

Ethernet-CAN Protocol Conversion Module

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Abstract. Networked industry control system usually consists of Fieldbus and Ethernet. The protocol conversion problem of this kind of heterogeneous network has become one of the focus problem be researched in the technology of networked measurement and control system. The method of Ethernet and CAN bus protocol conversion has been presented in this paper based on the protocol conversion problem of Ethernet and CAN Bus has been studied. Ethernet and CAN bus protocol conversion module has been designed and implemented, by using STM32F103RC ARM microprocessor and ENC28J60 Ethernet controller. By using simplified Ethernet communication protocol-uIP, the protocol conversion efficiency has been improved and the stability of the system communication has been guaranteed. The experimental results show that the module be designed can realize high-speed and transparent protocol conversion.

Keywords: protocol conversion; Ethernet; CAN bus; STM32 ;uIP

1 Introduction

Among the modern industry control field, bottom control system are the mostly used field bus technology. Most of the upper layer control and management systems consider a computer with an Ethernet interface as a terminal. In the field of industrial control, CAN (Controller Area Network) bus technology has been widely recognized and widely used in industrial automation, because of its high performance and reliability and it has been applied widely in the ship, medical equipment, intelligent building and other fields^[1]. However, its communication distance is short when using high-speed communication, and its less access node shortcomings limit wider application. Ethernet technology has the advantages of far transmission distance and easy networking, which can make up for the shortcomings of the CAN bus^[2], and it has shielding the underlying differences in the function of the control network. So this kind of CAN and Ethernet integrated heterogeneous network have been widely used. Besides, it makes two kinds of protocol conversion issue become a hot research scholars. In order to solve such problems of heterogeneous network networking communication, literature 3 put forward a solution based on the C8051F040, the use of low-speed 51-core chip's ability to limit the data processing.

Other solutions (such as described in literature 4 solution) require the high cost, transmission opaque problems.

According to the low cost, efficient and transparent transmission requirements, this paper put forward conversion scheme based on the STM32 Ethernet-CAN protocol , Able to provide the Ethernet technology and CAN bus technology advantages a good play, for such problems be put forward new ideas.

2 Analysis of the related protocols

CAN bus and Ethernet are using sub-definition hierarchical network communication protocol standard, but there is a huge difference between the two^[5]. Therefore, we analyze two protocols respectively, provides a theoretical basis for the design of Ethernet-CAN protocol conversion model.

CAN protocol only has data link layer and physical layer. The data link layer is divided into LLC (Logical Link Control sub layer) sub layer and the MAC sub layer. MAC sub layer is the core of the CAN protocol, MAC sub layer is responsible for message framing, arbitration, response, error detection and calibration. The physical layer defines the actual transmission mode signal, the technical specification does not define the physical layer characteristics of the transceiver, so as to allow their application to the transmission media and optimize the signal level^[6].

In the course of the practical development of Ethernet-based TCP/IP protocol stack, four-layer model has been most widely used. This four-layer structure is the respectively network interface layer(physical layer and data link layer), network layer, transport layer and application layer. TCP/IP communication protocol using this hierarchical structure, each layer needed is under a layer to provide services to complete their tasks. The model uses the TCP / IP protocol stack referring to a series of protocol set, it includes the IP protocol, ICMP protocol, ARP protocol, RARP protocol, TCP protocol and UDP protocols and a series of network protocols. Among them IP, TCP protocol are especially important.

According to the CAN protocol and TCP/IP protocol characteristics, the conversion reference model designed based on the STM32 Ethernet-CAN protocol is shown in Figure 1.

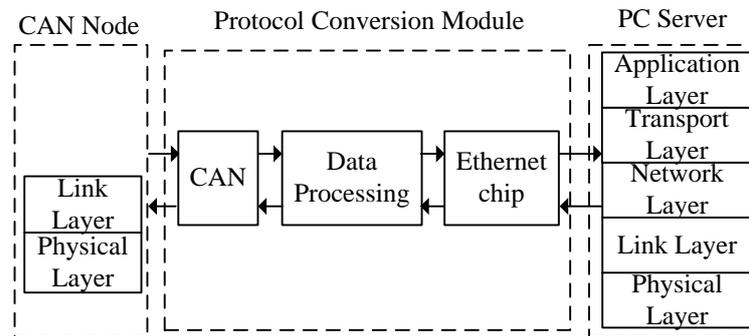


Fig. 1. Protocol Conversion Model

Conversion model using Ethernet User Data and CAN Data frame is shown in Figure 2.

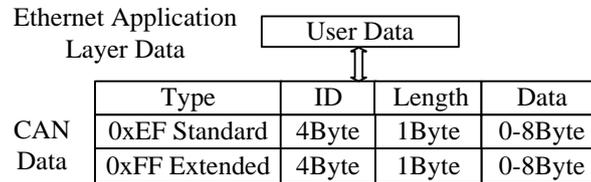


Fig. 2. Data Frame Transformation Model

3 Hardware Design

STM32F103XX Enhanced Series ARM micro processor controlled high-performance Cortex-M3/32 bit RISC core operate at the frequency of 72MHz, work at -40 °C to +105 °C temperature range, built-in high-speed memory with rich peripheral resources including high-speed SPI interface and CAN controllers.

ENC28J60 is a Ethernet controller chip accorded with IEEE 802.3 all protocol standard. With a standard serial peripheral interface (Serial Peripheral Interface, SPI), data transmission rate reached 10Mb / s by SPI transceiver data and commands.

4 Software Design

According to Figure 1 it shows an Ethernet-CAN protocol conversion model design software programs, complete implementation forwarding between Ethernet data and CAN data. The follows introduce transplant Ethernet protocol and Ethernet-CAN bidirectional data transceiver program.

Because CAN bus can only achieve half-duplex communication mode, so the entire network is divided into uplink and downlink traffic. The whole Ethernet-CAN transceiver process use interrupt system treatment, TCP protocol for data transmission to ensure the data transmission efficient and stable.

5 Experimental testing and data analysis

In order to provide reliable data transmission by using TCP connection of data transmission. Set your computer as a server end model using TCP Server protocol, set the IP address 192.168.1.103, select the 1400 port. Ethernet-CAN conversion module is connected to the CAN network (CAN protocol with the highest rate of 1Mbps, at a certain time interval to send a large number of the same data). After establishing a connection, the Ethernet-CAN conversion module sends and receives data is shown in Figure 8.

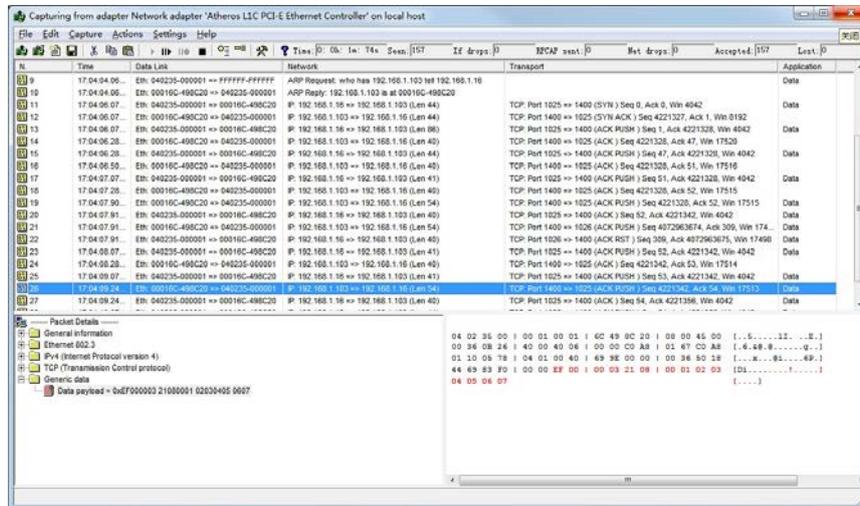


Fig. 3. Send and Receive Data

6 Conclusion

This paper designs Ethernet and CAN bus protocol conversion module, realizing Ethernet and CAN data transparent transmission of data. Innovative points lies: hardware circuit design using the higher cost of STM32F103RC micro control processor, higher operating frequency, extremely fast interrupt response, the CAN controller with FIFO receive guaranteed real-time data; software used on uIP TCP protocol to establish a stable service to ensure that data in high-speed and low-speed CAN Ethernet network stable and reliable transmission.

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