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Design of Vehicle Data Acquisition and Capture System Based On OBD

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ABSTRACT: The paper connects vehicle CAN bus via on-board diagnostics (OBD), collecting real-time data of vehicle, at the same time, captures the message data transmitted on the bus. The paper establishes two ways of CAN modular circuits using MCP2515 and TJA1050. One way of CAN node sends the request of the state information of vehicle and receives the return information from the vehicle via OBD port; The other way of CAN circuit in the receive mode, identify the format of data frame and receive all of the data transmitted on the CAN bus. The system extends external application of OBD port. Application of automotive protocol is ISO15765-4 that support OBDII CAN. The two modules controlled by MCU, the data sent and received display through the outer serial port RS232. The results show that the system realizes vehicle data acquisition and capture.

Keywords: on-board diagnostics; vehicle CAN bus; acquisition; capture; ISO15765-4

I. INTRODUCTION

Currently OBD (On-Board Diagnostics) has received rapid development, foreign country that based vehicle self-generated data exchange protocol has realized OBD remote detection[1], also has developed OBD detector[2], and received recovery mechanisms to reduce vehicle energy consumption[3], at the same time, OBD data acquisition system can process large data[4]. A large number of domestic suppliers of automotive software developer and designer, automotive electronic product manufacturers and operators put pole into the development of OBD applications, which through the OBD to get 'instantaneous fuel consumption', 'car trouble', 'mileage' and other informations, which can develop a powerful, new products easily used[5]. This system not only to get the car to achieve a driving speed, engine speed, cold fluid temperature, intake air temperature and other informations from OBD, but also to detect transmission datas by capturing them during transmission time.

II. AUTOMOTIVE OBD

In the car's self-diagnostic system, which can be divided into three large system—OBD, OBD I and OBD II, and OBD III will also appear[6-7]. Currently, it is widely used OBD II system. As is shown in Figure 1, which is based on OBD connect cars and the external circuit.

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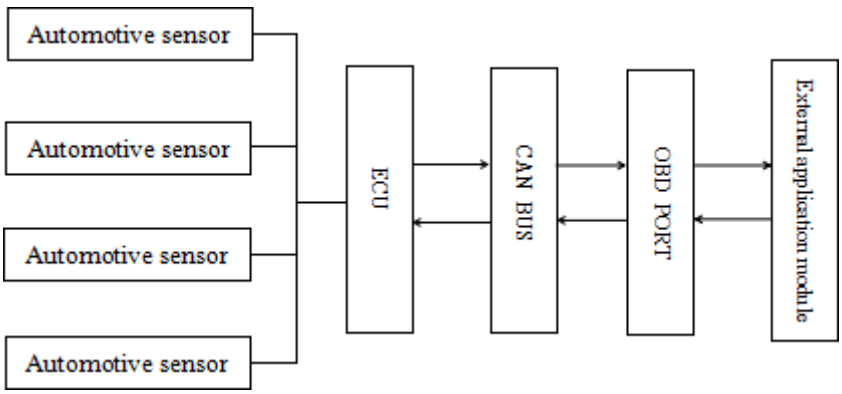

Figure1. Cars with an external circuit connection diagram

Automobile manufacturers use the same standard format of 16-pin OBD diagnostic port, fault code is same, the packet transmission standard is also in agreement with the form of ISO or SAE, so use common diagnostic systems. OBD II standard communication protocols used generally include: ISO 9141-2, ISO 14230-4

(KWP2000), SAE-J1850 PWM, SAE-J1850 VPM, ISO15765-4 (CAN-BUS)[8]. In this paper, it applies ISO15765-4 protocol which can support the CAN bus. As is shown in Figure 2,which is CAN OBD data transmission format in the message.

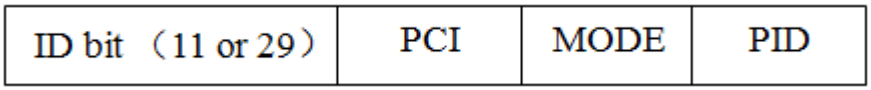

Figure 2. CAN OBD data transmission format in the message

PCI indicates the number of protocol control information bytes, MODE indicates mode OBD system, PID tag obtained informations.

III. SYSTEM DESIGN

The system consists of two modules, module I for sending the data of vehicle CAN bus request and receive, module II for the CAN message data capture. Module I is to send a CAN message to the car bus, and receives packets returned by OBD port. Module II is in data capture state, capturing data packets transmitted for all nodes on the bus. As is shown in Figure 3, which is realization diagram.

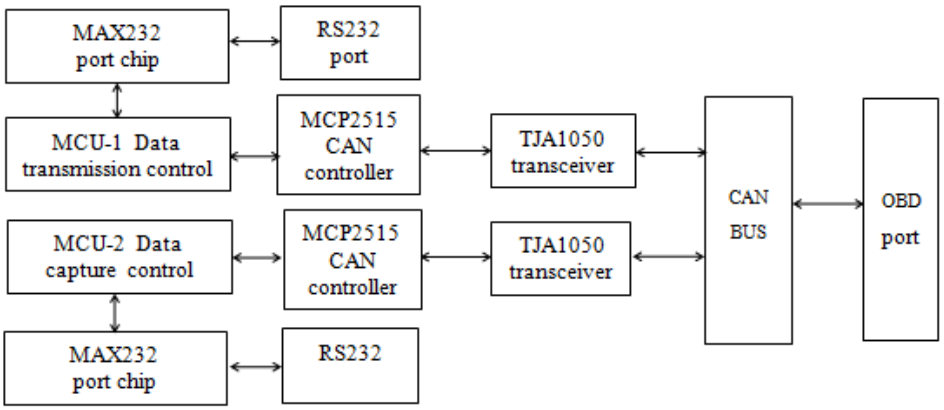

Figure3. overall system block diagram

A. Hardware Design

Two modules CAN module hardware design is basically consistent. CAN controller applies the controller chips MCP2515 of Microchip mining company produces, it comes with an industry-standard common SPI serial port, which can meet CAN2.0 technical specifications, and compared with products which is available in the market, it has the features of small size, low cost, easily used[9]. CAN transceiver adopts chip production TJA1050 which is produced by NXP Semiconductor Corporation. TJA1050 can achieve convert between differential signals transmitted on the bus and the CAN controller signals. And MCU adopts STC89S52. Power supply using car OBD port which can provide 12V power supply.

B. Software Design

Data transmission format of the data acquisition module follows ISO15765 protocols, data formats, including standard frames and extended frames. In the MCP2515 configuration mode, setting the CAN baud rate and data frame format, opening the packet receive interrupt controller, and the interrupt is generated after reading the received data. The working process is in the normal mode. As is shown in Figure 4, which is acquisition module software flow chart.

Data capture module CAN nodes are only in the receiving state. It close up MCP2515 acceptance masks register and acceptance filter register, to receive packets all the nodes of the bus. Receiving process would identify the data frame format firstly, and it is on the basis of standard frame or extended frame format, which means the received data should be processed once by two groups. A group is to send a request to the bus, the other group is the information which received after sending back the request. Because the response time is very short, MCP2515 need once collected two sets of data, then what should be processed, which is to prevent the reception register overflow error. MCP2515 has two receive buffers RXB0 and RXB1, and through using the configuration RXB0CTRL accumulated manner, which can complete data reception. As is shown in Figure 5, which is capture module software flow chart.

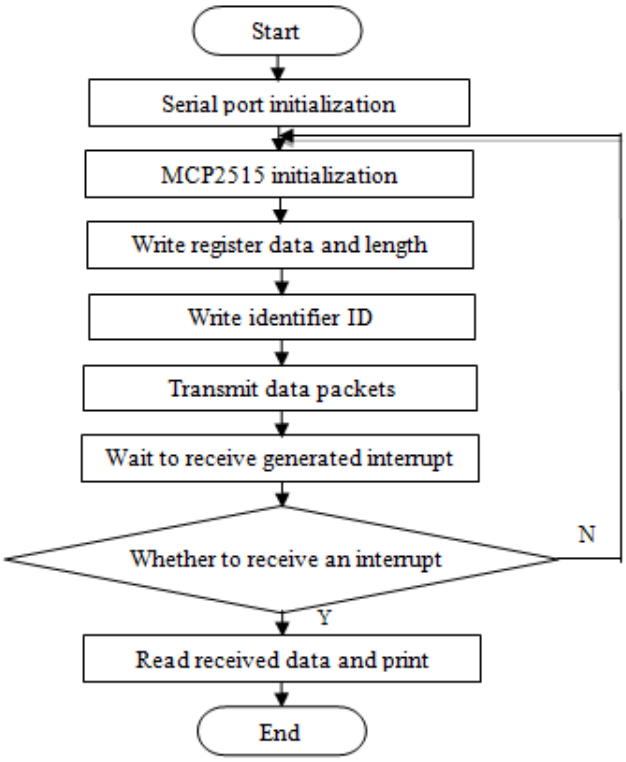

Figure 5. Data capture software flow chart

IV. SYSTEM TEST

The system uses a test environment for automotive ECU emulator, which supports a variety of automotive bus protocol. After the system starts up, the access circuit module male OBD port socket, and only when we insert the OBD port to the emulator, the system is to work. As is shown in Table 1, which is test content.

Table 1. vehicle data information test content

Identifiers ID	PCI	MODE	PID	Test content	Identifiers ID	PCI	MODE	PID	Test content
	0X02	0X01	0X0C	Engine speed		0X02	0X01	0X0C	Engine speed
0X7DF	0X02	0X01	0X0D	Driving speed	0X18DB33F1	0X02	0X01	0X0D	Driving speed
Standard frame	0X02	0X01	0X05	Coolant temperature	Extended frame	0X02	0X01	0X05	Coolant temperature
	0X02	0X01	0X0F	Intake air temperature		0X02	0X01	0X0F	Intake air temperature

Data transceiver control module sends a request message, receives cars ECU return information, data capture module obtains data transferred on the bus. Figure 6(a), which is to send and receive data control module detects engine speed continuous acquisition of cars. Figure 6(b),which is to capture data collected on the bus transmission. The results show that the data transmission control module properly collected automobile engine speed information, and data transceiver module is completely received on the bus transmission.

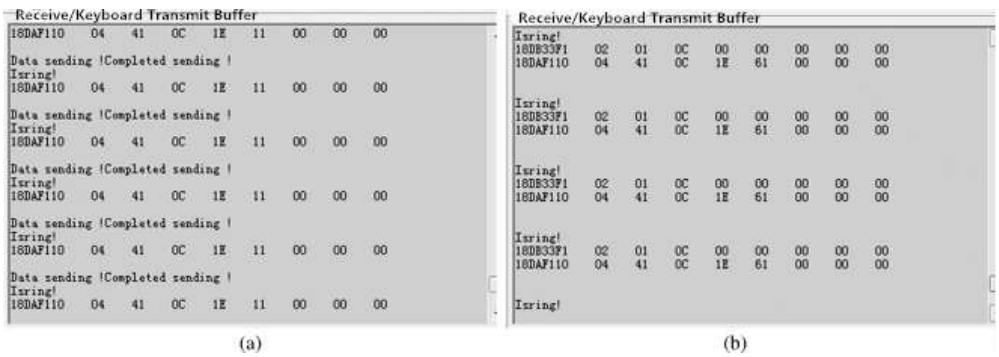

Figure 6. Two circuit modules acquire data

V. CONCLUSION

This article provides an automobile CAN bus data and the capture solutions of the data bus by car OBD port, and the received data is displayed by the serial port RS232. Data acquisition module can realize car status information acquisition. Data capture module can make the data transmission of the bus to detect.

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