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Research Article

Design of smart home security system based on 52 MCU

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ABSTRACT

Before the smart home has appeared in people's vision, people do not have a deep understanding. But we may think something is insignificant in daily life. The article designs a simple, convenient, easy way to operate, and connected with the real life of smart home system. This design is based on the STC89C52 microcomputer as the control system, the smoke sensor and temperature and humidity sensor is used to detect the external environment. The system uses the button to adjust the threshold of the smoke concentration limit. LCD1602 can display the sampled external environment information in real time. This system can be used for anti-theft in shopping malls, warehouse, bank and other occasions. The device has a strong guiding significance for the current people's daily life.

1. Introduction

Today, with the continuous growth of economy, people's life quality has also been improved. In addition, the level of science and technology has been constantly improved, and new technologies have been added to people's lives, which all announce that intelligence is no longer a fantasy.

Different from the traditional home, the smart home is very convenient, it can give people a variety of intelligent services, so as to meet people's various needs. For example, even if we work in a distant company, we can operate the home's bathtub, so that we can take a warm bath soon after we come home. We can also monitor our homes by remote monitoring, which greatly reduces the security risks of burglary, and fire-prevention is no longer a very difficult problem.

The paper introduces the concept of the overall framework of this topic and the selection of circuit module components of each module, then the circuit diagram of each module and the principle are analyzed. Then the design of software program is considered. Finally it summarizes and predicts the design of this system.

The design mainly consists of five parts, namely temperature and humidity detection, smoke concentration detection, human infrared sensing, alarm information and display screen information [1].

- The DHT11 temperature and humidity sensor sends the detected data to the LCD1602A LCD screen through a single-chip microcomputer. If the detection result is not within the setting range, an audible and visual alarm is issued.
- The smoke sensor can analyze and check the indoor carbon dioxide, methane and smoke concentrations. When the concentration of these gases exceeds a predetermined alarm value, the LED lights up and the buzzer sounds to alarm.
- When the owner leaves the house or rests, he/she can enter the password on the keyboard of the security system to arm, and the system will enter the arming state. When someone invades the room, the human body infrared sensor can quickly locate the human's range of motion and

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send corresponding command signals along with the area where the human body moves [2].

2. Overall system design

2.1. Design scheme

This design is the indoor environment monitoring system based on a single chip microcomputer. The reference style chosen for this design is about 120 square meters, with three bedrooms, one living room and one bathroom.

2.2. System composition

The smart home control system in this paper includes the detection and control of temperature, humidity, smoke concentration. The doors and windows will be opened when the temperature, humidity and smoke concentration reach the upper limit.

This paper uses the single chip microcomputer (52 MCU) as the main operating system, the external sensor as the detection unit. We used the stepping motor, MQ-2 smoke sensor, keypad, DHT11 temperature and humidity sensor, buzzer, relay and other external modules. All the data sampled by the sensor are collected, and then are feed back to the single chip microcomputer [3].

3. Hardware circuit design

3.1. Main control circuit

STC89C52 is a low power, high performance CMOS 8-bit microcontroller with 8K system programmable flash memory. The minimum system includes a single-chip microcomputer and its required power, clock, reset, and other components, which can keep the single-chip microcomputer in a normal operating state at all times. Circuits such as the power supply and clock are necessary conditions for the single chip microcomputer to be operated. The minimum system can be taken as the core part of the application system. By performing memory expansion and A/D expansion, the single chip microcomputer can complete more complex functions.

3.1.1. Reset circuit

The reset operation selected in this design is performed manually. The capacitor in the circuit and the switch used are operated in parallel to meet the predetermined requirements. The resistor R1 plays a role of protecting the circuit. The schematic diagram of the reset circuit is shown in the Fig.1 below.

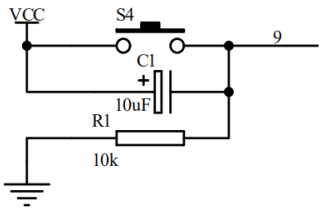

Fig.1 Reset circuit schematic

3.1.2. Clock Circuit

An internal clock circuit is used, and the selected external crystal is 12MHz. C1 and C2 are load capacitors with a capacitance of 30pF. The function of the two capacitors is to improve the frequency stability and the quickness of oscillation. The selection range of the capacitor is 5-30pF, and the oscillation frequency selection range of the crystal is 1.2-12 MHz. The internal clock circuit of MCU is shown in the Fig.2 below.

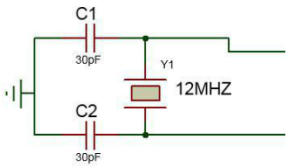

Fig.2 MCU internal clock circuit

3.1.3. Interrupt System

Interrupt technology is mainly used for real-time monitoring and control. It is required that the single-chip microcomputer can respond to the service request made by the interrupt request source in time, and make a quick response and timely processing. This is achieved by the on-chip interrupt system. When the interrupt request source issues an interrupt request, if the interrupt request is enabled, the single-chip microcomputer temporarily suspends the main program currently being executed and transfers to the interrupt service handler to process the interrupt service request [4].

3.1.4. Temperature and humidity detection

DHT11 is a temperature and humidity composite sensor with a calibrated digital signal output. It uses special digital module acquisition technology and temperature and humidity sensing technology. The sensor includes a resistive humidity sensing element and an NTC temperature measuring element, and is connected to a high-performance 8-bit microcontroller. The typical application circuit of DHT11 is shown in Fig.3.

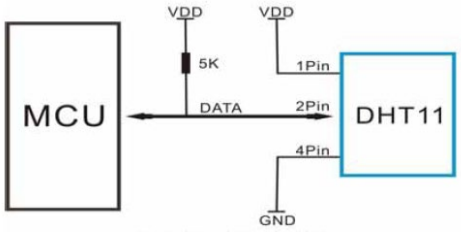

Fig.3 Typical application circuit of DHT11

3.2. MQ-2 smoke module

The MQ-2 smoke detection module mainly uses the MQ-2 gas sensor to detect hydrogen in coal gas and other gas components. This chip is mainly composed of ceramic tubes, sensitive layers, measuring electrodes, heaters and other sensitive components.

The structure and shape of MQ-2 gas sensor is shown in Fig.4. The heater is fixed in the cavity made of plastic or stainless steel, and it provides necessary working conditions for the gas sensor. The packaged gas sensor has six needle pins, four of which are used for signal extraction and two for providing heating current [5].

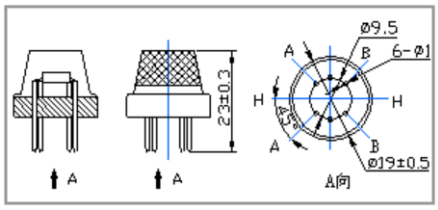

Fig.4 Outline structure of MQ-2 components

3.3. Alarm module

Light-emitting diode is short for LED. It uses a semiconductor device to convert physical signals into electrical signals. In addition, the component uses tungsten wires and phosphors to emit different colors of light as alarm signals. This design scheme is to use LED lights to emit different colors of light as an alarm signal.

3.4. LCD Module Design

LCD1602A uses a digital liquid crystal display, which is easy to operate, small in size, fast in response, high in sensitivity, and clear in picture.

3.5. Button module design

The key design of this project uses a stand-alone keyboard. Because the different output and input pins in this type of key will be stringed together with a certain coded key. The other port is usually grounded. Generally, the single-chip microcomputer is operated at a high-potential position in the initial state.

3.6. Design of human detection module

The passive infrared detectors are used for human detection. Passive infrared sensing technology uses infrared light-sensitive devices to convert trace infrared rays emitted by living organisms into corresponding electrical signals, which are amplified and processed.

It can distinguish the moving organisms from falling objects. At the same time, it also has the characteristics of large monitoring range, good concealment, strong anti-interference ability and low false alarm rate [6].

4. Software design

In the single-chip application system, Keil software and C language are used for programming. Then Proteus is used for simulation. Finally, the data is analyzed whether it achieves the purpose. The program source code is downloaded to the single-chip microcomputer. Check whether the actual circuit achieves the expected effect. The overall flow chart of security system design based on 52 single chip microcomputer smart home is shown in the Fig.5 below.

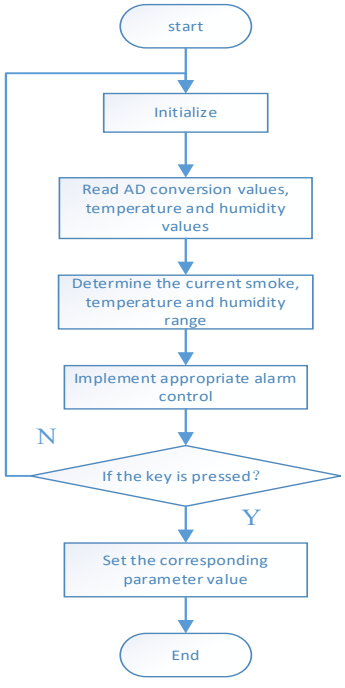

Fig.5 System flow chart of smart home

5. System testing and conclusion

5.1. Hardware testing

The physical circuit diagram of the hardware is shown in Fig.6. In Fig.6, the key1 is the setting key to set the temperature and humidity module and smoke module. The Key2 is the plus key, and key3 is the minus key. The key4 is the arm/disarm key.

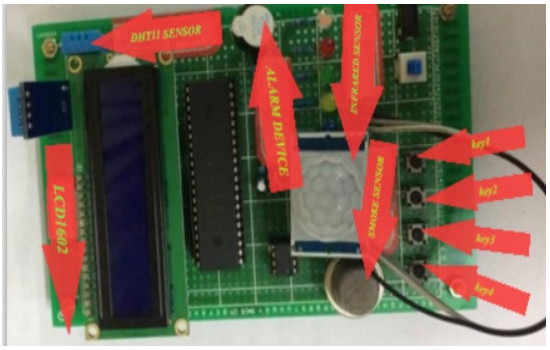

Fig.6 Hardware physical circuit diagram

When it is detected that the indoor smoke density is higher than the setting values, the first LED light turns white and an alarm is given. The detection distance of personal infrared is 7 meters. When a person intrudes, the LED light turns purple and alarms. Only pressing key4 to cancel the arming. When the temperature is lower than the setting lower limit values, the LED turns yellow and gives an alarm.

5.2. Software testing

When the indoor temperature and humidity, smoke concentration exceed the setting values, the buzzer will alarm. When the simulated pyroelectric signal is pressed, it represents someone enter and the human body infrared alarms [7].

For the human infrared sensor module, pressing the key4, the LCD screen displays "Z". Next the LCD screen displays "B" for about 20 to 30 seconds and the system enters the armed state. Protues simulation arming circuit diagram based on smart home is shown in the Fig.7.

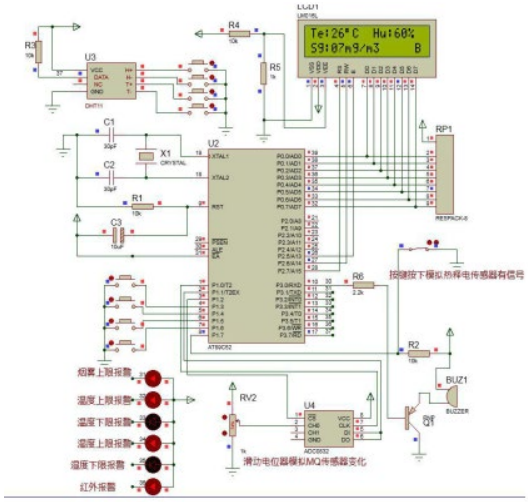

Fig.7 Arming simulation circuit diagram

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References

1. Samuel Bimenyimana, Aimable Ishimwe, GodwinNorense Osarumwense Asemota, et al. Web-Based Design and Implementation of Smart Home Appliances Control System. 2018, 168(1).
2. Jianhua Cai, Chao Huang, YuLong Li, et al. Intelligent Home Anti-theft System Based on MCU and GSM. 2013, 2(4):24-29.
3. Qing Ye, Si Meng Yu, Yi Sun. Design and Implementation of the Security Subsystem in the Smart Home System. 2014, 3468:3906-3910.
4. Kong, Fan Rong, Wang, Wenxin, Zhu, Jiajun. A Smart Home Control System Based on Controller Area Network Bus. 2013, 11(9):1667-1671(5).
5. A. Singaravelan, M. Kowsalya. Design and Implementation of Standby Power Saving Smart Socket with Wireless Sensor Network. 2016, 92:305-310.
6. Sandy Suryo Prayogo, Farid Al Rafi, Yulisdin Mukhlis. Design and Built IoT Home Panic Button for Smart City. 2019, 1175(1)
7. Chong-Yao Xu, Xin Zheng, Xiao-Ming Xiong. The Design and Implementation of a Low Cost and High Security Smart Home System Based on Wi-Fi and SSL Technologies. 2017, 806(1)

Authors Introduction

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She is a second-year master candidate in Tianjin University of Science and Technology, majoring in pattern recognition, principle of automatic control, engineering mathematics and other important control disciplines. Her research area is about deep learning and image processing. During her study, she has published several research papers.

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