The Invisible Eye-Security System Using PIR Sensors, Microcontroller and Camera

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Abstract— In this paper, Invisible Eye saving of power consumption and memory space of the recording system has been proposed. It evaluates the development of a Low-cost security system using small PIR (Pyroelectric Infrared) sensor built around a microcontroller. The low power PIR detectors take advantage of pyroelectricity to detect a human body that is a constant source of Passive Infrared (radiation in the infrared region). The system senses the signal generated by PIR sensor detecting the presence of individuals not at thermal equilibrium with the surrounding environment. Detecting the presence of any unauthorized person in any specific time interval, it triggers an alarm and sets up a call to a predefined number through a GSM modem. According to the change in infrared radiation there will be a change in the voltages generated which was amplified and used to turn ON the camera and lighting system through a relay. The camera placed on a stepper motor rotates to the direction of the intruder and starts to record and save the video. Once the intruder moves out of detection range of the sensor the camera and light gets turn OFF. Thus saves the power consumption and memory of the recording system.

***Keywords*—PIR sensor,camera,microcontroller,GSM modem.**

I. INTRODUCTION

Due to increasing number of crime and burglary, need of security system is very essential. The security system that monitors the area throughout the time and reacts effective to the threat is in need. We have lots of security system in the market for both indoor and outdoor applications such as ultrasonic detectors, photoelectric detector, infrared detectors etc.an output. Fig 1 shows he block diagram of the system.

The PIR sensor is used to detect the presence of a human through the detection of infrared radiated from that of a human body. PIR does not emit an infrared beam but passively accepts incoming infrared radiation. The output from PIR sensor is read by the microcontroller. According to the pulse received by the microcontroller, a call is established to mobile station through a GSM modem and thus warns presence of a human. The camera on the stepper motor turns towards the human and the video footage is recorded. On the other hand this security system remains in ideal position and performs nothing if no one is in the place.

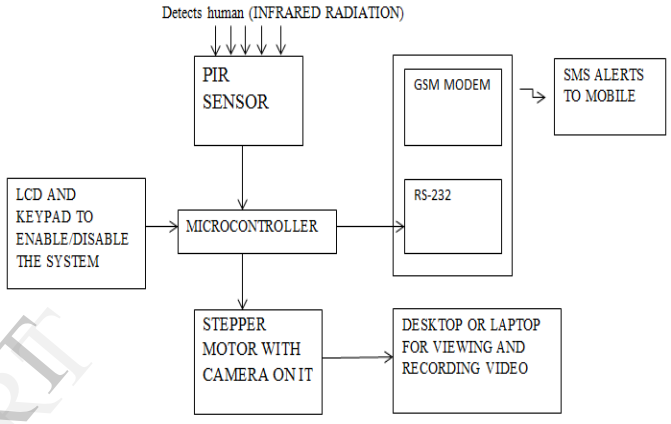

Figure 1: System Block Diagram

A LCD and keypad is used to enable and disable the system. The system is called Invisible Eye because the camera used is very small and it can be placed anywhere in the room. So are the PIR sensors. By this the intruder will be unaware about the presence of the system. This paper is organized into eight sections, including this section. Section II discusses some related works and section III presents an overview of PIR sensors and detection process. Circuit diagram and operation details are in section IV and Vrespectively.The application flowchart is given in section VI. Section VII discusses the experimental results of the implemented prototype system. Finally, future improvements and the conclusions are presented in section VIII

II. RELATED WORKS

Today's indoor security system uses various sensors like ultrasonic sensors, microwave sensors, photo electric, sensors, infrared detectors etc. Each of these systems has its own limitations. As an example, photo-electric beam systems detect the presence of an intruder by transmittingvisible or infrared light beams across an area, where these beams maybe obstructed. But the drawback lies within it if theintruder is aware of the presence of this system. Despite of having strong dependence on surrounding environmental status, pyroelectricity has become a widely used

detectionparameter because of simplicity and privilege of interfacing to the digital systems. Now, it is extensively used for intruder detection, smart environment sensing, and power management applications. Several works have been conducted in various applications. Intelligent fireproof and theft-proof alarm system
[1], GSM (Global System for Mobile) network based home safeguard system [2], human tracking system [3] and intruder detection systems [4] are some notable works done previously based on pyroelectricity sensing technique. Our work
Introduces a low-cost security system solution. Utilization of existing cellular network to alert and inform the system owner.
About the security breach is made to cope up with ever increasing demand for cheap but reliable security system.

III. PIR SENSOR

A passive infrared sensor (PIR sensor) shown in Fig 2 is an electronic sensor that measures infrared (IR) light radiating from objects in its field of view. They are most often used in PIR-based motion detectors. All objects with a temperature above absolute zero emit heat energy in the form of radiation. Usually this radiation is invisible to the human eye because it radiates at infrared wavelengths, but it can be detected by electronic devices designed for such a purpose.
The term passive in this instance refers to the fact that PIR devices do not generate or radiate any energy for detection purposes. They work entirely by detecting the energy given off by other objects. 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 (e.g., a detector of X-rays or gamma rays would not be considered a heat detector, though high temperatures may cause the emission of X or gamma radiation).

Figure 2: PIR sensor

Infrared radiation enters through the front of the sensor, known as the 'sensor face'. At the core of a PIR sensor is a solid state sensor or set of sensors, made from pyroelectricmaterials—materials which generate energy when exposed to heat. Typically, the sensors are approximately 1/4 inch square (40 mm^2), and take the form of a thin film.
The PIR sensor itself has two slots in it, each slot is made of a special material that is sensitive to IR. The lens used here is not really doing much and so we see that the two slots can 'see' out past some distance (basically the sensitivity of the sensor). When the sensor is idle, both slots detect the same amount of IR, the ambient amount radiated from the room or walls or outdoors. When a warm body like a human or animal passes by, it first intercepts one half of the PIR sensor, which causes a *positive differential* change between the two halves. When the warm body leaves the sensing area, the reverse happens, whereby the sensor generates a negative differential change. These change pulses are what is detected as shown in Fig 3.

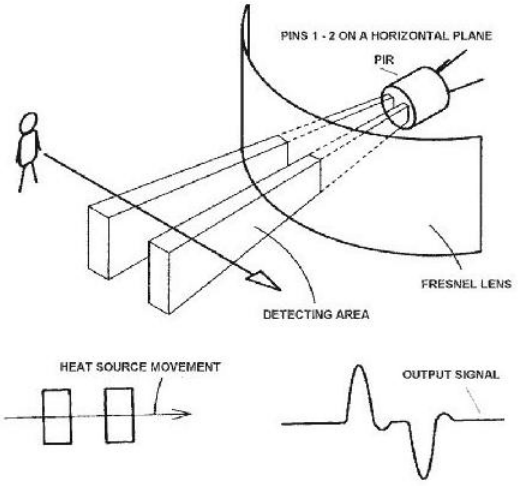

Figure 3: Working of PIR sensor

IV. WORKING CIRCUIT

The total system can be divided into three segments:

A. Sensor:

- PIR sensor module is show in Fig 4. The PIR positive input terminal (3) is fed with a +5V supply and negative terminal is grounded. PIR sensor module output pin is connected to MCU pin. Four sensors are used which are connected to the pins of port 1. For re-triggering purpose, a jumper (JP) is attached on the COMMON (C) pin and HIG H (H) pin.

- LM7805: LM7805 is a fixed output voltage regulator IC 7805 takes + 12V input and gives a fixed regulated output voltage of +5V.

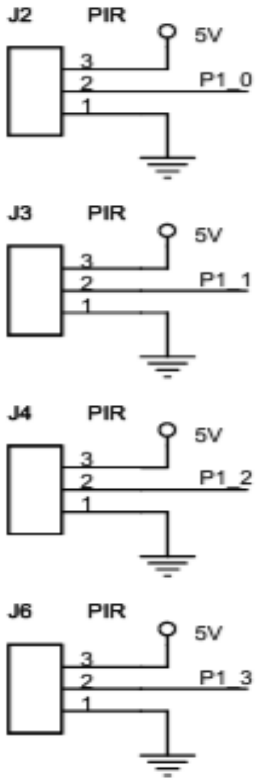

Figure 4: PIR sensor module

- MCU: For this system, AT89S52 is used as the MCU, i.e. Microcontroller unit.

B. GSM Modem interfacing segment:
This segment is shown in Fig 5.

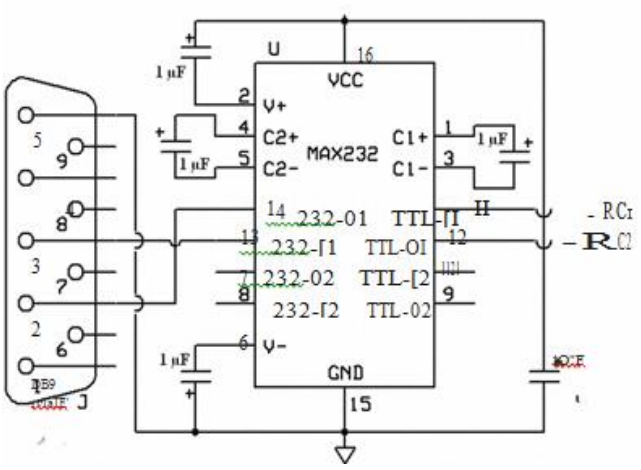

Figure 5: GSM modem interfacing segment

As GSM modem uses serial communication to interface with other peripherals, an

Interface is needed between MCU and GSM modem. This segment consists of four parts:

-OB9 male connector: The serial port used here is a 9 pin OB9 male connector as the GSM modem side uses a female connector. Pin 14 and 13 of MAX232 are connected to pin 2 and 3 ofOB9 respectively. Pin 5 ofOB9 is grounded.

- MAX232: This particular IC is necessary for increasing the voltage swing at the outputs. It takes 0V and +5V inputs and makes it a + 12V and -12V output voltages. This increased voltage swing is a requirement for serial communications. Two 1 /IF capacitors are connected between pins 4, 5 and 1, 3 of MAX232. V+ and V- pins are fed from VCC and G NO, i.e. Ground through two 1 /IF capacitors. Between VCC and G NO pins, one 10 /IF capacitor is placed.

- GSM modem: GSM modem is connected through a OB9 female connector to the interfacing circuit.

- MCU: The VCC, i.e. power pin, TTL input and TTL output pins of MAX232 are connected to the pins RCO, RCI and RC2 of MCU respectively.

C. Stepper Motor:
The Fig 6. Shows thestepper motor driving segment. The stepper motor is interfaced using ULN2003/2004 - Darlington Arrays. Here in this circuit the four pins "Controller pin 1",2,3 and 4 will control the motion and direction of the stepper motor according to the step sequence sent by the controller. It is connected to port 0 of the MCU

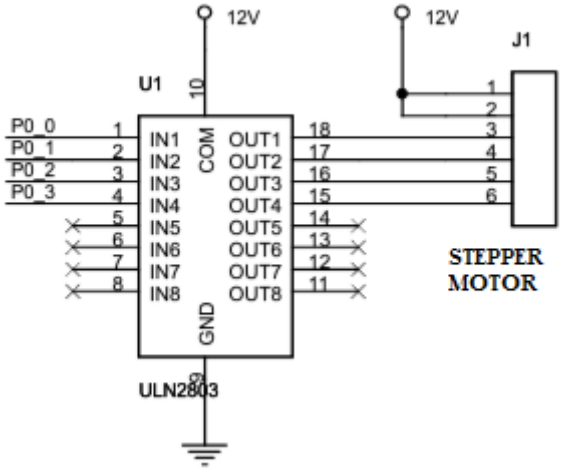

Figure 6: stepper motor driving segment

V. SOFTWARE

The whole system is built around a MCU. MCU requires to be burned with software written for specific applications. The code is written using EMBEDDEDC language and compiled using KEIL. WlPro accepts the Intel HEX format file generated from compiler to be sent to target microcontroller. It auto detects the hardware connected to the serial port. It also auto detects the chip inserted and

bytes used.This section demonstrates the flowchart of the software which is shown in the Fig. 7.

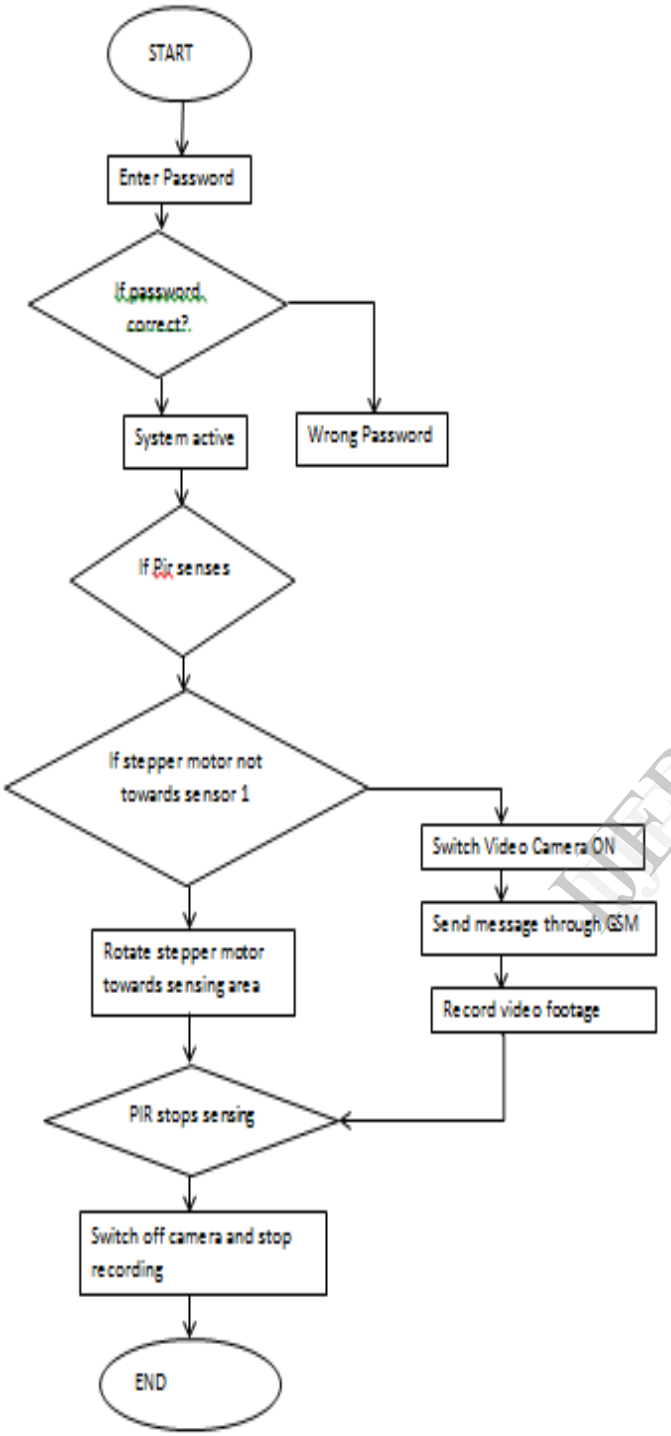

Figure 7: Flow chart of Invisible eye

VI. RESULT AND DISCUSSIONS

The proposed prototype system is implemented and tested for the desired functionalities. The system sent messages to a three pre-defined cell phone number and started recording the video after the stepper motor rotated towards the sensing area. The whole test procedure is done in a laboratory having the mentioned criteria for optimal performance. Based on several experiments conducted under various conditions, it is verified that this system can resolve the presence of any warm body within the coverage area and execute subsequent actions.

In order for a PIR sensor to work well most of the time, it is designed with certain limitations. A PIR sensor cannot detect a stationary or very slowly moving body. If the sensor was set to the required sensitivity, it would be activated by the cooling ofa nearby wallin the evening, or byvery small animals. Similarly, if someone walks straight towards a PIR sensor, it will not detect them until they are very close by. PIR sensors are temperature sensitive - they workoptimally at ambient air temperatures of around 15-20 degree Celsius. If the temperature is over 30 degree Celsius, the field of view narrows and the sensor will be less sensitive. Alternatively, if the temperature is below 15 degree Celsius, the field of view widens and smaller or more distant objects will activate the sensor. On cold nights, the difference in temperature between a person, e.g. normal body temperature is 37°C and the outside air temperature is relatively large, giving an apparent increase in performance of the sensor. On hot nights, this difference in temperature is relatively small and a decrease in performance of the sensor can be expected . Moreover, the PIR sensors are sensitive to exposure to direct sunlight and direct wind from heaters and air conditioners. Precaution is required if there are pets in the house. PIR's are sensitive enough to detect dogs and cats. There are special lens available or a tape can be put on lower part of the existing

VII. FUTURE WORK AND CONCLUSION

In this security system PIR sensor has been used which is low power, and low cost, pretty rugged, have a wide lens range, and are easy to interface with. This security system can be implemented in places like home, office, shop etc. The sensitivity range for detecting motion of the system is about 3 to 4 feet. It can be raised up to 20 feet through careful use of concentrating optical lenses as future development. In addition to this, this system can be equipped with glass break detectors to enhance the level of protection. In order to enhance the location accuracy and to enhance the method of processing the PIR sensor signal, use of more advanced techniques such as probabilistic theoriesand soft computing is left open for the future. In future we can use high end cameras to send the video footage to the mobile for enhanced security.

ACKNOWLEDGEMENT

The satisfaction and euphoria that accompany successful completion of any task would be incomplete without mentioning the people who made it possible. This humble endeavour bears the imprint of many persons who were in one way or other helpful for the completion of the paper.

With deep gratitude, we acknowledge all those guidance and encouragement, which served as bacon of light and crowned our efforts with success.
First and foremost we ought to pay due regards to this renowned institution, which provided us a platform and an opportunity for carrying out this work.
We are especially grateful to our beloved principal Dr. H. S. NANDA for extending his support in successful completion of the work.
We consider it's a privilege and honour to express our sincere thanks to Prof. REKHA J, H.O.D, Dept. of ECE, for her support and invaluable guidance.
We would like to thank our seminar coordinator MRS. DEEPA T, Asst. Prof., Dept. of ECE, for her kind consent and co-operation in carrying out this work.
I would like to express our gratitude to our internal guide MR. RAJSHEKHAR NAIK H. S., Asst. Prof., Dept. of ECE, for his support and guidance.
Finally we would like to express our gratitude to our parents and friends who always stood by us.

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