Design of Microwave Anti-theft Alarm Based on Microcontroller

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Abstract
At present, most households use safety gates and install safety nets on windows to prevent theft and protect family safety, but these are not sufficient to meet the current requirement to prevent external threats. In order to more effectively ensure the safety of the home and prevent theft, the anti-theft facility must be upgraded accordingly. So more and more alarm products are available on the market to meet this requirement. At present, the market is equipped with pressure-induced burglar alarms, electronic switch burglar alarms, and pressure and light shielding to trigger burglar alarms, but it is more common to use electromagnetic fields and microwave sensors as detectors and single-chip microcomputer-controlled smart alarms. This design uses an infrared sensor and a microwave sensor as a detector and a home burglar alarm controlled by an AT89S51 microcontroller.

Keywords
Microcontroller; anti-theft; microwave; alarm.

1. Introduction
The microwave burglar alarm system designed in this project consists of pyroelectric infrared sensors, microwave detectors, sound and light alarms, single-chip microcomputers and their control circuits, and related management and control software. It has a basic anti-theft alarm function, can automatically detect signals, automatic alarm function. The automatic alarm means that when the MCU receives the intruder signal detected by the detector, it automatically outputs an alarm signal through the program control to cause the speaker and the LED to emit an alarm. The system operates in such a way that when it is time to go out, the alarm system is set to the outbound prevention state[1]. This is when the detector starts to work. If a person invades, the pyroelectric infrared detector and the microwave detector detect the intrusion action at the same time and send the signal. To AT89S51 one-chip computer, after AT89S51 one-chip computer processes and calculates the output signal to carry out the warning circuit.

2. Design elements and working principle
2.1 Pyroelectric Infrared Sensor
Pyroelectric Infrared Sensors (PIPs) generally use a differential balance structure consisting of sensitive components, field effect transistors, and high-value resistors. "It is a sensor that can detect infrared radiation emitted by a human body and output electrical signals[2]. It can The non-contact form detects the change in the infrared energy emitted by the human body and converts it into a voltage signal output that can drive various control circuits."

In principle, any heat generating body will generate infrared rays. The sensitivity of the pyroelectric body infrared ray sensor to infrared ray mainly manifests in the temperature change of the sensor's sensitive unit, and the change of temperature leads to the generation of the electric signal. The change
of the environment and its own temperature determines that it does not output signals to the outside; however, the low-frequency response of the sensor (usually 0.1–10Hz) and the response to specific wavelength infrared (usually 5–15μm) determine the sensor only External infrared radiation is sensitive to changes in the sensor's temperature, and this change is moving to the human body. Therefore, the sensor is sensitive to the movement or movement of the human body, and is insensitive to static or slowly moving human bodies; it can resist the interference of visible light and most infrared rays.

2.2 Microwave Detectors

Microwave detectors are space detectors used to detect objects that prevent movement in space. The reliability of microwave detectors has no requirement for light and heat sources, and exploration requires low environmental requirements. In the microwave section, when the microwave is at a frequency, in the coverage area, if there is motion of the object, another frequency emission frequency will be adopted, so the transmission frequency will have a frequency difference.

When someone moves, the reflected microwaves will change, so that the microwave detector outputs a low-frequency signal whose frequency is related to the speed of the human body. According to this feature, it is also the reason why the microwave detector is selected as a probe for the alarm. The loop antenna and its surrounding resistors, capacitors and MOS FETs form a circuit for the self-oscillating frequency of the near-microwave segment. The

When the circuit is powered on, the single-frequency amplitude signal generated by the oscillation is transmitted from the external antenna to the space, creating a three-dimensional space microwave protection zone, and the antenna can also receive an echo. The reflected microwave signal is mixed with the frequency of the original signal to generate a weak frequency shift signal, which is amplified by the signal transmission amplifier. The amplified signal is sent to the discrimination comparator, and after comparison, the detection signal of a certain intensity is converted into a pulse output of different amplitude and width. Microwave detector principle shown in Figure 1

![Microwave Detector Principle](image)

Figure 1 Microwave detector

2.3 Principle of Microwave Detector

Among the numerous 51 series single-chip microcomputers, ATMEl's AT89C51 single-chip microcomputer and AT89S51 single-chip microcomputer are more practical, because it is not only fully compatible with 8051 instructions and pins, but also has 4k on-chip program memory as a flash memory technology. In this process, users can immediately the memory is erased and rewritten. The general design of the ATMEl AT89XX microcontroller has these functions. Obviously, the requirements for such SCM application development equipment are very low, and the development time is greatly shortened. You can also encrypt the program written to the microcontroller, which protects your scientific and technological achievements[3].

The current price of AT89S51 and AT89C51 is lower than that of the 8031 single-chip microcomputer, and the market supply is quite adequate. AT89S51 has become the darling of the practical application market at present, compare, AT89S51 one-chip computer is newer than AT89C51 in the craft, carried
on improvement in many aspects, adopt new craft, reduce cost, adopt 0.35nm new craft to promote function, increase competitiveness. AT89SXX can be backward compatible with 89C51 series chips.

3. **Specific circuit module design**

For the 51 series microcontrollers, the minimum system should generally include: MCS-51 series microcontrollers, crystal oscillator circuit, reset circuit and a stable 5V power supply. The positive pole is connected to 40 feet, and the 20-pin ground is connected to the control pin EA. EA/VPP (pin 31) is the internal and external program memory selection control pin. When EA is low, the microcontroller fetches instructions from the external program memory. When EA is connected high, the microcontroller fetches instructions from the internal program memory. . . There are 4KB of AT89S51 one-chip computers can erase the program memory more than 1000 times repeatedly, so we connect EA to +5V high level, let the one-chip computer run internal procedure. We will connect the above circuit with the 51 single-chip microcomputer and get the total circuit diagram. The overall circuit is shown in Figure 2:

![Figure 2: The total circuit diagram](image)

### 3.1 Amplification circuit design

Fig. 3 is the input signal amplifying circuit used in this design, Vcc connects the high level, Vi is the input signal, V0 is the output signal.

![Figure 3: Amplifier circuit design](image)
3.2 Clock Circuit Design

The 51 microcontroller has a high-gain inverting amplifier for the oscillator. The input and output are XTAL1 and XTAL2, respectively. The two-pin transboundary quartz crystal oscillator and trimmer capacitor form a stable self-oscillator. The clock is the heart of the SCM. The operation of the various functional components of the SCM is based on the clock frequency and works in an orderly manner. Therefore, the clock frequency directly affects the speed of the microcontroller, and the quality of the clock circuit also directly affects the stability of the microcontroller system. There are two commonly used clock circuits: one is the internal clock and the other is the external clock\[4\]. This article uses the internal clock method. Figure 4 shows the clock circuit.

![Figure 4 clock circuit](image)

3.3 Reset Circuit Design

The MCS-51 microcontroller reset is implemented by an external reset circuit. The reset pin RST is connected to the reset circuit through a Schmitt trigger. The Schmitt trigger is used to suppress noise. In each machine cycle S5P2, the output level of the Schmitt trigger is sampled once by the reset circuit before getting the signal needed for an internal reset operation.

The Power-on reset: The power-on reset circuit is a simple reset circuit. As long as a capacitor is connected to VCC at the RST reset pin, a resistor can be connected to ground. Power-on reset means that when the system is powered on, the reset circuit adds a short high-level signal to the RST reset pin through the capacitor. This reset signal falls back as VCC charges the capacitor, so the RST pin is reset. The high hold time depends on the charging time of the capacitor. In order to ensure a safe and reliable reset of the system, the high signal of the RST pin must be maintained long enough. The Power-on automatic reset is achieved by charging the capacitor of an external reset circuit. As long as the rise time of Vcc does not exceed 1ms, automatic power-on reset can be achieved. Figure 5 shows the reset circuit.

![Figure 5 reset circuit design](image)
3.4 Alarm Circuit Design

Alarm circuit design is divided into LED light alarm circuit design and speaker alarm circuit design. In the LED light alarm circuit design, three light emitting diodes are connected to the P2.0 pin of the single-chip microcomputer and externally connected to the high level Vcc. After the low-level output of the P2.0 pin of the single-chip microcomputer, the light emitting diode emits light and plays an alarm role. In the speaker alarm circuit design, the input signal is output by the single-chip P2.1 pin, and the speaker is controlled by the switching characteristic of the transistor to trigger an alarm. Figure 6 shows the alarm circuit design.

![Figure 6 alarm circuit](image)

4. Alarm software design

The system's MCU uses ATMEL's low-power microcontroller AT89C51. Only the system initialization is completed in the main program, and then it enters standby mode. Other function modules are completed in the interrupt service routine. When an interrupt occurs, the MCU wakes up and executes the corresponding interrupt service routine. After returning from the interrupt routine, the system enters standby mode again. The entire program is designed so that the system is in the lowest power state most of the time. The entire program is written in C language, using a modular design method, put each module-related program in a file, easy to block debugging and management, shorten the debugging cycle.[5]

In the main program, the watchdog and the master interrupt are first closed, which prevents the watchdog or other interrupts from causing the microcontroller to reset during the initialization process, so that the initialization cannot be completed. The entire system software needs to manage the pyroelectric infrared sensors, alarms, and protection network control systems. The above modules complete the initialization process in the main program.

When the sensor detects a child signal, the motor rotates forward, the alarm sounds and the protective net pops up; when the alarm is released, the reset button is pressed, the motor is reversed, and the protective net is retracted.

5. Conclusion

This design studies a smart burglar alarm based on microcontroller technology. The burglar alarm uses the AT89S51 microcontroller as its working core, an external pyroelectric red sensor and a microwave detector, both of which are used as detectors of the alarm. When both detect the intrusion signal at the same time, the input signal is sent to the MCU, and the MCU receives the input signal. After that, after the internal software programming processing, the microcontroller output control signal to drive the
sound and light alarm circuit to start the alarm. The biggest characteristic of the alarm is simple, practical, flexible, high intelligence and low false alarm rate.

References


