Design of Home Intelligent Alarm System Abstract

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Abstract. This paper describes the research and development of home intelligent emergency alarm system and its working principle. In the design, STC12C5A60S2 single chip microcomputer is used as the control core of the alarm system, which controls infrared sensor, MQ-2 smoke sensor, SIM900A module, buzzer, LCD1602 display screen and GSM module. The corresponding circuit of each module is designed, and each part of the circuit is integrated to complete the required function.

1. Introduction

With the development of computer technology, especially single-chip microcomputer technology, single-chip microcomputer has been more and more widely used in intelligent instruments, industrial control, daily life and many other fields. Family intelligent emergency alarm system can ensure the safety of residents' own lives and property. In the event of emergencies, it can inform the residents in a timely manner so as to reduce people's economic losses, and even save human lives [1]. Xinhua Zhao of Harbin University of Engineering has studied the infrared alarm system and realized the function of field alarm [2], Bo Sun of Shandong University of Science and Technology has studied the smoke alarm system and realized the high sensitivity detection result [3]. There is also the application of GSM module, but also shows its excellent adaptability. In this paper, through the integration and connection of infrared module, smoke alarm module and GSM module, a kind of home intelligent alarm system equipment with many functions is completed.

2. Design scheme

2.1. Basic design idea

This paper analyzes the practicality and design of home intelligent emergency call system at home and abroad, combined with the situation of Chinese residents and various aspects. The selection of components must meet the design requirements and be able to be used properly. Therefore, the system requires the following conditions:
- there should be human infrared sensors, which can detect intruders;
- there should be smoke sensors to detect gas leakage and fire;
- there should be an emergency call button, which can call the police at a critical moment;
- there should be a liquid crystal display (LCD), which can understand whether the system is normal and the sensor monitoring data;
- there should be GSM module, in order to ensure that residents know the accident in a timely manner, make the fastest response, send text messages to users.
2.2. Overview of the overall programme
This design is controlled by STC12C5A60S2 single chip microcomputer [4]. The fire alarm part adopts MQ2 smoke sensor to monitor [5], the anti-theft alarm part uses the human body infrared sensor [6], the emergency call part is designed in the form of keys, and the display part uses LCD1602 liquid crystal display. The alarm part is composed of buzzer and GSM module [7]. The GSM module sends an alarm text message to the household at the time of alarm. The design block diagram is shown in figure 1.

![Figure 1: System principle block diagram](image)

3. Specific Design of Family Emergency alarm system

3.1 STC12C5A60S2 microcontroller system
The home emergency alarm system automatically alarms through the system designed by the STC12C5A60S2 single-chip microcomputer. The console is connected to all modules, which is relatively stable in technology and relatively inexpensive. STC12C5A60S2 series MCU is a single-chip microcomputer of machine cycle (1T) produced by Hongjing Technology. It is a new generation of 8051 microcontrollers with high speed/low power/super interference immunity, and the instruction code is fully compatible with the traditional 8051. It integrates MAX810 dedicated reset circuit, 2-channel PWM, 8-channel high-speed 10-bit A/D conversion (250K/S) for motor control and strong interference. It is widely used in industrial automation control, data acquisition, intelligence, and mechatronics research.

3.2 Infrared sensor selection
The human infrared sensing system is based on the model HC-SR501. 8 ~ 14 μm is the detectable wavelength, and the infrared wavelength emitted by human body is about 10 μm, which is within the detection range. HC-SR501 sensors can be monitored 24 hours a day. When an illegal person enters, the sensor outputs a high level. after the illegal person is far away from the monitoring, the system closes the high level after delay and outputs a low level.

![Figure 2: HC-SR501](image)
3.3 Smoke sensor selection

MQ-2 for smoke sensors. MQ-2 sensor belongs to semiconductor smoke sensor, which has the advantages of good anti-interference, long service time, high sensitivity, large monitoring area and relatively simple circuit. Analog signal is the form of signal received by MQ-2 sensor, and A/D module can carry out analog-to-digital conversion. When the suspicious gas or smoke is monitored and increased to a certain value, the MQ-2 sensor will pass the signal processing to the single-chip microcomputer after AD, and finally the single-chip microcomputer controls the alarm. The MQ-2 sensor is buffered for a period of time before it works, and the accuracy is higher.

Figure 3. MQ2 smoke sensor

Figure 4. ADC0832

ADC0832 converter is produced by NS (National Semiconductor) Company, with 8-bit serial interface, in which the working consumption is low, the performance is sufficient, the price is low, and it is widely used in many small machines.

3.4 GSM module selection

The type of GSM communication module designed in this paper is SIM900A. The GSM uses advanced technology to consume a particularly low current consumption of only 1 milliampere at the lowest level, and the interface is an industry-standard interface [8]. The main functional features of SIM900A are as follows:

- many functions: telephone, short message, GPRS network communication and so on;
- there are many power supply modes: USB charger and lithium battery can supply power;
- the protection function is complete: the power supply has reverse protection and SIM card protection.

Figure 5. SIM900A
4. Hardware circuit design

4.1. Design of burglar alarm Circuit

The anti-theft module adopts infrared sensor. In order to make the alarm system safe and reliable, when illegal personnel break in, the infrared sensor can be found in time, and the infrared sensor can work with other sensors and key modules to protect the safety of residents. The infrared sensor consists of three pins, the first pin is connected to the power supply, the second pin is connected to the single-chip microcomputer, and the pull-up resistance is connected with the first pin, because the ability of this sensor to output high level is weak, and the third pin is grounded. The circuit diagram is shown in figure 7.
4.2. Fire alarm circuit design

Home intelligent emergency alarm systems can also detect fires. The smoke sensor is selected, which can not only detect the fire, but also detect the gas leakage. The smoke sensor module model is MQ-2, to convert analog signal into digital signal through ADC0832 and then give it to STC12C5A60S2. The MQ-2 smoke sensor has six pins, pin 1.2.3 is connected to the power supply, pin 4.6 is connected to the AD module, and pin 5 is grounded. The circuit diagram of the MQ-2 smoke sensor is shown in figure 8.

![Figure 8. Fire alarm circuit](image1)

4.3. Circuit Design of GSM Module

When the sensor of the system receives the signal, in order to inform the residents in time, the wireless alarm function is designed, and the short message is sent to the residents through the wireless module. The model of the GSM module designed in this paper is SIM900A. STC12C5A60S2 sends text messages by controlling the GSM module. The TX of single chip microcomputer is connected to the RX of GSM, and the RX of single chip microcomputer is connected to the TX of GSM, so as to realize the receiving and sending of data, and the GND is connected to GND. The GSM interface circuit is shown in figure 9.

![Figure 9. GSM module circuit](image2)
5. Physical drawing
As shown in the figure is the physical diagram of the intelligent alarm system, the annotations in the diagram correspond to each component one by one.

![Physical drawing](image)

**Figure 10. Physical drawing**

6. Program design
This design mainly uses the modular programming method, divides into the main module, the interrupt module, the initialization module, the short message module, the delay module and so on. C language is used to write the program. According to the design flow chart, after the initialization of the power supply, each module enters the working state. After the smoke sensor, the infrared sensor monitors the signal or the button to monitor and judge, the buzzer carries on the alarm, the GSM carries on the short message notification.
7. Experiment

7.1 Experimental purpose
Through the test of different performance single-chip microcomputers, the optimal single-chip microcomputer that meets the requirements can be selected.

7.2 Experimental protocol
Under the condition that other external conditions are guaranteed to be unchanged, the STC89C51 single-chip microcomputer and the STC12C5A60S2 single-chip microcomputer are selected for comparison test.

Based on the circuit board on which the STC12C5A60S2 is installed, the STC12C5A60S2 single-chip microcomputer is replaced with the 89c51 single-chip microcomputer to test the running speed.

7.3 Experimental results
Through experimental verification, after replacing the MCU, it can be clearly compared that the speed of running STC12C5A60S2 is 8 to 12 times that of STC89C51.

8. Conclusion
According to the test results, using a better performance single-chip microcomputer can improve the operating speed of the system without affecting normal use, and the safety performance and reliability meet the requirements.

The price of the parts in this design is relatively low, and there is no pollution during the work, which is in line with the requirements of sustainable development.
Acknowledgments

This work was supported in part by Key R & D project of Shandong Province under Grant 2017CXGC0215, Grant 2017CXGC0810, Grant 2018CXGC0908 and in part by Shandong Province Natural Science Foundation under Grant ZR2017LEE010, and in part by Research and Development Innovation Plan Project of Agricultural Machinery equipment in Shandong Province under Grant 2017YF047

Thank you, Mr. Zhang Chengliang, for your careful guidance, and thank you, colleagues and friends, for your encouragement and support. Along the way, from your body I harvest countless, but no return, here to express my deep gratitude to the teachers! Thank your parents! Thank you to all the students who have helped and supported me, my friends! You're all my solid pillars and backers. Thank you for applauding me when I succeed and comfort me when I fail. I will never forget your concern, trust, encouragement and help in your daily study, work and life!

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