus has its own advantages. However, generally speaking, these automobile buses are mainly divided into four or five categories according to speed. ABCDE is often used in the industry. Class A buses are mainly 100k / bps and below, this speed is more suitable for sensor information transmission; Class B bus is mainly at the speed of 100k / bps --- 1000K / bps. This kind of bus is mainly used in automobile power bus system and comfort bus system; Class C bus is mainly 1M / bps-100M /bps, which is mainly used in power bus or occasions with high transmission speed; Class D bus is mainly 100M / bps and above. This kind of bus is mainly used in systems with large data flow such as information entertainment system; Class E bus is a special kind of existence, which is mainly used in diagnosis system.

The typical representative of class A bus is LIN bus; The typical representative of class B bus is CAN bus; The representative of class C bus is mainly FlexRay bus; Class D bus is mainly represented by

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optical fiber bus and vehicle Ethernet bus; Class E bus is applied in automobile fault diagnosis, which is a special kind of bus. The automobile network communication platform mainly involves CAN protocol, LIN protocol, diagnosis bus and display bus.The speed and price comparison of various buses are shown in the figure below:

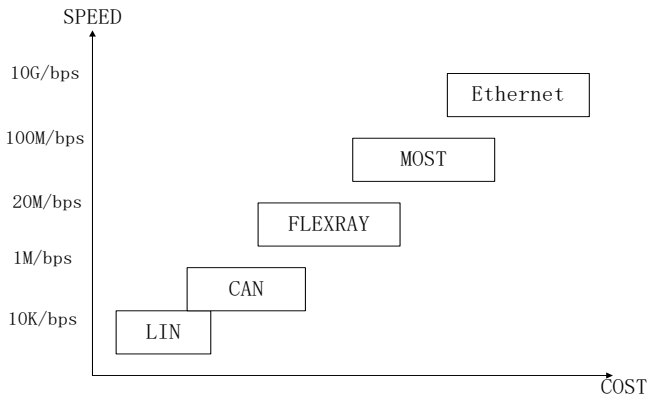

Figure 2. Cost performance diagram of automobile bus

4. Hardware Design of Automobile Network Communication Platform

In order to design the automobile bus communication platform, we must first design the hardware system of the automobile bus communication platform, because the hardware system is the foundation of the platform. With the hardware foundation, the function of the bus platform can be realized. For the hardware design of automobile bus communication platform, the selection of platform controller is a key problem. Now there are many series of microcontrollers on the market, and there are more than a dozen mature series. In each series, there are hundreds of small models according to performance and speed, so how to choose a practical CPU has become the top priority. We chose the principle of reliability and economy. Firstly, the automobile bus communication platform we designed should be safe and reliable. As we all know, the primary problem of automobile is safety, so the microcontroller we selected must be reliable and comply with the automobile industry standards, so that the automobile bus communication platform can have practical application significance. In addition, we should also consider the cost, because the competition in the automotive industry is also very fierce. If the cost is too high, the products will not be competitive, so we should also consider the cost in the selection process.

According to the above two basic principles, we have preliminarily got two design schemes. The first scheme is to select the microcontroller without CAN function module and expand the CAN function module. The second scheme is to directly select a microcontroller with CAN function module. The selection basis of the first scheme is that under the condition of safety, the microcontroller without CAN controller is cheap. For the recent rising market of microcontroller, selecting a low-cost microcontroller is decisive to save the cost of products. The selection basis of the second scheme is that the performance of the microcontroller with CAN function module is more stable without considering the problems such as electromagnetic interference. Moreover, selecting such a scheme will greatly reduce the workload of software development in the later stage, which is conducive to shortening the development cycle of bus platform products. After comprehensive consideration, we adopted a more reliable second scheme. The selected microcontroller is Freescale series 16 bits chip. Freescale chip is a chip specially used in automobile. It has high stability and reliability, powerful function, easy to learn and use. This platform mainly selects MC9S12XS128 chip as the main controller. This chip has 112 pins, the main frequency speed of the chip is 16M, and can reach 40M or higher through frequency doubling. The chip has rich internal resources, including CAN module, SPI module, 2 SCI modules, 8-Channel 24 bits interrupt timer, 8-Channel 16 bits timer, 8-Channel PWM control output, 16-Channel 12 bits AD acquisition, up to 91 general I / O ports, low-voltage

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protection interrupt, low-voltage wake-up function, etc; 128K flash and 12K RAM storage space; The wake-up voltage is 3.135v to 5V; The working temperature is - 40 ° - 125 °; And good EMC protection. The resource function diagram of MC9S12XS128 chip is as follows:

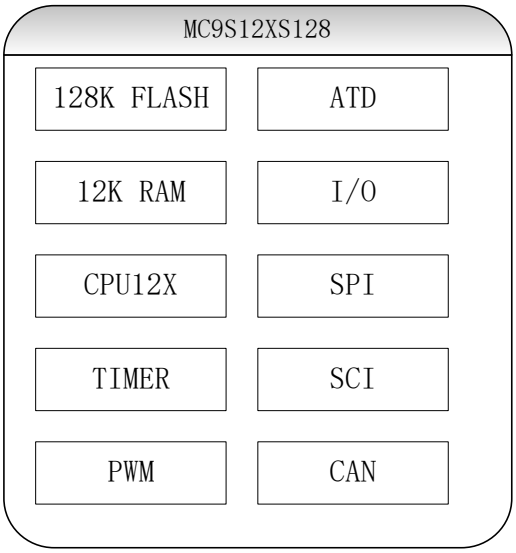

Figure 3. Resource diagram of MC9S12XS128 chip

After the main controller is selected, the CAN transceiver is selected. According to the performance and economy of the product, we selected the TJA1040 transceiver of Philips. TJA1040 has been tested by the market for a long time, has wide application and low price, and is the only choice of can transceiver.For LIN bus transceiver, we also choose TJA1020, which has been tested by the market, so we choose our main chip modules.The remaining devices of the platform are also the devices commonly used in automotive products, so that our products can not only meet the automotive industry standards, but also achieve the stability and reliability of the system in function.

5. Design of Automobile Network Communication Platform Gateway

One of the characteristics of the automobile bus communication platform designed in this paper is that there are four kinds of buses working together, so the design of gateway module is very important. Gateway is a special module, which is mainly used to realize the content conversion of two or more different protocols. In this platform, there are CAN high-speed bus, CAN low-speed bus, LIN bus and SCI bus. Among them, CAN high-speed bus is mainly used in automobile power system, and CAN low-speed bus is mainly used in automobile comfort system. A lot of data interaction is required between these two buses, However, the transmission speeds of the two buses are different, and there is no communication between the buses, so a gateway is needed. There are many ways to realize the gateway. After comparing the advantages and disadvantages of several methods, we finally selected Freescale's MC9S12XEP100 chip. This chip has 5 channels of CAN, one of which is connected to the power CAN bus system and the other to the comfort CAN bus system. After CPU processing, the function of interactive data can be realized. For example, the vehicle speed information is transmitted to the power CAN bus system through the vehicle speed sensor, but the comfort bus system also needs this information. At this time, the gateway module will receive the vehicle speed information in the high-speed CAN bus system, extract it by the gateway module CPU, convert and package the vehicle speed into a low-speed CAN message, and then send it to the CAN comfort bus, This completes the conversion of high and low speed CAN bus information and realizes the function of gateway.The gateway workflow is shown in the figure below:

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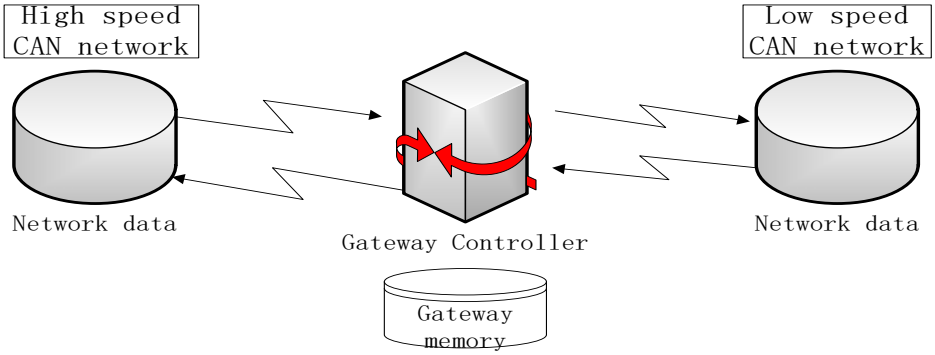

Figure 4. Schematic diagram of gateway workflow

6. Conclusion

The automobile bus communication platform designed in this paper covers four kinds of buses: CAN high speed, CAN low speed, LIN and SCI. The system includes automobile power bus main control module, gearbox module and ABS module; Comfort system module of comfort bus and four door controller modules; And gateway module and display module, which basically realize the main electronic function modules of the vehicle. These modules can operate independently or cooperate with each other to form a bus operation system. Different buses can also interact through the gateway. This platform can not only be used to train the engineering and technical personnel of 4S stores, it can also be used to train talents in automobile in Colleges and universities.

Acknowledgments

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