

Design and implementation of home alarm system based on Singlechip

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Abstract: In this paper, a remote control household alarm based on dual-tone multi-frequency technology Singlechip is designed. The system can use the existing public telephone network to realize remote monitoring of the situation in the home at any time, and can timely transmit information to the host when dangerous situations occur in the home, which has the advantages of convenience and safety.

1. Introduction

Nowadays, China's economic development is very rapid, the material and cultural needs of the people are also growing rapidly [1]. In terms of housing, they no longer only consider the comfort level of the house as before, and the safety level of the house has attracted more and more attention. At the same time, the current urban population in our country has great mobility, which has also caused great potential safety hazards, and the related illegal and criminal acts are also increasing day by day. Therefore, people also have more and more urgent needs for the safety of residential buildings. At the same time, the means of criminals are becoming more hi-tech, resulting in a big gap between the traditional residential safety measures and the current residential prevention needs [2].

On the other hand, due to the progress of science and technology, liquefied gas, gas and a lot of household appliances have been widely installed in the current housing. These devices bring great convenience to the common people, but also introduce a huge security risk. In the face of the situation of seed delivery, the previous houses and their security methods are far from meeting the safety requirements of modern people [3]. Therefore, the safety alarm system with the function of danger detection and alarm plays a very important role. It can help residents find dangerous situations in the first place and deal with them in a timely manner, thus effectively ensuring the safety of residential buildings and solving people's worries. In order to effectively ensure the safety of residents' lives and property, we have designed an intelligent home anti-theft alarm system. The system uses the ubiquitous telephone network to monitor, organically combines AT89S51 Singlechip, ISD4000 integrated voice chip, HT1602 liquid crystal display driver chip and dual-tone multi-frequency dialing circuit composed of integrated circuit, etc. to form a family intelligent anti-theft alarm with advanced function, practicality and low cost [4].

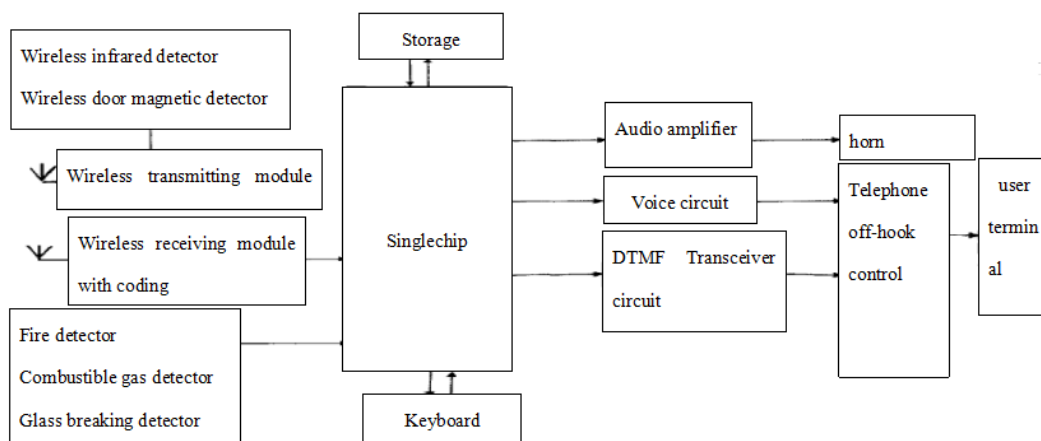


Fig.1. Overall diagram of system hardware

2. Circuit composition block diagram and basic working principle

2.1 Circuit block diagram

The intelligent home anti-theft alarm system is composed of a wireless sending/receiving module, an alarm module, a keyboard module, a liquid crystal display module, a voice module, a DTMF decoding/encoding module, etc. The overall hardware block diagram of the system is shown in Figure 1.

2.2 Introduction of Basic Working Principle of Circuit

When an alarm occurs in the home, the wireless module or other sensor module set in the home will send an abnormal signal to Singlechip. Single Chip will immediately send an on-site audible and visual alarm signal to deter intruders after receiving the signal. At the same time, Single Chip will automatically dial the telephone number stored in advance in 24C02 to give an alarm to the owner or the residential property so as to take timely anti-theft measures to avoid property loss. When the owner wants to monitor the situation of home or remote control the switch of home appliances in a different place, he only needs to dial the home fixed telephone number, because the telephone interface of the alarm system is connected in parallel on the telephone, if there is no one connected after the ring rings five times (the specific times can be set by the software), Then the alarm system will automatically simulate off-hook, and after the host inputs the predetermined password, it can monitor the movement of the home and control the switch-off and switch-off of the electrical appliances in the home.

When the host does not need security at home, the alarm system can also display clock, temperature, etc. and can also set up multiple functions such as wake-up alarm, etc., which can be realized by combining software and related chips.

3. Introduction to some circuit functions of the system

3.1 MCU module

MCU device adopts AT89S51 chip produced by ATMEL Company, as shown in Figure 2. AT89S51 is a low power consumption, high performance CMOS 8-bit Singlechip, which contains 4K bytes ISP (in-system programmable) Flash read-only program memory that can be rewritten 1000 times. It has the characteristics of high density and non-volatile storage technology. A general-purpose 8-bit CPU and ISP Flash memory unit are integrated into the chip.

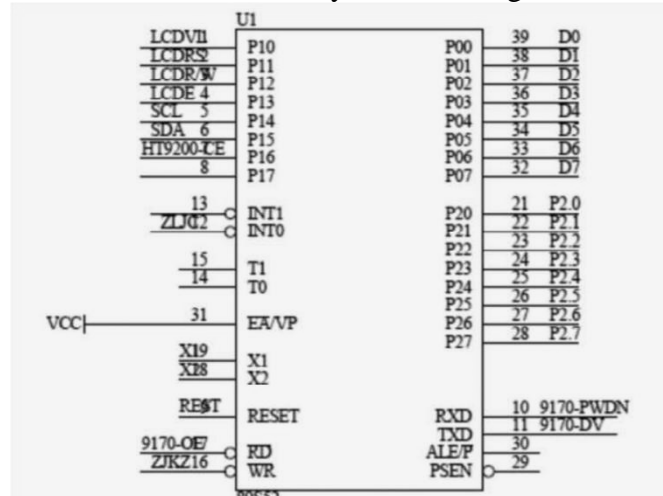


Fig.2. Circuit diagram of MCU module

3.2 Wireless module

The wireless module mainly processes infrared and wireless signals. Comprises a door window magnetic alarm module, a fire detection module, a harmful gas detection module and other sensor modules.

Here, the magnetic alarm module for doors and windows is mainly explained. The magnetic detector for doors and windows uses wireless door magnet, which consists of a permanent magnet and a door magnet main body (with a normally open reed switch inside). The sensor application circuit diagram of the wireless receiving module is shown in Figure 3.

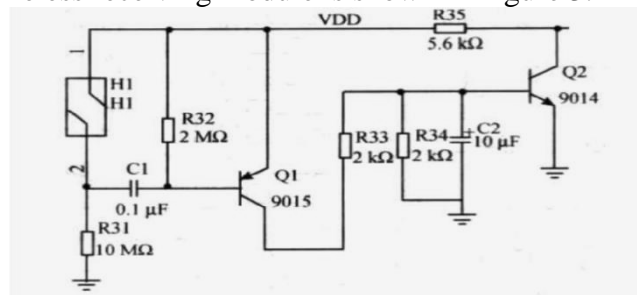


Fig.3. Wireless door magnetic receiving module sensor circuit diagram

H1 is a reed switch. When the door is closed, H1 is sucked in. The points at both ends of C1 are the same. Q1 is off and Q2 is off. When the door is opened, the reed switch contact is opened, and a current flows through the emitter of Q1, R32 (in parallel with H12), C1, R31, and ground, making Q2 saturated and conducting, outputting a low level of 0 to Singlechip, and sending an alarm signal.

3.3 Alarm module

P3.2(INT0) Connect an anti-theft detector to detect theft. If theft occurs, an external interruption of 0 will be triggered. After MCU receives the alarm signal, it starts flashing alarms such as LED, and at the same time starts a sound alarm of 100dB to deter burglars entering the house. At the same time, it sends the signal to the telephone module to inform the owner or the alarm center that there is a burglar entering the house.

3.4 LCD module

The liquid crystal display module is implemented by LCD1602. Its main function is to display the time, date, temperature in the home and the type of alarm when giving an alarm.

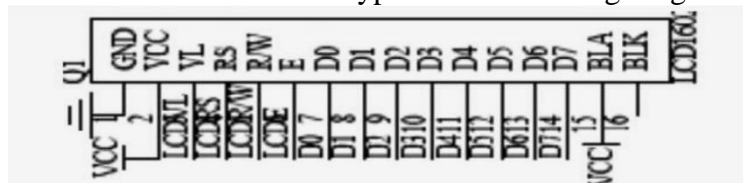


Fig.4. LCD circuit diagram

3.5 Voice module

The voice module uses ISD4000 chip, and its connection circuit diagram is shown in Figure 5.

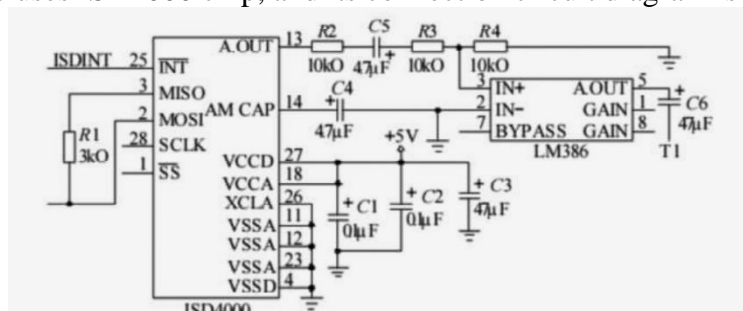


Fig.5. Voice chip connection circuit diagram

3.6 DTMF encoding / decoding module

The alarm circuit shares a telephone line with the user telephone. HT9200B is selected as DTMF encoder and HT9170 as DTMF decoder. the application circuit diagrams are shown in Figure 6 and Figure 7.

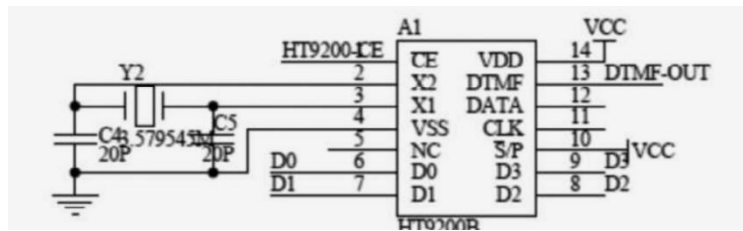


Fig.6. HT9200B circuit diagram

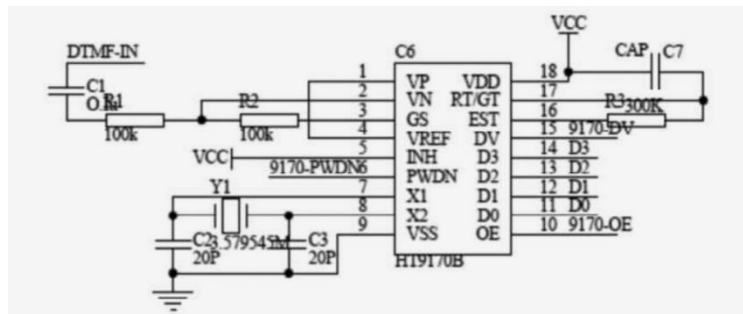


Fig.7. HT9170B circuit diagram

Provide HT9200B with a definite 4-bit binary number (such as telephone number). if input from D0--D3, the corresponding DTMF signal can be output from pin 13, and the DTMF signal can be sent to the telephone line to realize automatic dialing function. The function of HT9170 is mainly to convert the input DTMF signals into corresponding binary numbers, decode the remote telephone key signals and transmit them to Singlechip to realize remote control.

DTMF (Dual Tone Multi Frequency), or Dual Tone Multi Frequency signaling, is basically used on push-button telephones worldwide. One DTMF signal is formed by superimposing audio signals of two frequencies. The relationship between DTMF signals and telephone keys is shown in Figure 8.

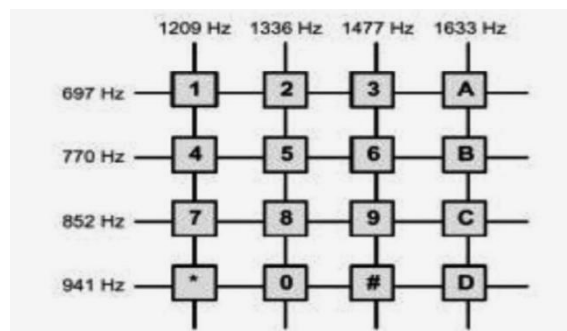


Fig.8. DTMF signal and telephone key diagram

3.7 Telephone interface module

The telephone interface module comprises a ringing detection circuit, an off-hook control circuit and a ringing detection circuit.

Ringing detection means that after ringing for a certain number of times (for example 5 times, can be set by software), if there is no answer, the master will enter the password. After the password is correctly entered, Singlechip will automatically simulate going off-hook to check the situation at home. If the password is incorrectly entered for 3 consecutive times, it will be forced to hang up.

The circuit diagram of the ringing detection circuit is shown in Figure 9. after being rectified, the 25Hz AC ringing signal is regulated, fed into the photocoupler, and then the square wave signal is output to the external interrupt 0 of Singlechip, and the ringing signal is discriminated by software.

The circuit diagram of analog off-hook detection circuit is shown in Figure 10. The circuit uses triode to simulate telephone off-hook. When the base level of Q4 is low, the collector of Q3 is disconnected from the transmitter and is on-hook. When the base level of Q4 is at high level, the collector of Q3 and transmitter are saturated and turned on to off-hook state, so telephone signals

are sent in.

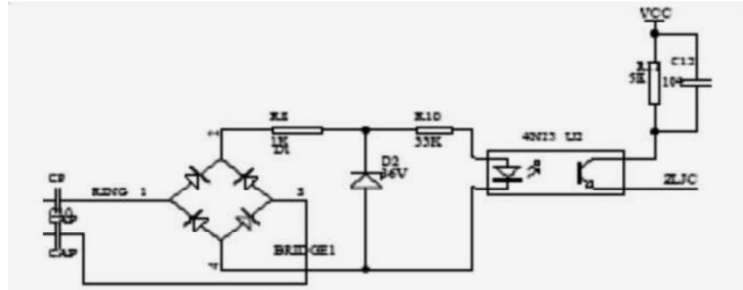


Fig.9. Ring detection circuit diagram

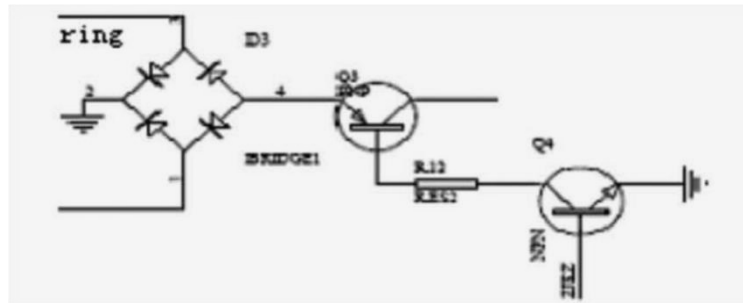


Fig.10. Analog off hook detection circuit diagram

But the ring back tone, busy tone, line error tone and other telephone process tone are signals with a carrier of 450hz. Different signals only have different modulation cycle and duty cycle. Therefore, the detection of these signals is to detect the cycle and duty cycle of 450hz signals. The circuit uses phase-locked loop LM567 to form a detection circuit (the center frequency of LM567 is adjusted to 450Hz). when the input signal is 450Hz, LM567 outputs a low level and sends it to Singlechip to distinguish various signals by software. the detection circuit is shown in Figure 11.

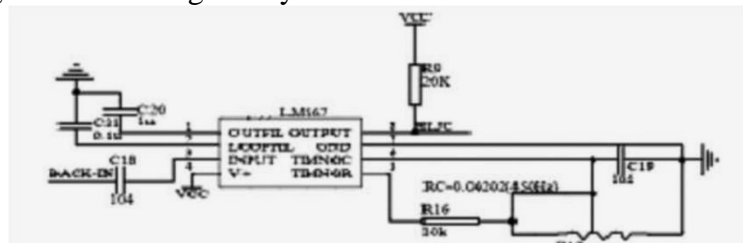


Fig.11. ringback tone detection circuit diagram

4. Introduction of Program Flow Chart

The overall flow chart of this topic is shown in Figure 12.

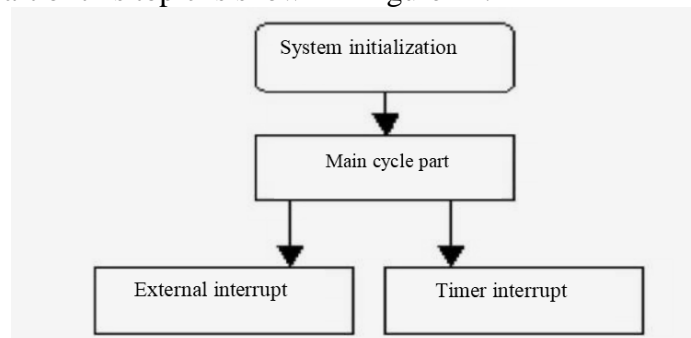


Fig.12. general procedure flow chart

Here we focus on the flow chart of the main cycle module, as shown in Figure 13.

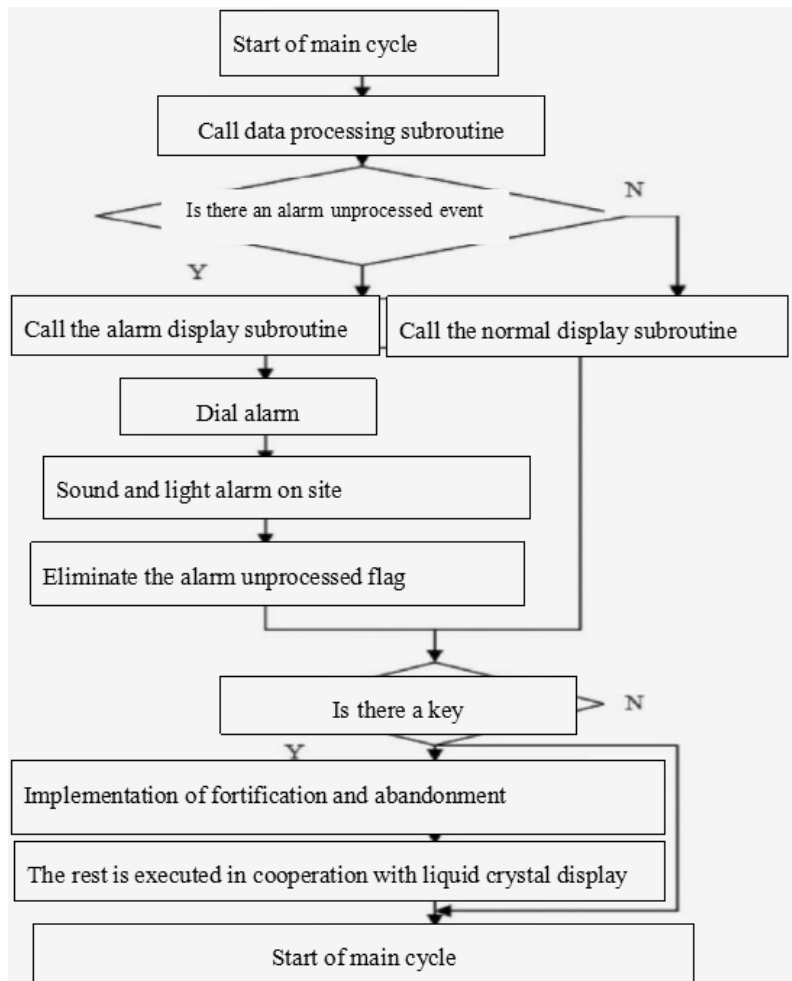


Fig.13. main cycle flow chart

5. Conclusion

This system uses telephone network to communicate, without rewiring, convenient, without electromagnetic pollution, environmental protection and low cost. After debugging, the system runs stably and reliably and has good practical value.

References

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