

Design of Electric Control System Based on CAN Field Bus



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ABSTRACT: Field bus is an extension of network communication technology, so it is a hot spot in the field of automation. Field bus technology provides strong technical support for reliable data transmission. CAN is one kind of field bus technology, and other communication bus, it has obvious superiority in the distributed control. Field bus technology marks the beginning of a new era in the industrial control technology. It includes computers, automation, communications and other technical fields, being in continuous improvement and perfection. Because of its flexibility, it is widely used in the production of life. With the development of technology, CAN field bus technology have been unified international production standards. The paper focus on the combination of field bus and Ethernet, field bus real-time performance, choice of field bus, field bus integration, field bus network architecture and development of field bus networks, and deeply discusses the issue. This paper analyzes the characteristics of CAN field bus, and the design of the electrical control system based on CAN field bus.

Keywords: CAN bus, Electric control system, Field bus

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1. Introduction

Field bus is a comprehensive product of computer communication technology and control technology, so the field bus is the intelligent and digital communication network. Because of its high performance and low cost characteristics, it is widely used in industrial field, through the field bus communication technology, can realize the information exchange between different equipment. Intelligent control is the advanced stage of the development of control theory and technology, and it is a new and rapidly developing field[1]. It is mainly used to solve the control problems of complex systems which are difficult to be solved by

traditional methods[2]. Field bus is suitable for the development of industrial control system, and its characteristics meet the needs of modern industrial production automation) [3].

CAN field bus have the characteristics of openness, operability, equipment control, structural dispersion and environmental adaptability? Development refers to the consistency of the standard, as long as the unified standard arbitrary devices and systems can achieve mutual connection[4]. The disclosure of the communication protocol, the equipment produced by different manufacturers can also carry out the exchange of information[5]. And customers can buy according to their actual needs of different manufacturers of products, from the construction equipment, through the field bus and system. Interoperability is to allow the interconnection of devices and systems to communicate with each other. Autonomy is the field bus in the actual use of the process, can only rely on the field of equipment to complete the automatic control, and can always determine the working state of the running equipment [6].The field bus simplifies the structure of the system, and changes the original control system. Improving the reliability of the system by using the distributed system. At the same time as the factory floor of the communication network, the field bus is designed according to the actual situation of the field[7]. Its anti interference ability, safety explosion-proof performance requirements are more stringent, so the adaptability of the environment is also strong. This paper mainly discusses the design of electrical control system based on CAN field bus, introduces the concept and characteristics of field bus, CAN bus and intelligent control. And to explore the mediated subject at the beginning of the development and design of intelligent air conditioning control system, including system design and implementation, control scheme, control algorithm with adaptive and self adjustment function of multi modal, simulation and comparison research and software design [8].

2. Start of the Art

2.1 Field Bus Overview

The international organization for Standardization (ISO) provides the structure of the computer network including: physical layer, data link layer, network layer, transport layer, session layer, presentation layer and application layer. But the field bus in the actual application does not need so many levels of structure; therefore the International Electrical Technical Committee provides the field bus structure to be 3 layers. Namely: physical layer, data link layer and application layer. However, due to the further demand, the American ISA/SPSO society has added a user layer to the custom field bus structure model. Therefore, the structure of the field bus is 4 layers. Figure 1 is a schematic diagram of the application of field bus, we can see that the redundant network connectivity and control equipment. Field bus is one of the automation of hotspots, known as the computer network in the field of automation. Field bus technology marks the start of a new era in the field of industrial control technology. It includes computers, automation, communications and other technical fields, is now in an ongoing, continuous improvement and perfection. Studying on field bus started late, both theoretical research and applied research are lagging far behind the foreign, in depth research of field bus network technology in China is imminent.

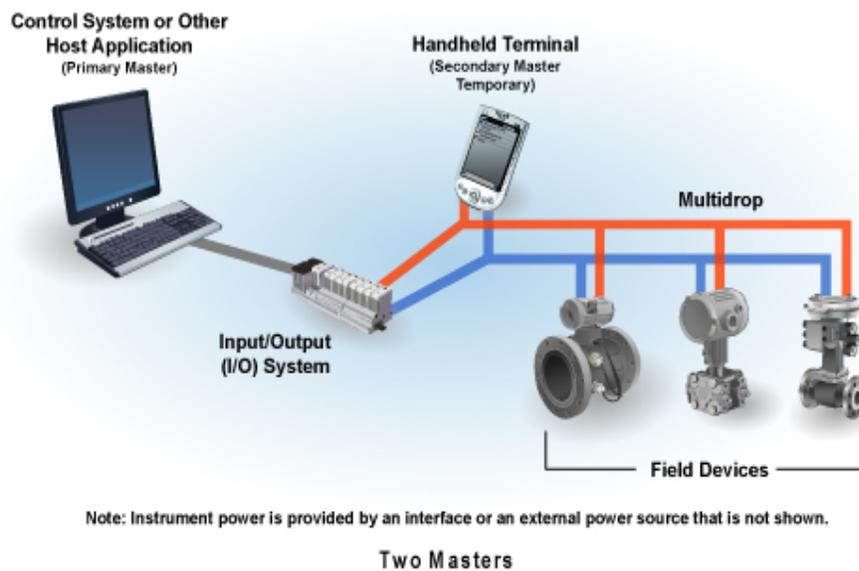


Figure 1. Sketch of field bus application

2.2. Features of CAN Bus

As a kind of development and broadcast communication protocol, CAN bus has some outstanding characteristics. (1) can have more than one host to work, the way of communication is very flexible; (2) the data of communication has the characteristics of real-time; (3) point to point, one to many broadcast information transmission and reception; (4) the transmission time is short, the anti-interference ability is strong; (5) using twisted pair as the medium, the cost is low; (6) data transmission synchronization, more reliable [9] (as shown in Figure 2).

CAN-bus compatibility.

With an integrated CAN-bus system, this unit communicates with factory fitted Intelligent Multi Information Display (I-MID) screen, pulse dimmer and steering wheel control buttons.

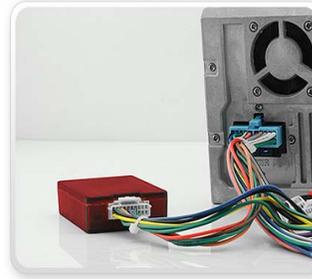


Figure 2. CAN-bus compatibility

The CAN bus model is divided into physical layer and data link layer. The physical layer defines the signal transmission between the device and the system. Although this is related to the characteristics of the driver, receiver, but the device on the bus and not too many regulations, which is to facilitate the optimization of the actual situation in accordance with the. The data link layer includes logical link control sub layer and medium access control sub layer, which mainly deal with various problems in data transmission, such as packet filtering, overload notification and so on. The medium access control sub layer is the core of CAN, which is mainly used to regulate the data transfer rules, so it can not be modified flexibly. Table 1 is field bus parameter information, we can see that the use of field bus and the traditional equipment has the same point. In Ethernet physical layer Ethernet provides a physical electrical, mechanical and other properties, using the medium to coarse cables, thin cables, twisted pair or fibre (as shown in Figure 3).

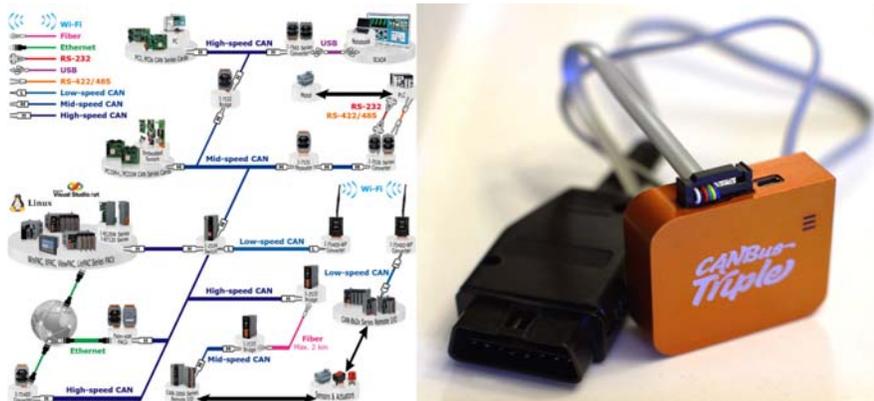


Figure 3. CAN-bus data

The data link layer provides media access method, which follows IEEE802_3 standard and uses CSMA/CD mechanisms to control Ethernet nodes access to the media. Network layer defines the Ethernet data packets from the sender to the receiver, using the IP protocol. TCP sampan DP for Ethernet of transmission layer agreement, defined application layer and network layer of interface. Between source and purpose Zhijian established a end to end of connection, which TCP agreement main processing oriented connection service, transmission of reliability get has guarantee, but TCP agreement on network resources of occupied to big some; UDP agreement processing no connection service, data reported no confirmed mechanism, UDP of data reported in the not exists connection information, so transmission efficiency to above TCP. Application layer protocol operations of network interface for the application process, it directly to consumers, provide valid data for user services.

Symbol	Parameter	Condition	MIN	MAX	Unit
VCC	Power voltage		4.5	5.5	V
ICC	supply current	V1=1V	-	70	MA
VCAN	DC Voltage	0V<VCC<5.5V	-8	14	V
VDIFF	bus voltage		1.5	3.0	V
TPD	propagation delay	High Speed	-	50	NS
TAMB	ambient temperature		-40	125	C

Table 1. Field bus parameter information

3. Methodology

CAN field bus electrical control system, the use of open broadcast network architecture to the multi controller nodes distributed to the field and intelligent devices, and ultimately constitute a comprehensive control system. And the structure of the network topology is arbitrary; communication media can also choose different styles. The decentralized control system makes the reliability and flexibility of the system to be improved. This shows that the system can be easily carried out restructuring and expansion. The use of field bus intelligent equipment for a variety of debugging, check the work will become more relaxed, but also makes the maintenance of the system becomes simple and easy [10]. CAN serve as a network protocol, although the object of the application is communicating field devices, but not with overall network communication is totally different. Given the maturity and the de facto standard of Ethernet, CAN-bus is corresponding to the ISO/OSI 17-layer network protocols. Whether CAN the standardized, or for different applications developed in the context of the high-level application protocol, are based on the established model. The other hand, the features of a mountain in the industrial field-level data communication, real-time and short frame transmission. Therefore, CAN bus specification references in the initial development of the OSI model have been developed. Talking into account the environment and the cost of the problem alone defines the physical layer and data link layer. This chapter introduces the features of the CAN bus, described the advantages and functions of field-level communications. And then details the basic contents of CAN-bus communication protocol, and discusses the unique message transport mechanism of CAN bus and CAN bus communication is studied on the basis of the basic network structure.

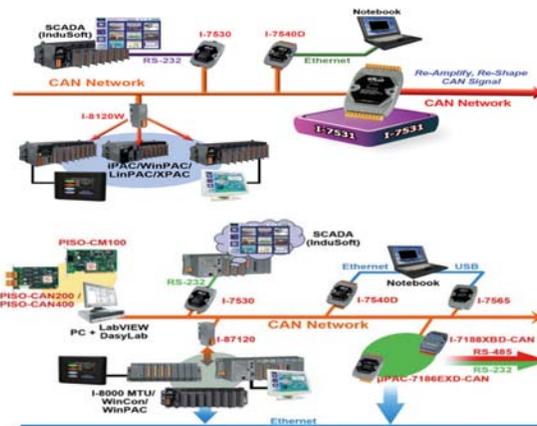


Figure 3. CAN field bus electrical control system

The differential reception capacity of the CAN controller and the differential transmission capacity of the bus are provided by the controller. In addition, it also has the advantages of low Current standby mode; bus can connect nodes, can protect the bus and so on. The current limiting circuit is designed in the driving circuit of PCA82C250, which can effectively prevent the occurrence of short circuit. Even a short circuit, it will not cause damage to the equipment. Physical layer is between different nodes in accordance with all electrical properties for the actual transmission of information. However, within the same network,

the physical layer must be the same for all nodes. Nevertheless, the choice of physical layer is still free. The purpose of this technical specification is to define the transport layer, and defines the CAN protocol surrounding the role of each layer (as shown in Figure 3).

4. Result Analysis and Discussion

The electric control system of CAN field bus realizes the digitalization and information of the factory, which is convenient for the maintenance and trouble shooting of electrical equipment. However, when using the field bus technology, it should be noted that the structure of the network should not be more than three layers, so as to improve the anti-interference ability of the equipment. In addition, the rate of communication is controlled by controlling the number of nodes (as shown in the table).

Symbol	Lead	Introductions
TXD	1	To send data input
GND	2	Ground
VCC	3	Power Supply
RXD	4	Accept the data input
CANH	5	Reference voltage output

Table 2. The field bus system function test

The nodes on the CAN network can meet different requirements at the same time according to different priorities. And its data transmission is used in short frame structure, so that the number of bytes per frame is limited to 8, so that can greatly shorten the time of data transmission, reduce the probability of interference. System self diagnosis, equipment monitoring and so on to improve the reliability of the system, but also to facilitate the staff of the equipment inspection and repair. Any node in the CAN network can send information to other nodes at any time, and the communication mode is very flexible. When the CAN node is a serious mistake, it will automatically turn off the bus to cut off the connection between the node and the bus, so that other nodes on the bus will not be affected by any.

5. Conclusions

Field bus is a digital, bidirectional transmission and multi branch communication network which connects intelligent field devices and automation systems. It is the product of computer technology, communication technology and control technology. It is a kind of open and distributed new mode, and the field bus is one of the hot spots in the field of automation technology. The electric control system based on CAN field bus can receive a large amount of information data from all kinds of intelligent equipment in the work field, so the automation integration of information in modern chemical plant can be realized. CAN bus because of high cost, high communication rate, unique design and other characteristics of the growing popularity of the people, so the market prospect is very open. Although CAN was first used in the automotive field, but today, whether it is the machinery industry or marine aviation can see the application of CAN. With the development of technology standardization and standardization, as well as the continuous development of the electrical equipment and other front-end equipment, the unified standard of different equipment communication interface for the choice of equipment to provide more possible. And the electrical control system will be gradually improved. In this paper, a distributed control system based on CAN field bus technology is designed and developed. System in the computer, control, communication, network and circuit design of more advanced technology, the system has relatively complete control functions and rich monitoring function, with intelligent control algorithm, steady performance, friendly interface and excellent performance price compared to. The control system has been widely used in the control and monitoring of air conditioning and fire control system, and has achieved good results.

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