Enhancement of the Reliability and Efficiency of an Embedded Home Surveillance System by Sensing Loop

Sufiyan S. KhanTirupati M. Goskula
Assistant Professor (ACET, Nagpur) Assistant Professor (ACET, Nagpur)

Abstract—In this paper we design a reliable home surveillance system based on embedded system and multiple sensors to enhance the system efficiency and reliability. We use simple and reliable security system as a watch dog by installing the sensing loops around building. You have to stretch the loop wires two feet above the ground to sense the unauthorised entry into your premises which makes next way or door to lock automatically. Also other sensor modules are observing activities in surveillance area i.e. PIR (pyro-electric infrared) sensor used for motion detection and ultrasonic sensor for detection any person pass through surveillance area by spreading frequency at beam angle which is construct by using multiple sensors.

Keywords—Embedded Surveillance System, Sensing Loops, Automatic Door Latch, Majority Voting Mechanism, PIR Sensor and Ultrasonic Sensor.

I. INTRODUCTION

Nowadays surveillance system is most important for image detection. It is essential that home privacy is protected always and no outsider can affect it by any means. Some researchers use embedded home surveillance system for image processing or analysing [3].But the surveillance system method requires a low cost, low power consumption and high performance core that's meet with embedded system. We mount wire loops connected to door around building i.e. installing sensing loop to restrict the unauthorised 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. Single PIR sensor has high miss rate in sensing [2] will decrease the reliability of the surveillance system. Ultrasonic transmission will spread at beam angle [3] 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. The MVM determine the voting result of multiple PIR sensors and several ultrasonic receiver so that the embedded home surveillance system start the web camera to capture the image according to MVM result and the web server upload the image after finishing the image capture [1] [3].

II. MATERIAL AND METHODOLOGY

A) Sensing loop:

Figure. 1 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 unauthorised entry into your premises. Whereas 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 the loop 1 is broken, the display will show '1'. If two or all the three loops are broken, then 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.

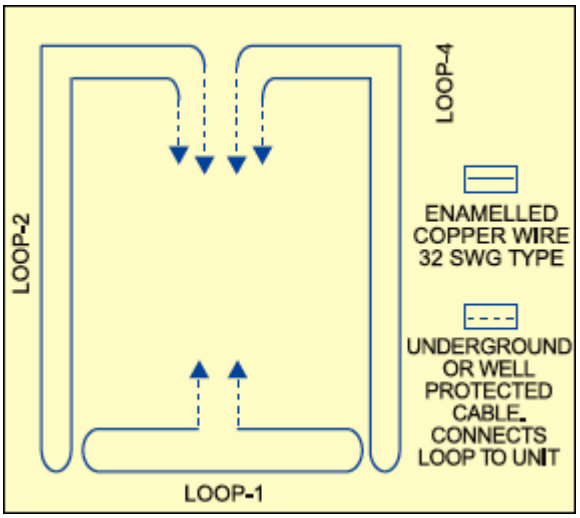

Figure. 1: The proposed Sensing loops diagram

B) Automatic Door Latch:

Home security system for automatic doors provides advance security of today's standard for home owners. It will be used to closed the home doors automatically just by receiving activating signal from sensing loop to closed the next door. In this design I worked to create a security system which is utilizing embedded technology to sense signal at the door knob for automatic door lock purposes. This system design is also connected with servo motor to perform a function of physical. This type of systems can be used in any type of

doors and gates for high class and fastest accessible security with ease of use.

C) Ultrasonic Security system:

The system uses ultrasonic sensor that has a transmitter section and a receiver section. The ultrasonic transmitter periodically emits ultrasonic signals into an open area in front of it to cover a wide range of area. If the signal ever hits a physical object, then it will be reflected back and, the receiver section of the sensor will then capture it with the object considered detected as its position.

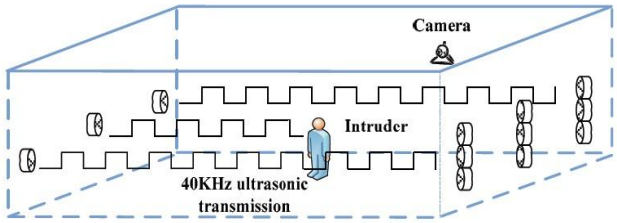

Figure. 2A: Experimental Environment

Figure. 2A shows we place the ultrasonic sensors on the walls around the room [3]. 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 includes an LED, which is turned on/off according to whether the receiver receives an ultrasonic signal or not.

D) PIR sensor:

All objects with a temperature above absolute zero emit heat energy in the form of radiation. Generally this radiation is invisible to the human eye because it radiates at infrared wavelengths, but even after it could be detected by electronic devices designed for such a purpose.

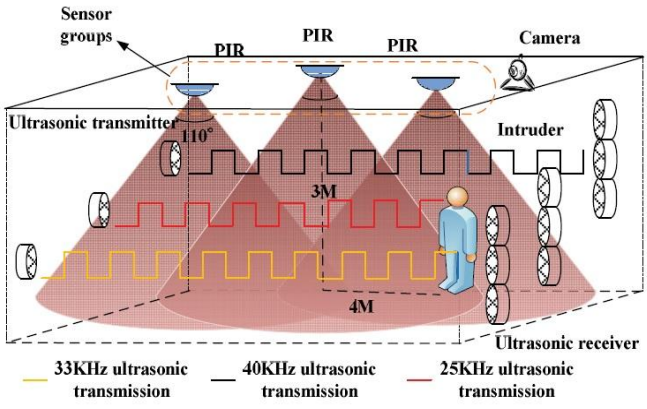

Figure. 2B: Experimental Environment

It is important to note that PIR sensors don't 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 human, animals, or other objects.

Figure. 2B shows the experimental environment [1] [3]where we placed the group of PIR and ultrasonic sensor in surveillance area for detecting any movements or activities in a room by intruder, if they find it capture by camera and uploaded by embedded system [1] [3].

III. MAJORITY VOTING MECHANISM

Majority voting Mechanism state that the resolution count must be greater than 0.5n, where 'n' being the total number of sensors [1] [3].To fit the extreme value of n we use w x n to deduce the relationship between P multiple (n) = Pm and P single = Ps in the extreme value of n [3], by this relationship we can find the overall voting probability of multiple sensors [1] [3].

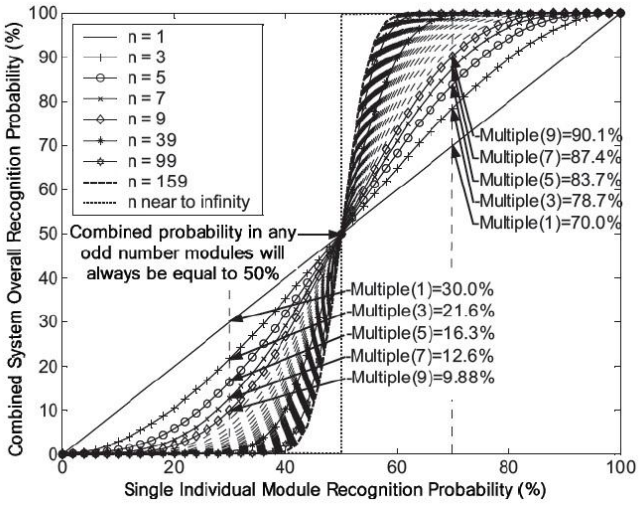

Figure. 3: Sensing probability of both single sensor and multiple sensors.

Figure. 3shows the improvement of the sensing probability of multiple sensors through majority voting[3]. If the sensing probability of a single sensor is 0.7, the sensing probability of 7 sensors will be 0.874 [3].

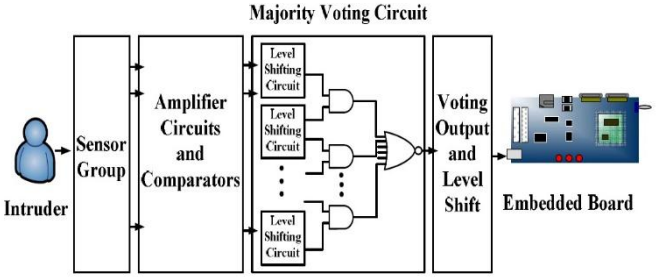

Figure. 4:Block diagram of Majority Voting Mechanism

Figure. 4 shows the block diagram of the Majority Voting Mechanism (MVM). The first part shows the sensor group

connecting with multiple sensors which is interrupt by person. When the sensors are sensing, the signal is transmitted to the amplifier circuit because of sense signal are weak and noise effected. This amplifier circuit filter it and remove the noise and amplify the signal. After amplification and comparator circuit we obtain digital signal that received by MVM circuit and determine majority voting [3].

IV. System Architecture

Fig. 5 shows block diagram which uses the embedded board as the system core [3]. We use multiple sensors which interface with embedded system. Sensing loop position in building indicates person enter from which door and give that signal to embedded system that activate the automatic door latch which closed the door by physical force generated by motor. When an intruder enters the in surveillance area, the human body blocks any ultrasonic transmission. If the receivers don't receive a transmission, and the embedded home surveillance system counts the sensing states of all ultrasonic sensors [2]. PIR sensor provide information to embedded system if the sense any motion or change in temperature in surveillance area, because of the result, the MVM is used; the Web camera immediately begins to capture the images of the intruder. After capturing the images, the embedded surveillance system uploads these images to the Web page through the Internet. The user can then watch them on either a PC or a PDA by connecting to the Internet [3].

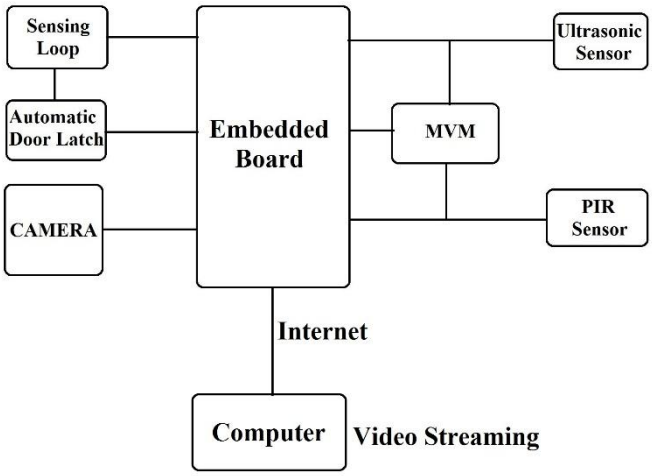

Figure. 5: Block Diagram Embedded Home Surveillance System

To increase the amplitude of the voltage waveform from the receiving the ultrasonic signal of the room we place a PET bottle at the front end for focusing. PET will focus on the original divergence of the ultrasonic signal to reduce noise interference for the ultrasonic properties of the room wall [3].

Figure. 6 show the software modules of the embedded system. The bottom layer is the boot-loader; it lies between the development kit and the firmware of the operating system. It manages the hardware in the development kit which needs to be initialized and then marks out the memory for burning the OS kernel [1] [3]. The second layer from the bottom is the OS kernel, and we use the Linux OS kernel 2.6.9 in our experiments. The system can execute each application program procedure requirements of the user by scheduling and multitasking of the kernel. Now we burn the root file system above the kernel. The root file system is also called the application layer. After cross-compiling the application program that we need to execute, we compress it and put it into the root file system. In our experiment we bundle the USB Web camera driver and the general purpose input and output (GPIO) driver into the root file. We use the command 'insmod' to load the drivers into the kernel and the command 'rmmod' to unload them again. The external sensing circuit communicates with the embedded board by means of a GPIO and captures the images by a USB Web camera through the parameter setting and hardware communication protocol of the driver [1] [3].

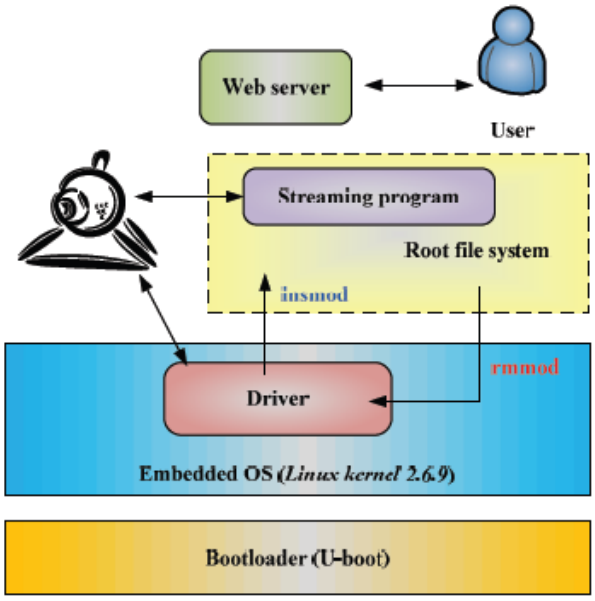

Figure. 6: Software Module of Embedded System

V. Conclusion

Our design provide total security by adding sensing loop in building with automatic door controlling as well as increase sensing probability when using multiple sensors with majority voting mechanism which is greater than single sensor and also improve the reliability.

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