Design of the Fingerprint Control Power System Based on Single-chip Microcomputer

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Abstract

In modern society, more and more attention has been paid to electricity safety in laboratory. In order to achieve safety management of power supply, the fingerprint control power supply system has been developed based on a single chip, which controls power supply on-and-off by fingerprints. When the power load exceeds the set point, the power supply will be cut off automatically, which can avoid safety accidents effectively resulted from the over-load of the power supply. ITC3780 are used as power module. STM32 single chip and JLX12864G are used as control core and LCD module respectively. At the same time, the system is equipped with alarm module. When the fingerprint is illegal or the power supply is overloaded, an alarm signal will be sent out to ensure the safety of the laboratory power.

Keywords

Single chip, Fingerprint control, Power supply, alarm system.

1. Introduction

As we all know, the safety of laboratory electricity is getting more and more attention. On the one hand, the energy used by laboratory equipment and instruments is basically electric energy. In many cases, laboratory fires are caused by overload of power supply [1, 2]. On the other hand, abuse of electricity is happened in many laboratories, which cannot be strictly controlled in the power management. Moreover, with the increasing awareness of confidentiality, people put forward higher and higher requirements on security.

At present, manual management, "user name + password" and magnetic cards are adopted in laboratory power management. The former greatly increases the workload of management personnel, while the latter requires users to remember passwords and account numbers, which not only increases the memory burden, but also is easy to be replaced by impostor. Moreover, due to the loan ability of magnetic CARDS, it is easy to cause confusion in management [3, 4].

In order to realize the safe management of power supply in laboratory, a fingerprint control power system based on single chip microcomputer is proposed. Fingerprint is used to control the power supply on and off. The power supply automatically cut off when the load of the power supply exceeds the set value, which can eliminate the safety accidents caused by safety accidents.

2. Structure of the System

The framework of the fingerprint control power system designed in this paper is shown in figure 1. ITC3780 and STM32 single-chip microcomputer are used as the power module and the main control system respectively. The main functional modules include fingerprint identification module, relay module, load monitoring module, display module and alarm module. Fingerprint identification module is used for fingerprint identification, so as to realize the registration and verification of user identity. The relay module acts as a switch. The load monitoring module is used to monitor the power load. The display module is used to display the working status of the system and the legitimacy of the user's identity. Alarm module is used to alarm when fingerprint is illegal or power supply is overloaded, which plays the role of security warning.

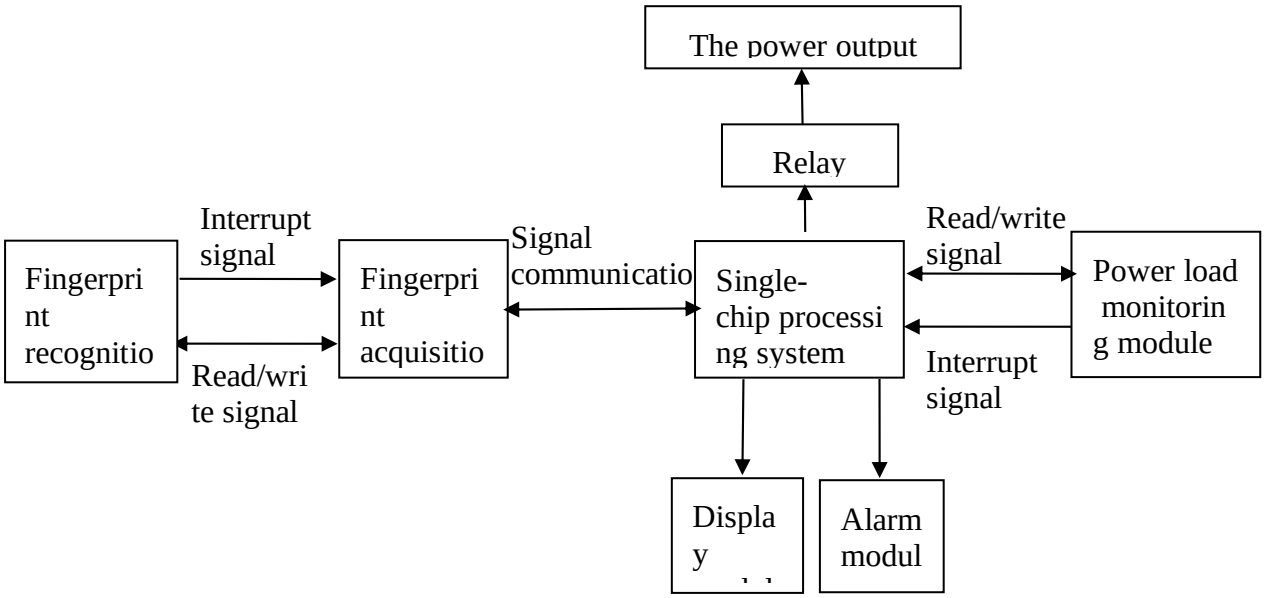

Fig. 1 Overall framework structure of the system

3. Design of System Module

3.1 Main Control Unit

The main control chip of the system is STM32F101, which uses the high-performance 32-bit RISC kernel with a working frequency of 36MHz, built-in high-speed memory (128k-byte flash memory and 16k-byte SRAM), rich enhanced peripherals and I/O ports connected to two APB buses. It contains a 12-bit ADC and three universal 16-bit timers, as well as standard communication interfaces: two I2C, two SPI and three USART. Its rich interface resources meet the design requirements of the system. In addition, in order to expand the memory, the main control chip is equipped with a flash of 2M.

3.2 Fingerprint Recognition Module

Fingerprint identification module is used for fingerprint identification, so as to realize the registration and verification of user identity [5]. The system adopts integrated semiconductor capacitive fingerprint module FPC1020AM. With the characteristics of quick response, strong adaptability, small size, low power consumption and simple interface, the identification result of fingerprint sensor is transmitted to the single-chip microcomputer processing system by USB communication mode, so as to realize the identification and collection of fingerprint signal.

3.3 Relay Module

The relay module plays the role of switch. The single chip microcomputer controls the relay to further control the on-off of the power supply. Mgr-1 series single-phase solid-state relay is selected, which uses DC signal to control AC signal, and its control current range is 5-20mA. According to the trigger mode of the relay, the high level current of 5mA is output by the single-chip microcomputer to realize the switch on and off control.

3.4 Load Monitoring Module

In order to effectively control the safety accident caused by the power overload, the current detection chip is used to collect and monitor the current of the power supply in real time. When the load of the power supply exceeds the set volume, the power supply will be automatically cut off. ADE7755 chip is used in this paper. It can output the corresponding pulse frequency according to the current. And then, the current can be calculated by single-chip processing system according to the pulse frequency.

3.5 Display Module

The display module is used to display the working status of the system and the legitimacy of the user's identity. JLX12864g-212 LCD module is used in this paper. It can display 128 column *64 row dot

array monochrome pictures or 16*16 dot array characters, numbers, symbols, etc.. STM32 microcontroller connects with LCD module through serial port, so as to control the display content of LCD module.

3.6 Alarm Module

Alarm module is used to alarm when fingerprint is illegal or power supply is overloaded, which effectively plays the role of security warning. An active buzzer is used as alarm module. It only needs to output the drive level to the drive port and amplify the drive current through triode to make the buzzer sound, which has the characteristics of simple structure and easy implementation.

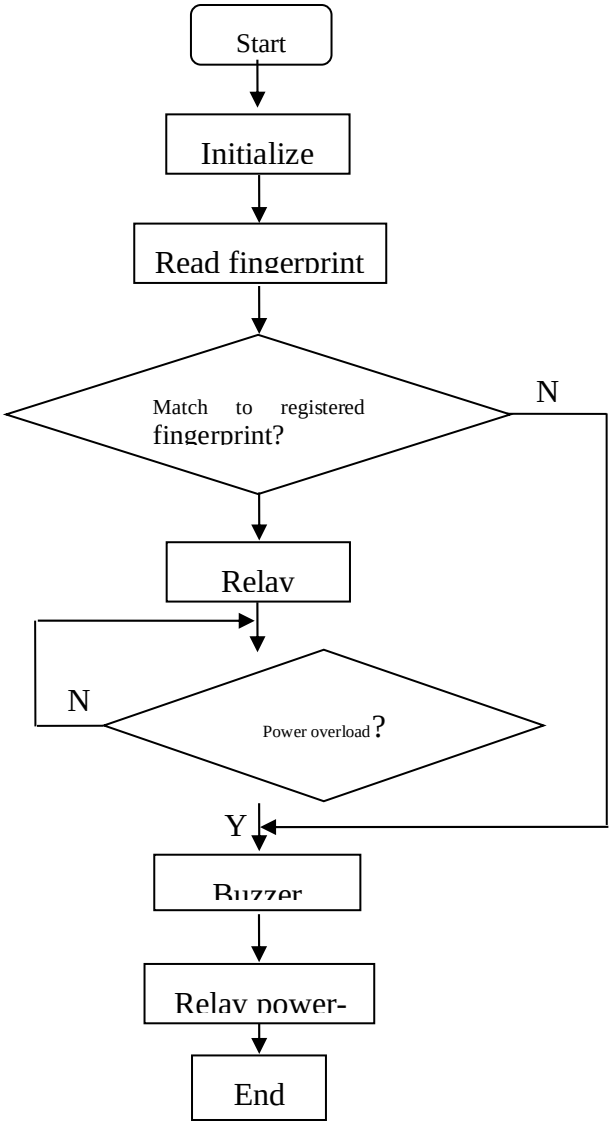

Fig. 2 The diagram of software systems

4. Software Design of the System

Fingerprint identification system mainly completes two major functions: fingerprint registration and fingerprint comparison. If the current fingerprint matches the registered fingerprint, the single-chip microcomputer system will send a high-level signal on to the relay, which enables the power to be switched on. At the same time, the load monitoring module monitors the current of the power supply load. When the load exceeds the pre-set load, the single-chip microcomputer system controls the breaking of relay and the alarm module to send out alarm signal. If the current fingerprint does not match the registered fingerprint, the single-chip microcomputer system controls the breaking of relay and the alarm module to send out alarm signal. The total flow frame diagram of the software system is shown in Figure 2.

5. Conclusion

Based on the microcontroller, the fingerprint control power system integrates fingerprint identification technology, microcontroller control technology and current monitoring technology. The user's identity is identified by fingerprint and the load of the power supply is monitored in real time. When the user's identity is mismatched or the power supply is overloaded, an alarm signal is sent and power is cut off to achieve the safety of the laboratory's electricity.

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