

A Reliable Monitoring System Based On PIR and Ultra Sonic Sensing

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Abstract: *In the present trends of technology the embedded technical environment plays a major role in sensing and automation. We design and implement an embedded surveillance system by use of ultrasonic signal coding of ultrasonic sensors with multiple pyro-electric 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. We design and implement an embedded surveillance system by use of ultrasonic signal coding of ultrasonic sensors with multiple pyro-electric infrared sensors (PIR) to detect an intruder in a home or a storehouse. The status will be sent to monitoring unit through ZIGBEE wireless communication.*

Keywords: Embedded Surveillance System; Majority Voting Mechanism; PIR Sensor; Ultrasonic Sensor

1. Introduction

Technology is the word coined for the practical application of scientific knowledge in the industry. The advancement in technology cannot be justified unless it is used for leveraging the user's purpose. Technology, is today, imbibed for accomplishment of several tasks of varied complexity, in almost all walks of life. The society as a whole is exquisitely dependent on science and technology. Technology has played a very significant role in improving the quality of life. One way through which this is done is by automating several tasks using complex logic to simplify the work.

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 [1-3], uses a sensor triggered to turn on a camera [4-5]. Some designs use different types of sensors to achieve reliability by means of the different features of each sensor [6-7]. 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 [8-9]. 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 [13-14]. 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 [16]. 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.

2. System Design Model

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.

A. Hardware Section

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. 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). When the system detects any intruder presence in house it will send an alert to the monitoring section through ZIGBEE wireless communication.

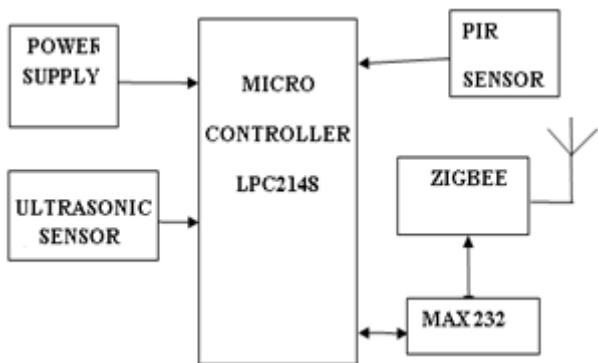


Figure 1: Block Diagram of Transmitter Section

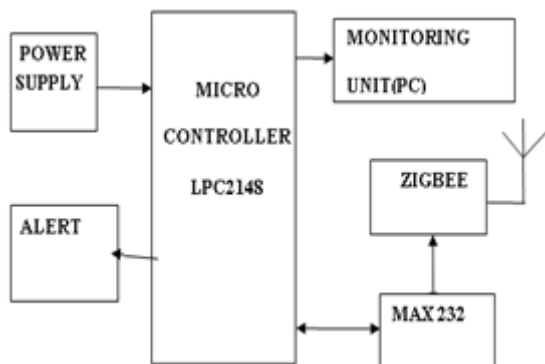


Figure 2: Block diagram of monitor section

We use two groups of the external hardware circuits, the PIR and the ultrasonic sensor group, which are shown in fig: 1 and 2. As the PIR sensor produces a weak voltage, we input the sensed signal to a two-stage OP amplifier to amplify the weak voltage by about 1000 times. Since the amplified signal changes between positive and negative voltage, we input this signal to the absolute value circuit, and then we input it to the adjustable comparator to compare the sensing voltage and the reference voltage which are set according to the environment temperature.

B. Software Section

This is an Operating System (OS) on which all the software applications required for our design are going to be run. This OS is flexible to any user to operate and easy to understand. Accessing the soft wares and using them is very convenient to user. The μ Vision development platform is easy-to-use and it helps you quickly create embedded programs that work. The μ Vision IDE (Integrated Development Environment) from Keil combines design management, source code editing, program debugging, and complete simulation in one powerful environment. Code written in 'EMBEDDED C'. The μ Vision3 IDE is a Windows-based software development platform that combines a robust editor, design manager, and makes facility. μ Vision3 integrates all tools including the C compiler, macro assembler, linker/locator, and HEX file generator.

3. Experimental Results

In the experiment results we found that an ultrasonic signal would be affected by environment sounds and the amplitude of the reference voltage. Those factors affect the transmission distance and the error rate of detecting. We

therefore put the transmitter and the receiver on both ends of the sensing area and make sure the intruder passes through if the outside group has detected an individual.

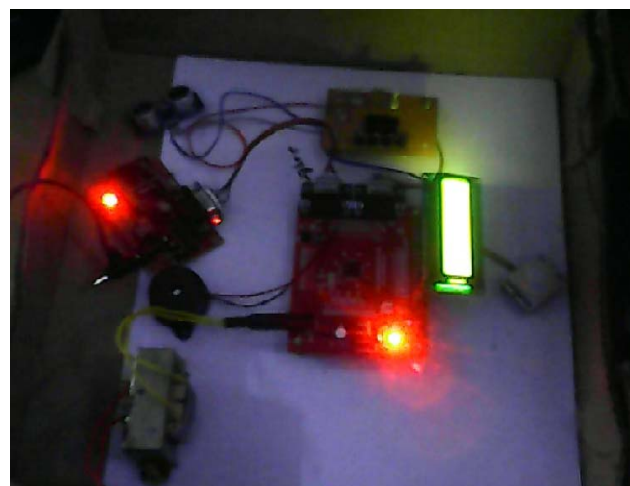


Figure 3: experimental Kit with Power Supply

In order to establish the serial communication between transmitter zigbee, receiver zigbee. We need to set the baud rate as 9600 bps in PC

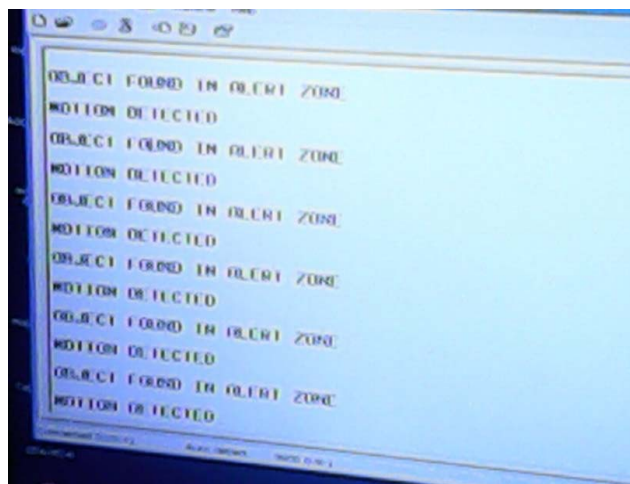


Figure 4: Motion Detected and analysis in PC.

4. 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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