



USE OF ULTRASONIC SIGNAL CODING AND PIR SENSORS TO ENHANCE THE SENSING RELIABILITY OF AN EMBEDDED SURVEILLANCE SYSTEM

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ABSTRACT: In this paper we design and implement an embedded surveillance system by use of ultrasonic signal coding of ultrasonic sensors with multiple pyroelectric infrared sensors (PIR) to detect an intruder in a home or a storehouse. The PIR sensors are placed on the ceiling, and the ultrasonic sensor module consists of a transmitter and a receiver which are placed in a line direction; however, ultrasonic sensors with the same frequency are subject to interference by crosstalk with each other and have a high miss rate. To overcome these disadvantages of the ultrasonic sensor, our design reduces the miss rate from the environmental interference by using an ultrasonic coding signal. Both ultrasonic sensors and PIR sensors are managed by the majority voting mechanism (MVM).

Key words: Ultrasonic Sensor, Pir Sensor, Ethernet, Pc

INTRODUCTION

Recently surveillance systems have become more important for everyone's security. The embedded surveillance system, frequently used in a home, an office or a factory, uses a sensor triggered to turn on a camera . Some designs use different types of sensors to achieve reliability by means of the different features of each sensor. In this paper we extend our previous design not only by using both multiple PIR sensors and ultrasonic sensors as a sensor group, but also by using the MVM. Ultrasonic receivers and transmitters are located at opposite ends . However, to reduce the interference from other frequencies in ultrasonic signals, we use a coding signal to enhance the ability to distinguish the random interference [10]. To enhance system reliability in the experiment, we focus on how to improve the

shortcomings of the ultrasonic sensor. Some research explores the influence of attenuation in air and crosstalk of ultrasonic signals by using a coding signal [11-12], while some provides improvement of the ultrasonic signal by using different coding signal types . Other research uses the application of a coding signal to increase resolution and contrast of images [15]. Yet another approach build a 3D image with an ultrasonic sensor in the PN code that solves the problem with time delay. To enhance the reliability of the ultrasonic sensors group, we propose adding to the number of bits with coding to reduce the probability of code breaking.

I. The Hardware System

Micro controller: This section forms the control unit of the whole project. This section basically consists of a Microcontroller with its associated circuitry like Crystal with capacitors, Reset circuitry, Pull up resistors (if needed) and so on. The Microcontroller forms the heart of the project because it controls the devices being interfaced and communicates with the devices according to the program being written.

ARM7TDMI:

ARM is the abbreviation of Advanced RISC Machines, it is the name of a class of processors, and is the name of a kind technology too. The RISC instruction set, and related decode mechanism are much simpler than those of Complex Instruction Set Computer (CISC) designs.

Liquid-crystal display: Lcd is a flat panel display, electronic visual display that uses the light modulation properties of liquid crystals. Liquid crystals do not emit light directly. LCDs are available to display arbitrary images or fixed images which can be displayed or hidden, such as preset words, digits, and 7-segment displays as in a digital clock. They use the same basic technology, except that arbitrary images are made up of a large number of small pixels, while other displays have larger elements.

I. Design of Proposed Hardware System

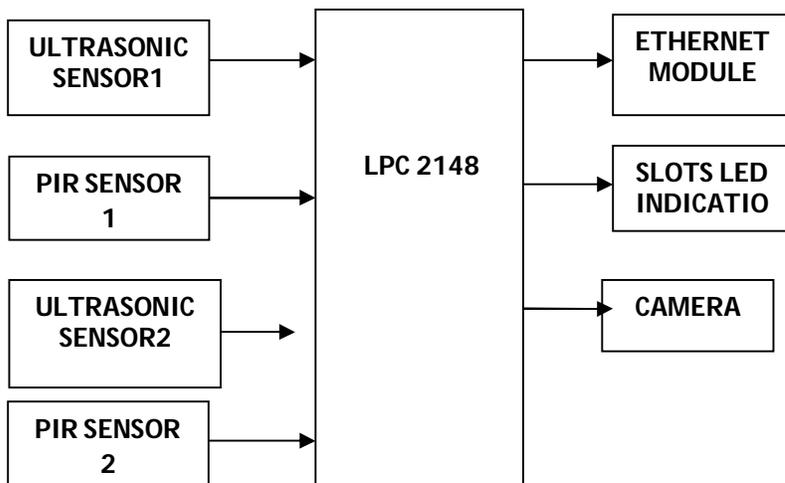


Fig.1.Block diagram

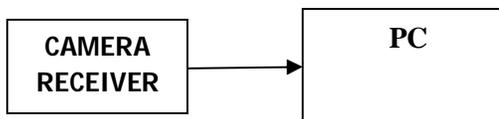


Fig.2.Block diagram

It shows our design which contains several ultrasonic and PIR sensor groups. In the modules of the ultrasonic sensor groups the transmitter and the receiver are separated. The transmitter circuit generates a multi-frequency square waveform, and the receiver circuit amplifies the received signals and filters out any noise. When a transmitter transmits an ultrasonic coding signal, the ultrasonic receiver determines whether there is an intruder passing through the sensing area. If there is no intruder, the MCU (Micro Controller Unit) will use the predefined ultrasonic signal pattern to decode the received signal. Use of relay stations and frequency conversion extends the sensing range. Our

design reduces the environmental interference with the ultrasonic signal. All sensing signals are input to the embedded surveillance system by the GPIO (General purpose input and output), and the MVM program counts the number of sensing states to determine whether to adopt the MVM or not. The PIR sensor groups obtain the sensing signals from human temperature. If the voting results of ultrasonic and PIR sensor groups pass the criteria, the embedded surveillance system starts the Web camera to capture images.

IV.Board Hardware Resources Features

Ultrasonic Distance Sensor

Its compact size, higher range and easy usability make it a handy sensor for distance measurement and mapping.

Features

- Minimum range 10 centimeters
- Maximum range 400 centimeters (4 Meters)
- Accuracy of +-1 cm
- Resolution 1 cm
- 5V DC Supply voltage
- Compact sized SMD design
- Modulated at 40 kHz
- Serial data of 9600 bps TTL level output for easy interface with any microcontroller

Ethernet

Networking is playing vital role in current IT era where data distribution and access is critically important. As the use of communication between two or more entities increases the networking technologies need to be improved and refurbished over time. Similarly the transmission media, the heart of a network, has been changed with the time improving on the previous one. If you know a little bit about networking you surely have heard the term Ethernet which is currently the dominant network technology. Wide spread of the Ethernet technology made most of the offices, universities and buildings use the technology for establishment of local area networks (LANs).



To understand what actually Ethernet is, we need to know about IEEE first which is a short of Institute of Electrical and Electronics Engineers. IEEE is a part of International Organization for Standardization (ISO) whose standard IEEE 802.3 is defined for Local Area Network. The standard IEEE 802.3 commonly known as ETHERNT defines the communication standards for how data is transferred from one network device to another in a local area network. Since the limit for Ethernet cable is few hundred meters Ethernet is commonly deployed for networks lying in a single

building to connect devices with close proximity. The same standard for Ethernet enables manufactures from around the earth to manufacture Ethernet products in accordance with the ISO standards that are feasible for all computing devices worldwide.

PIR SENSOR

The PIR (Passive Infra-Red) Sensor is a pyroelectric device that detects motion by measuring changes in the infrared levels emitted by surrounding objects. This motion can be detected by checking for a high signal on a single I/O pin.

Features

1. Single bit output
2. Small size makes it easy to conceal
3. Compatible with all Parallax microcontrollers.

Pyroelectric devices, such as the PIR sensor, have elements made of a crystalline material that generates an electric charge when exposed to infrared radiation. The changes in the amount of infrared striking the element change the voltages generated, which are measured by an on-board amplifier. The device contains a special filter called a Fresnel lens, which focuses the infrared signals onto the element. As the ambient infrared signals change rapidly, the on-board amplifier trips the output to indicate motion.

PC

Keyboards on an OEM basis to leading global PC manufacturers for use in desktop and notebook PCs and also supplies for retail keyboard OEMs.

Features:

- Internal Sourcing of almost all of main Parts

Almost all components - frame, key switches and membrane sheet - other than connectors and cord are manufactured in-house, giving Minebea an un-matched advantage in terms of quality, supply capabilities, cost-competitiveness and speed of delivery.

Especially, these products capitalize on Minebea's ultra-precision machining technology of components.

- Efficient Production System

Plant in China which supplies the global market employs the Minebea's vertically integrated manufacturing system, whereby all process, from machining components to final assembly are conducted in-house.

CONCLUSION

Our experiment shows two different types of sensors which are enhancing the overall sensing probability by using the MVM to reduce the shortcomings of both the ultrasonic sensors and the PIR sensors. By adding an ultrasonic coding

signal our design reduces the miss rate of the receiver with ultrasonic sensors by different patterns, improving the reliability of the overall system

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