

Design and Implementation of Reliable and Efficient Embedded Security System Based on Sensing Loop and Automatic Door Latch

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ABSTRACT: Security system was implemented more than years ago, but only today are the conditions united for mass application of this technology. The customer requires simple, reliable and high performance core system. In recently the system design with high resolution camera and built up with different sensor and also provides Internet service for global access for databases. In this design we survey the current work on security system and application. We examine the existing work, which is held by ultrasonic sensor to inform any intruder passed through the surveillance region, PIR (Pyroelectric Infrared) sensors for activities observation i.e. for motion detection with the help of majority voting mechanism and monitoring alarm system, which is commonly used. This review contributes to better understanding of the challenging in existing work on security system and further research direction. In this design we implemented a reliable embedded security system based multiple wireless sensors, sensing loop with automatic door latch to enhance the system efficiency and reliability. This embedded security system can be implemented in bank, home and in industry by installing the sensor loop around the building. The loop wires stretch two feet above the ground to sense the unauthorized entry into your premises which makes door to lock automatically in next way.

KEYWORD: Automatic door latch, Embedded system, PIR sensor, RF module, Sensing loop, Smartphone's, Ultrasonic sensors.

I. INTRODUCTION

Security system is now a crucial part for any Banks, organization and for home where we can monitor for 24 hours and provide necessary activities information. Security systems involve the use of various devices, techniques and sometimes-human efforts to protect individuals and assets from various hazards such as crime, fire and loss. The available security systems can be classified into different types; however they are overlap with one another. A monitored system alarm is one of the commonly used security systems. This system will alert a call center if the alarm is triggered and this call center will contact the police.

Nowadays security system is most important for image detection. Some researchers use embedded system for image processing or analyzing. In the last past year the implementation of security system was increase rapidly and technology terms are added with system day by day. In electronics terms, cameras for monitoring the activities that is video streaming did the first way of security system or capturing image and then system include some circuits to improving the security. In a system first we mount wire loops connected to door around building i.e. installing sensing loop to restrict the unauthorized entry into your premises. The next sensor module lock the next door automatically which is triggered by sensing loop when intruder enter in surveillance area and activate other sensor modules that's includes numbers of PIR and Ultrasonic sensor as well sending message to authorized person which makes the video calling in the security area where the smartphone is auto receive mode. PIR sensors was added to find any intruder enter in the surveillance area by change in room temperature or any motion. Single PIR sensor has high miss rate in sensing will decrease the reliability of the security system, then system auxiliary ultrasonic sensor, which make simple

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and reliable security system this sensors are judge by majority i.e. majority, voting mechanism. These sensors are also sense intruder pass through the security region.

The ultrasonic sensor provide transmitter and receiver section where ultrasonic transmission will spread at beam angle which required numbers of receivers in line direction at receiver by which human body block the frequency and receiver not receive any frequency. In addition, single sensor can be influenced by refraction and reflection we use numbers of PIR sensors to reduce miss rate and several receiver to receive ultrasonic frequency to enhance the reliability of the surveillance system. If any intruder passed through this sensor which cause blocking the transmitted frequency i.e. frequency not receive by ultrasonic receiver where we can identify that human body passes through the security region.

II. RELATED WORK

This work described the bank security system which involves the embedded board, sensing loop, multiple sensor, alarm, GSM module, video calling and automatic door latch. In the Bank building the sensing loop are mounted, where each door and windows are form with sensing wires which sense whether the door is broken or not. This sense signal are forward to the next way door, the automatic door controller receive that signal and take necessary action i.e. it automatically closed the door and also sense signal from the sensing loop fed to the embedded board. In embedded board where the TFT display is interface which display the “Door Broken” message as well as GSM 300 Module send this message to the authorized person.

In next step the multiple sensor like ultrasonic sensors and PIR sensors are formed inside the building in different room for detecting the position of the unauthorized person [1]. The ultrasonic sensor spread the 40 KHz frequency then the person pass through the transmission angle will block this frequency and signal is received by embedded board and it will again display on TFT, similarly the remaining ultrasonic sensor work exactly define the position of the person or objective. In room PIR sensors are also formed for motion detection, again it also spread the frequency and finding any object is in the room or not.

In embedded board we use the ARM7 (Advance RISC machine) processor, which processing all this sensing signal and microcontroller ATMEGA 8 as a controlling unit. The all sensing signal transmit through a wireless network i.e. RF module (CC2500 transceiver). After receiving message from GSM 300 module the person make video call in the surveillance area where the smart phone which is fixed with D.C motor and DTMF (MT8870) decoder. The person move the position of camera to left or right through the keypads by generating the different frequency tone and at the receiver the DTMF decoder accept the tone and move the camera using DC motor.

Automatic door closed make some delay in robs and crops have some time to make some action and video streaming help for identifying the activities in room and also multiple sensor identify the position of the unauthorized person.

III. ARCHITECTURE

This design used different methodology for security system, as we know that security is nothing but the monitoring, controlling and detecting the objects in the surveillance area. The first technique is the use of embedded system for security that means the central processor will accept all the sense signals and make them a decision panel. The ARM7 board is used with TFT interface for displaying the processing action. The control console which consists of ATMEGA 8 microcontroller and RF CC2500 module that are mounted on same PCB in our design. RF module is interfaced with MCU using max 232 converters. Also RF module takes instructions from MCU for actuators using the same interface. MCU is heart of the system. On one hand it is interfaced with RF module while on the other hand it is communicating with the GSM module. To allow compatibility of data communication between MCU and mobile phone, an interfacing standard RS-232 was engaged. And for this intention MAX- 232 level converter IC is used.

International Journal of Innovative Research in Science, Engineering and Technology

(An ISO 3297: 2007 Certified Organization)

Vol. 5, Issue 1, Januray 2016

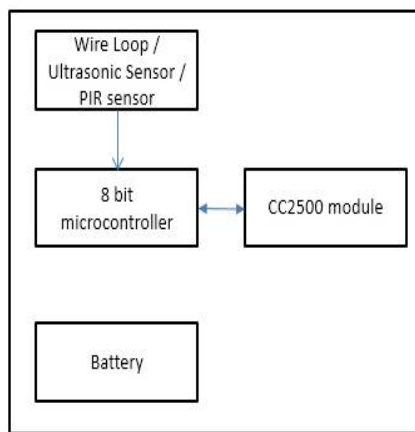


Fig.1 Block diagram of Sub-unit

When the authorized person is at network region and if there is a security break then he/she is informed about it through SMS. The controller in turn that can control the latch and door lock through the DC motor. Three sensors that are Passive Infrared, Ultrasonic and sensing loop are used. Ultrasonic and PIR sensors are installed at wall of the building and sensing loop installed door and windows. PIR sensor is sensitive to the infrared radiation emit by human being and hence used for human detection [1]. Ultrasonic sensor is used for detecting any person pass through the room and sensing wires used for detecting window or door breaking. Magnetic read switch is used for sensing breaking or door opening. When the intrusion is detected by these sensors, it then sends the signal instantly to the MC. The micro controller converts the analog signals in to digital signals for transmitting it to the RF module. The RF module is interfaced with the microcontroller using the max 232 converter which provides serial communication. The RF module end device then transmits the signal to the RF module coordinator.

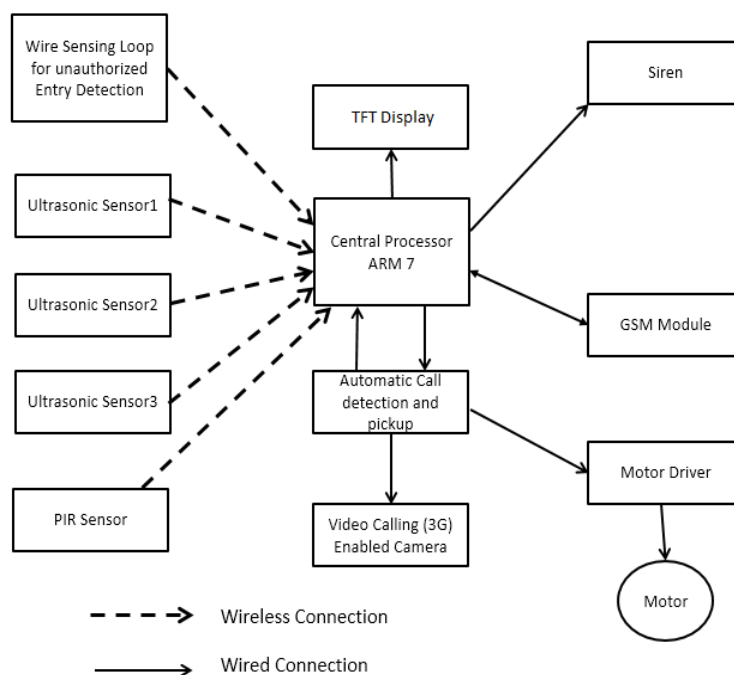


Fig.2Block Diagram of Main-unit

International Journal of Innovative Research in Science, Engineering and Technology

(An ISO 3297: 2007 Certified Organization)

Vol. 5, Issue 1, Januray 2016

Then the user can communicate with the authority through reply SMS or Call. Simultaneously sensing loop communicates with MCU in the same manner. The mobile phone number is already feed in ARM7 processor for sending message to authorized, and then further communication is made. Then accordingly the automatic control for lock the door or window is done. The door locking is activated by SMS sent to the owner, the DC motor starts working. The shaft of the DC motor exerts a force on the door and as a result the door is close with automatic latch locking in the room. Then finally the user can lock the door by sending the corresponding signal to the embedded board. Thus the system is not only used for monitoring but also for controlling purpose ensuring the reliability and safety of bank, home and industry.

IV. DESIGN TOOL

Passive Infrared (PIR) Sensor

All objects with a temperature over absolute zero emanate heat energy in the form of radiation. Usually this radiation is invisible to the human eye because it radiates at infrared wavelengths, but electronic devices designed for such a purpose can detect it. It is important to note that PIR sensors do not detect or measure "heat" per se; instead, they detect the Infrared radiation emitted from an object, which is different from but often associated/correlated with the object's temperature. A PIR-based motion detector is used to sense movement of people, animals, or other objects. PIR sensors may be designed to be wall or ceiling mounted, and come in various fields of view, from narrow "point" detectors to 360-degree fields. PIRs require a power supply in addition to the detection signaling circuit [1]. We can say that, PIR sensors do not detect motion; rather, they detect abrupt changes in temperature at a given point. As an intruder walks in front of the sensor, the temperature at that point will rise from room temperature to body temperature, and then back again. This quick change triggers the detection.

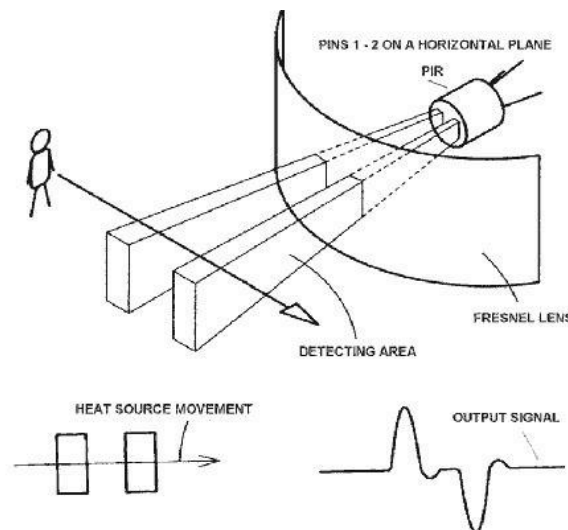


Fig.3 Change Pulses are what is detected

Ultrasonic Sensor (HC-SR04)

Ultrasonic sensors work on a principle similar to radar or sonar, which evaluate attributes of a target by interpreting the echoes from radio or sound waves respectively [1] [2]. Ultrasonic sensors generate high frequency sound waves and evaluate the echo, which is received back by the sensor. Sensors calculate the time interval between sending the signal and receiving the echo to determine the distance to an object [2]. The system uses ultrasonic sensor that has a transmitter part and a receiver part. The ultrasonic transmitter periodically emits ultrasonic signals into an open area in front of it. To cover a wide range. If the signal ever hits a physical object, it will be reflected back and, the receiver part of the sensor will then capture it with the object considered detected as its position.

International Journal of Innovative Research in Science, Engineering and Technology

(An ISO 3297: 2007 Certified Organization)

Vol. 5, Issue 1, Januray 2016



Fig.4 Ultrasonic Sensor

Figure. 2A shows we place the ultrasonic sensors on the walls around the room [2]. The ultrasonic transmission will be blocked when an intruder enter into the transmission path of the sensing area. The distance between the transmitter and the receiver is 6 m. It including an LED, which is turned on/off according to whether the receiver receives an ultrasonic signal or not.

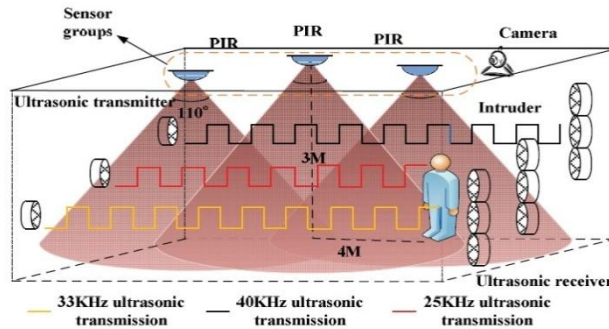


Figure.5 Experimental Environment

Sensing Loop

Figure. 3.7 shows the sensing loop that makes simple and reliable security system as a watch dog by installing the wiring around the building. You have to stretch the loop wires two feet above the ground to sense the unauthorized entry into your premises. Wire loops 1, 2 and 4 are connected to inputs of 7-segment display decoder. The loops are also connected to a dual 3-input NOR gate and inverter activate the alarm. A common-cathode, 7-segment display is used for displaying whether the loops are intact or not. If loop 1 is broken, the display will show '1'. If two or all the three loops are broken, the display will show the sum of the respective broken loop neatly. The loops are also connected to a dual 3-input NOR gate and to activate the alarm.

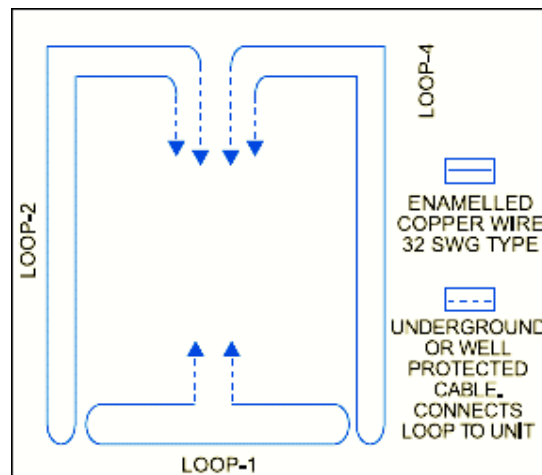


Fig.6 The Proposed Sensing Loops Diagram

International Journal of Innovative Research in Science, Engineering and Technology

(An ISO 3297: 2007 Certified Organization)

Vol. 5, Issue 1, Januray 2016

V. RESULT

In the implementation results, according to the specifications of the components, we mounting the sensing loop around the bank building that if any person break the door it will be found and RF module send door breaking signal to embedded board and starting the siren.

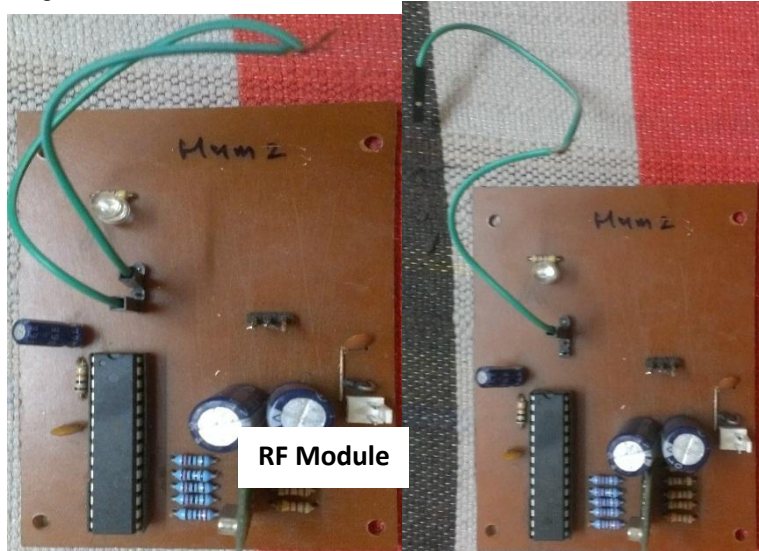


Fig.7 Mounted Sensing Loop

Fig.8 Break Sensing Loop

These sensing loops are mounted in each door and window, so that any door and window are break the signal are send through RF module C2550 to embedded board.

The unauthorized person position has been detected by use of multiple ultrasonic and PIR sensors



Fig.9 Multiple Ultrasonic Sensor

The ultrasonic sensor which existing transmitter for spreading the frequency i.e. 40 KHz and receiver for receiving that frequency, i.e. implemented in each room. while PIR sensor check temperature change in room by its principal it send the detected signal through RF module to embedded board which take the necessary action which is pre-program in ARM7 board and it will also display on TFT screen and “door broken” message is send to the authorized person.

International Journal of Innovative Research in Science, Engineering and Technology

(An ISO 3297: 2007 Certified Organization)

Vol. 5, Issue 1, Januray 2016

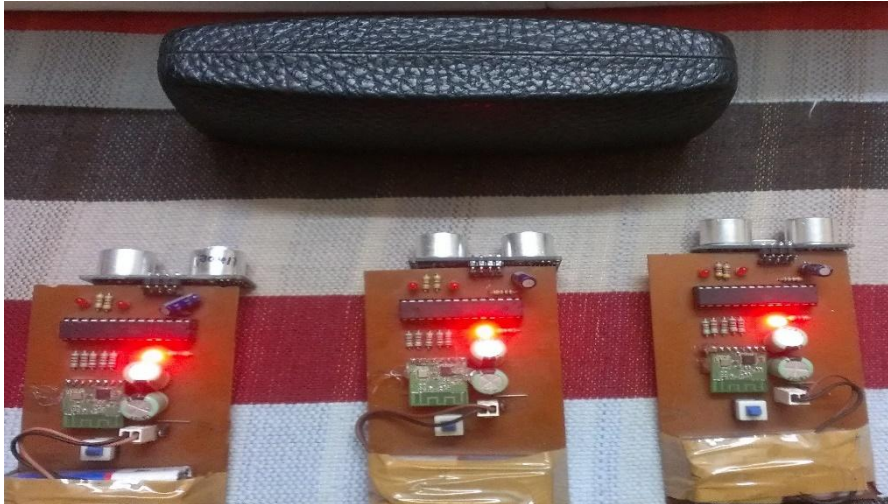


Fig.10 Object pass through the multiple sensors

If any object or intruder pass through this sensor the receiving frequency change and room temperature is also change which enabled the C2550 to send this changed signal to embedded board by using ATmega microcontroller which is preprogram for such action. This changed reading are also display on TFT screen.

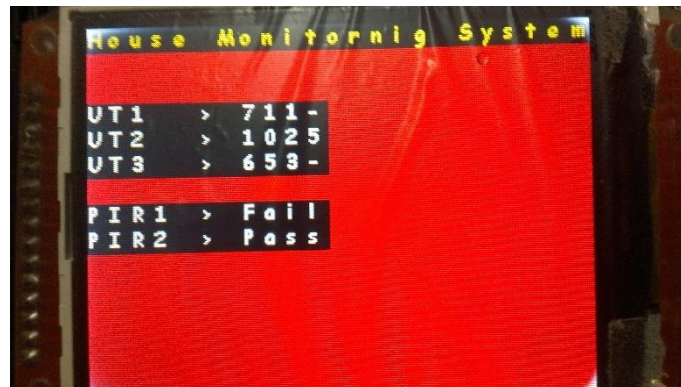


Fig. 11 Sensors Status on TFT Screen

while PIR sensor check temperature change in room by its principal it send the detected signal through RF module to embedded board which take the necessary action which is pre-program in ARM7 board and it will also display on TFT screen and “door broken” message is send to the authorized person.

VI. CONCLUSION

Today, secure embedded system design remains a field in its infancy in terms of research and pervasive deployment. Although historically, various security issues have been investigated in the context of Bank, Home security and Industrial security, the challenges imposed by the process of securing emerging environments or networks of embedded systems compel us to take a fresh look at the problem. The good news is that unlike the problem of providing security in bank (where the scope is very large), securing the application-limited world of embedded systems is more likely to

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(An ISO 3297: 2007 Certified Organization)

Vol. 5, Issue 1, Januray 2016

succeed in the near term. However, the constrained resources of embedded devices pose significant new challenges to achieving the desired levels of security.

This work shows that the overall controlling and sensing probability improves with the use of multiple sensors with a sensing loop and automatic door control. The result is a higher cost because of the use of multiple sensors, amplifier circuits and the wireless devices. However, the improvement of the reliability significantly reduces the occurrences of false alarm from the bank, industry and home surveillance system.

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