Embedded Staff Identity Acquisition and Management System Based on Information Button and CAN Bus

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Abstract – Considering special working conditions of under ground coal mines, traditional IC cards, magnetic cards or radio frequency cards do not work well in entrance guard and work attendance check system because of inconvenient carry, damaged easily and unsuitable in severe surroundings. So an access and attendance system for mine which is more firmly, durable and good performance is designed using new intelligent information carrier – iButton(Information Button). For iButton has a stainless steel shell, which make it has the advantages of anti-strike, antirust, anti-magnetism and anti-folded, the reliability of the system is enhanced greatly.

Key words – *access control*; *iButton*; *microcontroller*; 1-*Wire protocol*

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1 Introduction

As normal information storage medium, magnetic cards, IC cards or radio frequency cards are usually used in traditional access and attendance systems. But when they are used in severe conditions such as underground coal mine, some obvious disadvantages cannot be ignored, which may be damaged easily, carried inconveniently, narrow temperature range, unreliable data reading and short lifetime. While as a new intelligent information carrier, the iButton(information Button)has many merits due to its stainless-steel package which is highly resistant to such environmental hazards as dirt, moisture, shock, corrosion, magnetism and fold. Each iButton is produced with a guaranteed unique 64-bit registration number that allows for absolute traceability. Its compact coin-shaped profile is self-aligning with mating receptacles, allowing the iButton to be used easily by human operators. The accessories enable the iButton to be mounted almost on any objects including containers, pallets and bags, which makes it convenient to carry. What's more, it has a wide temperature range. Therefore, the reliability of the new system based on iButton technology is enhanced greatly[1].

The outline figure and some key ring mounts of iButton are showed in Fig. 1 and Fig. 2. From the figures it can be seen that the size of the iButton is very small, and owing to the perfect key fobs design, the iButton can be carried easily and conveniently.

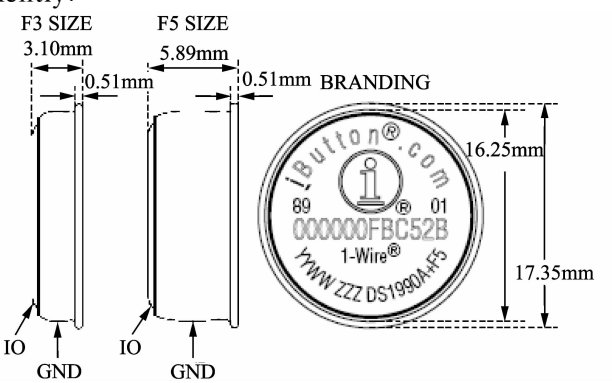

Fig. 1 Outline of iButton

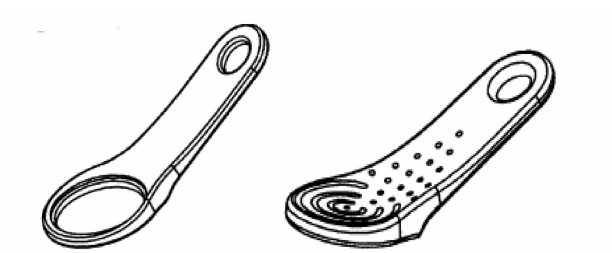

Fig. 2 Key fobs of iButton

For the iButton, the data is transferred serially through the 1-wire protocol, which requires only a single data lead and a ground return[2]. Thus the system has some features such as saving I/O lines, simple structure, low cost, easy to maintain and expand.

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2 System description

2.1 Structure and theory of the iButton

There is a large scale integrated circuit in the iButton, which consists of I/O processor, memory and parasitic power module. Fig. 3 shows structure-function block diagram of iButton DS1990A.

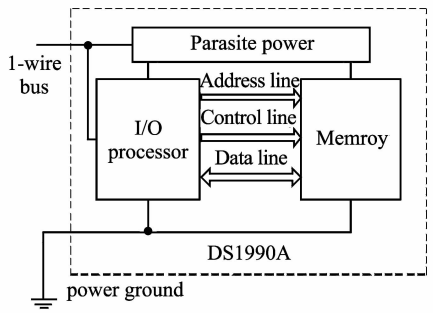

Fig. 3 Structure diagram of iButton DS1990A

According to the structure diagram of the iButton, information can be accessed with minimal hardware, for example, a single port pin of a microcontroller. The power to program and read iButton is derived entirely from the 1-Wire communication line. Because the iButton adopts the 1-wire protocol, it has a particular master-slave serial communication method, always acting as a slave unit, and the outer processor acts as the master communication unit.

At the beginning of every communication, the outer master processor generates a low power reset pulse signal, and the iButton begins to check the wire power after it has received the reset signal[3]. When the wire power shifts to high level, the iButton outputs low power presence pulse for several microseconds to inform outer processor that the connection has been done, and then the outer processor begins to read or write the iButton.

2.2 The whole system structure

Considering main shafts and auxiliary shafts commonly in the mine, a multi-node work attendance check system is designed based on embedded system and CAN bus technology[4]. Each unit has the same function, no matter what the hardware and software are. The hardware of each unit mainly includes iButton read and write interface circuit, hardware clock module, alarm & display circuit, CAN bus interface and entrance guard driven module. The whole system diagram is showed in Fig. 4.

The master processor LPC2119 has CAN bus communication interface, which can obtain every miner's information, and send the information to computer management system via CAN bus when needed[5]. The computer management system can store, analyze and print the data.

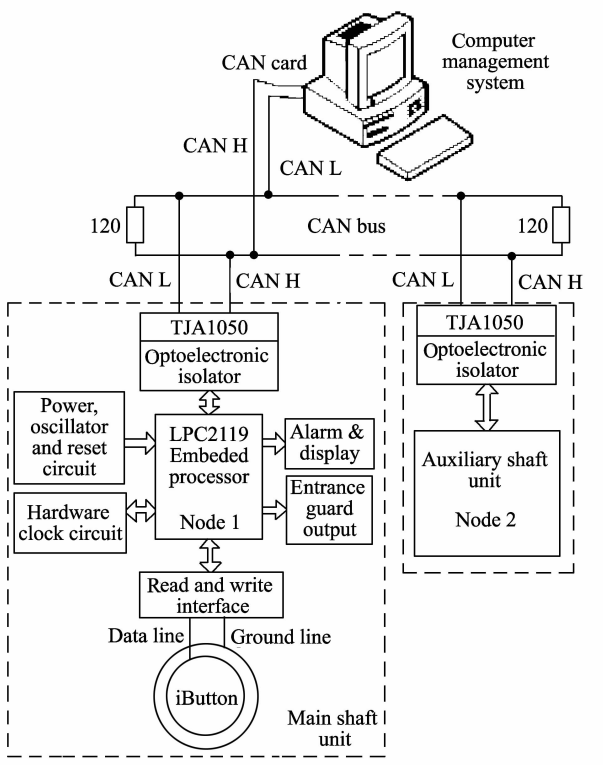

Fig. 4 System structure diagram

3 The iButton communication circuit

Since the 1-Wire communication protocol needs strict impulse sequnce, which is quite difficult to be obtained through the direct I/O pins of outer ARM processor LPC2119, a traditional serial communication to 1-Wire serial communication via chip DS2480B is designed. Because the DS2480B has a timer which enables it to generate 8 1-Wire time gap sequences according to one character, the system reliability and data communication throughput can be enhanced greatly. The circuit is illustrated in Fig. 5.

In order to protect the DS2480B interface circuit and ensure the communication reliability, a low capacitive impedance ESD protection diode and a RC filter circuit between the 1-Wire pin end and the iButton are designed as shown in Fig. 5.

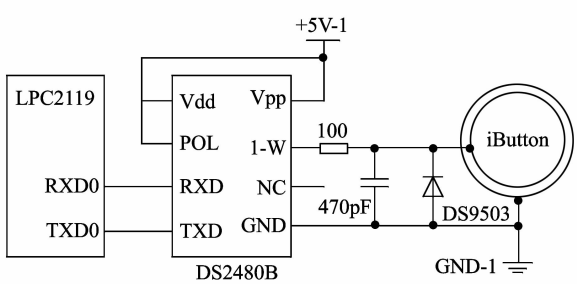

Fig. 5 iButton communication interface

The DS2480B has three working modes, i. e. command mode, data mode and checking mode. The command mode and data mode can switch each other via checking mode. After DS2480B receives the reset command byte, it will execute communication and collocation demands, and when it is working in data mode, the outer processor will begin to read or write iButton information.

4 CAN bus interface circuit

In order to improve the reliability of CAN bus communication system an optoelectronic isolation circuit is designed by using the single-channel high speed optocoupler 6N137, with the maximal speed reaching 10 MBits per second, which enables it to meet the needs of CAN bus high communication speed. The designed optoelectronic isolation communication circuit is shown in Fig. 6.

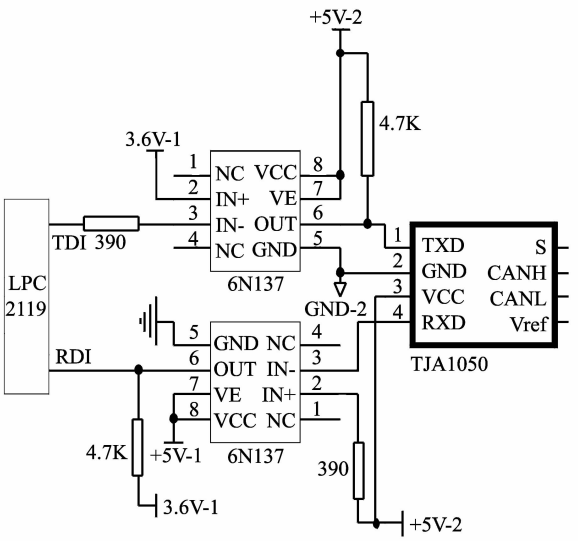

Fig. 6 Optoelectronic isolation communication block

The pins TD1 and RD1 of ARM chip LPC2119 are the output CAN bus pin and input CAN bus pin, each of which is connected to one 6N137 respectively. And then, the 6N137s is connected to the high speed CAN bus transceiver, thereby the CAN bus communication with optoelectronic isolation is achieved.

5 Software design

The system's program is compiled in C language, and in order to improve the reliability of the system, the Cyclic Redundancy Check (CRC) is used in the data communication. The flowchart of the system is shown in Fig. 7.

After the master processor LPC2119 reads each worker's iButton information, the CRC check program runs, and only when the CRC check is passed, can the following steps such as data communication and information management be executed.

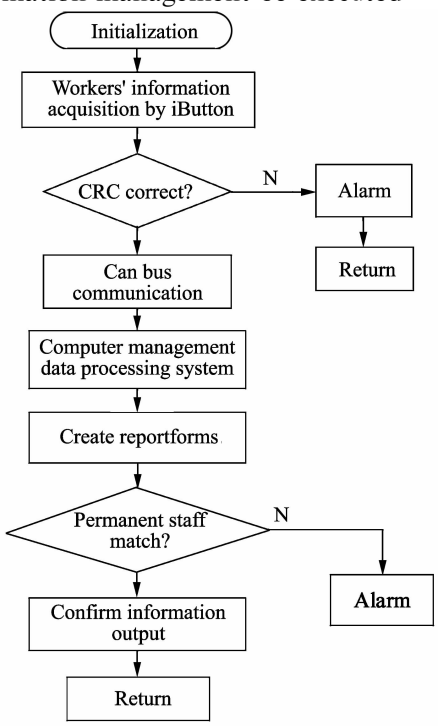

Fig. 7 Main program flowchart

6 Conclusions

The door access control and attendance system based on iButton and CAN bus is durable and reliable than the traditional methods. Furthermore, with the usage of CRC in data communication of iButton message, the reliability of the system has improved greatly. So it is very suitable for the tough working conditions of coal mines.

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