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Design of Home Infrared Alarm System Based on STM32

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Abstract: With the development of society and the progress of science and technology, security issues are also changing. The traditional anti-theft measures are to install anti-theft windows, anti-theft doors and other facilities for houses, but they do not meet the requirements of fire prevention, and there are certain hidden dangers. In this paper, a kind of infrared alarm system is designed by using a pair of tube infrared sensor and STM32 single chip microcomputer. It can be installed in a concealed position to generate alarm signals for the intrusion of infrared radiation objects and remind relevant personnel to take emergency defense measures.

1. Preface

In today's rapid economic and technological development environment, smart home has gradually come into our life, labelling indoor and outdoor objects, radio frequency identification, sensor sensing and connecting to the Internet of Things, so as to achieve intelligent control of home, making life more convenient and home more comfortable. However, many criminal means are becoming more and more intelligent, and the cases of property loss and personal injury caused by burglary are not uncommon. Therefore, the development of scientific and intelligent anti-theft equipment is an effective guarantee of home security[1].

2. Introduction of Infrared Sensors

When collecting infrared sensor data, infrared sensors are usually used. It is a device that can sense the infrared signal radiated by the target and use the physical properties of the infrared signal to measure. Considering that any object with a temperature higher than absolute zero will radiate infrared signals to the outer space, infrared sensors are widely used in aerospace, astronomy, meteorology, military, industrial and civil fields[2].

Commonly used infrared sensors include slot type, opposite reflection type, reflective plate type and human body sensing type devices.

2.1. Trough Type Infrared Photoelectric Sensor

The tank body of the slot type infrared photoelectric sensor includes a group of infrared emission tubes and infrared receiving tubes which are placed face to face, as shown in Figure 1. The infrared light emitted by the infrared transmitting tube can be received by the infrared receiving tube without blocking[3]. When the detected object passes through the slot, because the infrared light is blocked, the photoelectric switch will output a switch control signal to cut off or connect the load current, thus completing a control action. Generally, the detection distance of slot type infrared photoelectric sensor is only a few centimeters due to the limitation of the overall structure[4].

2.2. Opposite Infrared Photoelectric Sensor

The working principle of the anti radiation infrared photoelectric sensor is similar to that of the slot infrared photoelectric sensor. The main difference is that the distance between the infrared transmitter and the receiver tube is increased, and the detection distance can reach several meters to tens of meters.

This design is composed of a pair of infrared tubes (an infrared transmitting tube and an infrared receiving tube), a comparator, an indicator light, and a potentiometer. The infrared signal is collected and processed and output to the STM32 microcontroller. The principle block diagram is shown in Figure 1.

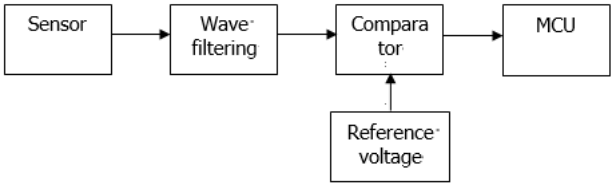

Figure 1: Working principle block diagram of infrared signal acquisition

Module interface: VCC is externally connected with 3.3V-5V voltage. This design uses 3.3V power supply; GND is externally connected to GND; OUT is connected to the GPIO port (0 or 1) of the microcontroller.

The transmitting tube (white lamp tube) emits infrared ray of a certain frequency. When the detection direction encounters an obstacle (reflective surface), the infrared ray is reflected back and accepted by the receiving tube (black lamp tube). After being processed by the comparator circuit, the output indicator lamp will light up and the digital signal (a low-level signal) will be output at the same time. At the same time, the detection distance can be adjusted through the potentiometer knob. The effective distance range is 2~30cm, the detection angle is 35 degrees, and the working voltage is 3.3V-5V.

3. Overall System Design

This design is mainly divided into three parts. The first part is the infrared detection module that senses the change of infrared radiation within the detection range. The second part is the alarm prompt for intrusion behavior, including buzzer and indicator light flashing. The third part is to clear the alarm. The overall design block diagram is shown in Figure 2.

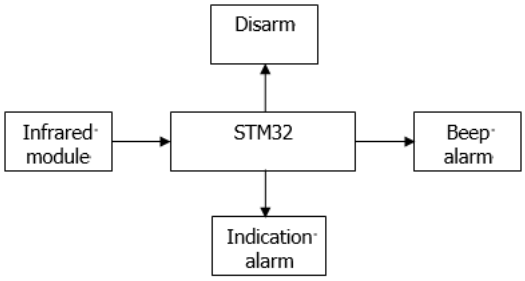

Figure 2: Overall design block diagram

The infrared detection module can be installed in the doorway, window or entrance channel and other relatively hidden places. The main task is to detect the changes of human infrared radiation and send out data. The alarm monitoring is composed of STM32 single chip microcomputer, sound alarm and indicator light alarm. After receiving the signal sent by the infrared module, STM32 single chip microcomputer will analyse it to determine whether to start the sound and light alarm. When the alarm is completed, press KEY1 on the board to release the alarm.

4. System Hardware Design

4.1. Core Circuit Design of STM32

STM32 series processor STMicroelectronics (ST for short) is a 32-bit microcontroller based on ARM 7 architecture that supports real-time simulation and tracking. The reason for choosing this control chip is that the system design is not to pursue the lowest cost or lower power consumption, but to provide richer interfaces and functions under the premise of realizing the design functions, so as to facilitate the design of peripheral expansion circuits required by various experimental projects of the experimental system. This control chip is easy to learn after completing the course of single-chip microcomputer. It is widely used in medical devices and has good learning and experimental research value.

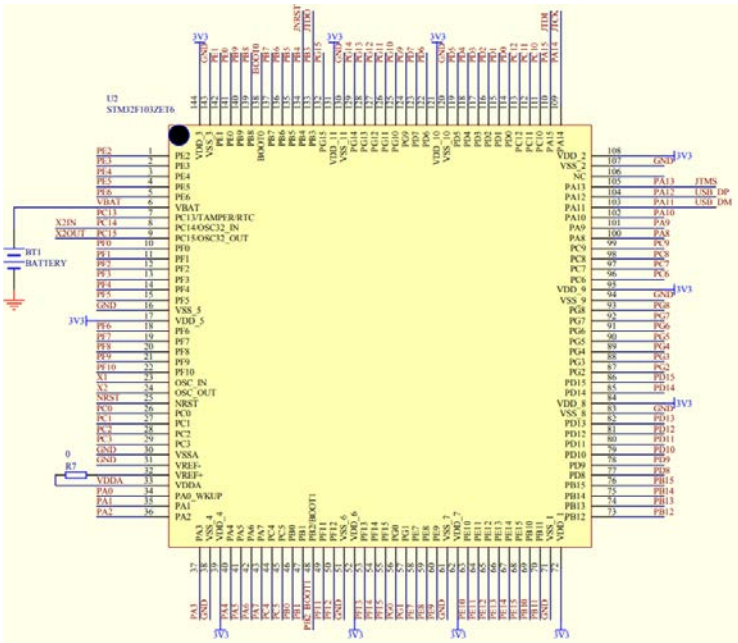

Figure 3: Schematic diagram of STM32 interface

The main advantages of STM32: use the latest and advanced architecture of the Cortex-M3 core of ARM; Excellent real-time performance; Excellent power consumption control; Outstanding and innovative peripherals; Maximum integration and integration; It is easy to develop and can make the product enter the market quickly.

There are many STM32 family products. This design uses STM32F103ZET6 single-chip microcomputer, and its core board interface circuit diagram is shown in Figure 3

4.2. Design of Buzzer Alarm Circuit

Active buzzer is a kind of electronic buzzer with integrated structure, which is powered by DC voltage and is widely used in computers, printers, copiers, alarms, electronic toys, automotive electronic equipment, timers and other electronic products as a sound generator. The alarm module used in this system is a 3.3V active buzzer module. The circuit is driven by a S8050 power transistor. As long as the control pin of the STM32 single-chip microcomputer is at a high level, the buzzer will continue to give an alarm, otherwise it will not give an alarm. The buzzer can also be controlled by controlling the square wave output of the pin of the single-chip microcomputer. The resistance is the current limiting resistance for protection[5].

4.3. Design of LED Lamp

Use LED0 (red light) as the alarm indicator. When STM32 MCU receives an effective signal from the infrared module and needs to alarm after analysis, pull the PD11 pin down (low level), and LEDO lights up. The MCU can also control the state of PD11 to control the way LEDO flashes. The resistance is a current limiting resistance, which plays a protective role.

4.4. Design of Infrared Acquisition Circuit

The infrared acquisition circuit is designed according to the interface of the infrared acquisition module. VCC is externally connected with 3.3V voltage, GND is externally connected with GND, and OUT is connected with GPIO port PF0 of STM32 microcontroller. When infrared detection detects human radiation, it will output a low level digital signal, PF0 of SCM will receive the signal, and then STM32 SCM will control and alarm.

5. System Software Design

This design uses infrared sensors to detect indoor infrared and other data, compares the collected data with the set threshold value, judges whether the residence is in a dangerous state, and processes the dangerous signals through the microcontroller, controls the actions of other modules, and carries out alarm processing. The main flow diagram of the system is shown in Figure 3.

In software design, abnormal information is handled by interrupt program. If an outsider intrudes into the user's home, the sensor module will transmit the collected data information to the microcontroller. The main control processing part of the single chip microcomputer analyzes and judges the sampled data, and controls the peripheral devices to process the abnormal information accordingly. In case of abnormal conditions, the photoelectric alarm device will also be started to achieve the alarm effect.

6. Conclusions

This paper aims at the phenomenon that ordinary families are stolen, and achieves the purpose of warning by installing a reliable infrared alarm device. The simple window infrared anti-theft alarm system is simple in structure and easy to arrange, and can meet the personalized needs of users without major adjustment.

The overall scheme design is basically correct and feasible, and its main functions are basically realized.

This system really realizes the safety protection system with low power consumption, high performance price ratio, and can realize the basic use requirements of urban families.

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