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Virtual Boundary System Using Passive Infrared Sensor

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ABSTRACT:
The aim of this paper is to discuss the application of passive infrared radial sensors to the problem of intrusion (human or animal) detection. This proposed research work is based on the combination of technologies that afford high level of detection, vigilance and barrier system via cost effective methods and equipments, require ideally no manpower to monitor. The virtual boundary system is a very high sensitive security system capable of detecting passage and providing early warning regarding intrusion. The system allows processed signals from the sensors to be relayed back to the base station or control room in the presence of any uncertainties.

KEYWORDS: PIR, GSM, RFID

1. INTRODUCTION:

Security system could actually play a pivotal role in the overall nation building process and helps in improving quality of life. Over the past few years security consciousness has been accorded a greater priority than before, though much needs to be done in this direction. Infrastructure and site surveillance is imperative with the increasing concern on security and safety. Most of the areas seem to pursue conventional fence to guard a site or building. The main problem with the conventional fence is that it has a physical barrier to allow an intruder to hide before break into the protected area and there is no notification of the intrusion. So we need an innovative superior method to detect the intrusion. This problem can be overcome by "virtual boundary system using passive infrared sensors" network which detect and localise the intruder. The perimeter of the boundary is segmented and protected using passive infrared sensors. It is very important to have long sensing range so that the units of sensors can be minimised. Performance of virtual boundary may vary in different environment and orientations.

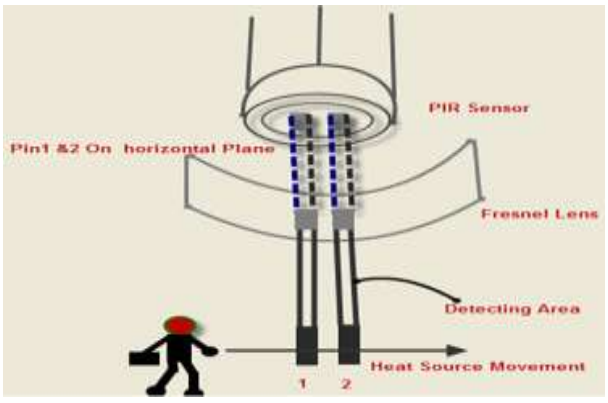


Fig.1.showing detection of intrude

2. SYSTEM ARCHITECTURE:

The block diagram of virtual boundary system is demonstrated in fig.2.. The system is supplied with +5V and +12V power supply. The passive infrared radial sensors at the perimeter of the boundary act like a virtual fence. They detect infrared radiation emitted from the intruder's body and provides input signal to the microcontroller. The microcontroller receives the signal and performs the necessary control operations

like sending SMS to the control room via GSM module, operates lights and buzzer and display message on LCD. The system is divided into two blocks - PIR virtual boundary and Monitor block.

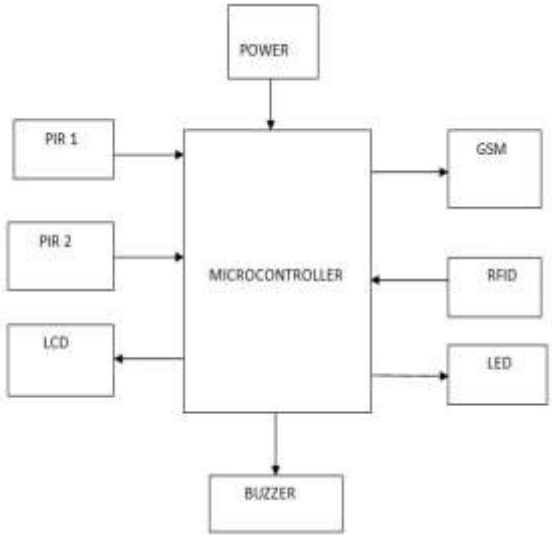


Fig.2. Block diagram of virtual boundary system

2.1 PIR VIRTUAL BOUNDARY:

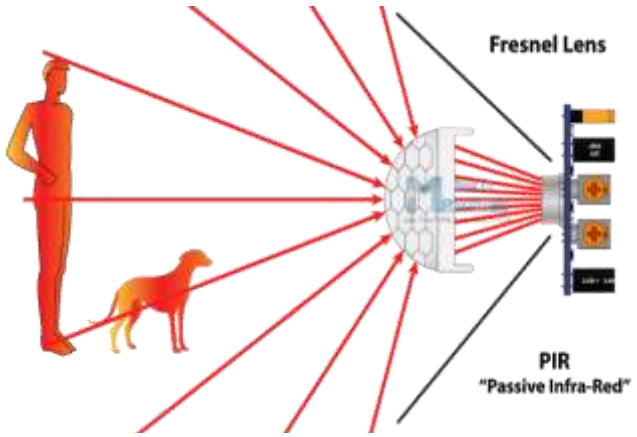
Passive infrared sensors at the perimeter form a virtual fence. The PIR (passive infrared) Sensor is a pyroelectric device that detects motion by measuring change in infrared levels emitted by surrounding objects. This motion can be checked by checking for a high signal on a single I/O pin.

2.1.1 FEATURES OF PIR SENSOR:

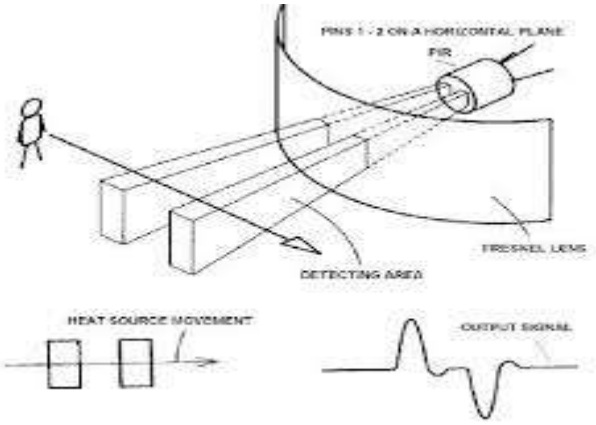
- Single bit output
- Small size makes it easy to conceal
- Compatible with all parallax microcontrollers
- 3.3V and 5.5V operation with <100µA current draw

2.1.2. THEORY OF OPERATION:

Pyroelectric devices, such as the PIR sensor, have elements made of 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 specific 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 output to indicate motion.



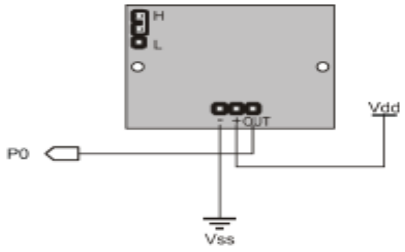
(a)



(b)

Fig.3. Showing working of PIR Sensor

2.1.3. PIN DEFINITIONS:



- - pin connects to GND or Vss
- +pin connects to Vdd (3.3V to 5V) @ ~100µA
- OUT pin connects to an I/O pin to set INPUT mode

2.1.4. CALIBRATION AND SENSITIVITY:

The passive infrared sensor requires a "warm-up" time in order to function properly. This is due to the settling time involved in "learning" its environment. This could take around 10 to 60 seconds. During this time there should be as little motion as possible in the sensors field of view.

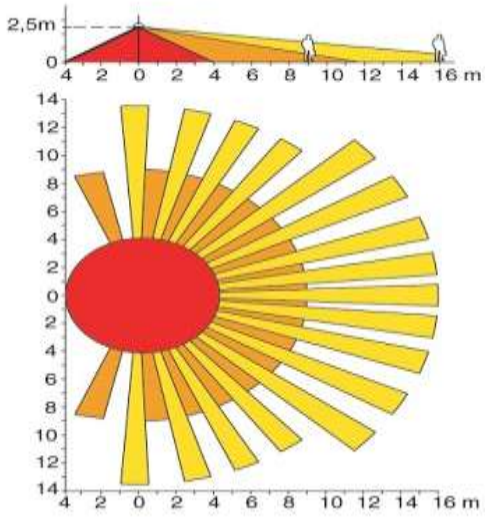


Fig.4. showing range of PIR Sensor

The PIR sensor has a range of approximately 20 feet. This can vary with the environmental conditions. The sensor is designed to adjust to slowly changing conditions that would happen normally as the day progresses and environmental conditions change, but it respond with high output when sudden changes occur.

2.2. MONITOR BLOCK:

Monitor block sends alert signals and drives the peripherals attached to the microcontroller. It consists of PIC16F877A microcontroller, LCD display, GSM SIM900 module, lights and buzzer. The working of the monitor block is explained below using flow chart of the system given in fig.

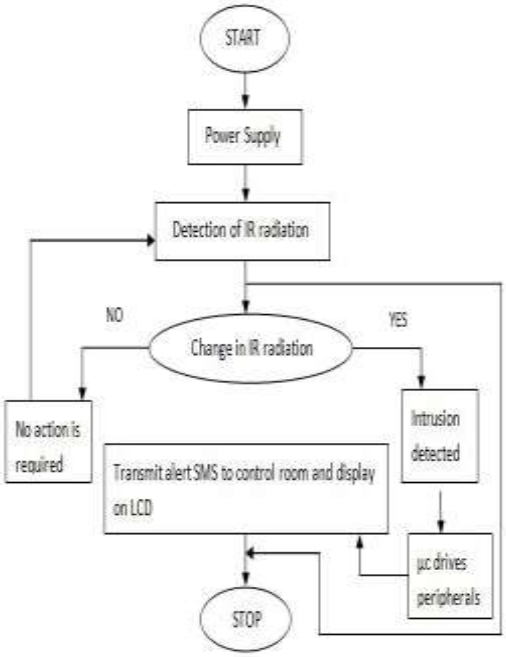


Fig.5. Flow chart of virtual boundary system

3. HARDWARE DESIGN:

3.1. PIC16F877A MICROCONTROLLER:

This is a powerful (200 nanosecond instruction execution) yet easy to program (only 35 single word instructions) microchip architecture into a 40 pin package. The PIC16F877A features 256 bytes of EPROM data memory, self programming, 2comparators, 8 channels of 10 bit A/D converter, 2capture/compare/PWM functions, synchronous serial port can be configured as either 3-wire Serial Peripheral Interface (SPI) or the 2-wire Inter-Integrated Circuit (I2C) bus and a Universal Asynchronous Receiver Transmitter (USART). All of these features make it ideal for more advanced level applications.

All other components are interfaced to this 40 pin microcontroller. When it receives signal from PIR sensors it operates the respective functions.

3.2. GSM SIM900 MODULE:

SIMCom presents an ultra compact and reliable wireless module-SIM900. This is a complete quad band GSM/GPRS module in a SMT type and designed with a very powerful single chip processor, allowing you to benefit from small dimensions and cost effective solutions.

GSM module in virtual boundary system is used to send an early warning text message to the base/control room.

Fig.6. GSM module

3.3. RFID MODULE:

RFID is a tracking technology used to identify and authenticate tags that are applied to any product, individual or animal. Radio frequency identification and detection is a general term used for technologies that make use of radio waves in order to identify objects and people.

In virtual boundary system RFID module is used at the legal entry gate for the identification of authorised and unauthorised people.

3.4. PIR SENSORS:

The PIR sensors are used to detect any kind of intrusion into the protected site and give a high output on detection.

4. CONCLUSION:

The developed virtual boundary system to control intruder management will automatically detect the intruder, send warning message to owner of field by GSM and also to duty personnel by buzzer and lights. This will reduce the problem regarding field security and improve the life style of guards. The key features of this product is

- Low maintenance
- Less man power
- Low Power consumption
- Easy to use and install
- Ease of modification
- Automated operation
- Portable

It can be used at open wide areas like airports, military base, and residential quarters as alert and detection system. To enhance the effectiveness of this barrier system, a camera can also be added along with the boundary monitor block. This will capture the intruder as soon as the intrusion is detected.

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