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Intelligent Border Security Intrusion Detection Using IoT and Embedded Systems

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ABSTRACT

Terrorists cross our borders unknowingly. It is not possible for our soldiers to watch the borders at each and every moment. An essential requirement in security is the capability to automatically detect terrorist in borders. In this paper we propose a robot which identifies terrorist using IR sensor and capture image of terrorist using pi camera and sends notification to respective admin. If admin accept to shootout that terrorist then that notification is sent back to robot through server to kill that person, if admin decline to shootout then the process will stop there itself. This development enables security personnel to effectively detect terrorist at low cost.

Keywords: *Camera, Raspberry pi, Intruder, Gas sensor, IR sensor, Metal detector.*

1. Introduction

An autonomous robot system is an innovation of modern technology. It has been able to provide significant support to mankind by accomplishing task that is impossible for human beings. These robots can be used to accomplish tasks like rescue, security, surveillance in unstructured and natural environments. An Internet-based intelligent robot security system, "iBotGuard" in detecting trespassers using face recognition algorithm. System can detect a trespasser using intruder detection subsystem which relies on invariant face recognition and it tracks the trespasser using intruder tracking subsystem based on streaming technology. Intruder detection subsystem captures images periodically when it detects trespasser in a secure area and verifies whether the object detected is human using invariant face recognition algorithm then robot will alert the security guards through alert signal using internet. The security guards use the images in robot camera to control robot motion and to recognize trespasser. The reconnaissance robot can be operated in three different ways in accordance with user requests and possessions of task.

2. Problem Identification

In the previous existing system they are monitoring the intruders with CCTV Camera with PIC microcontroller they are monitoring human intrusion only which is having their own advantages and disadvantages because in a growing world intruders cannot be humans only. It can be robot, toxic gas, bomb, landmine, drones. It can be anything that something we cannot imagine. We need to develop and design a system that has to detect and alert the soldiers for any kind of intrusion because our safety and soldiers safety is prime. So in this project we are proposing a system that will move and detect intrusions in the forms of human, drone, animals, bombs, landmines, and any harmful equipment with IR sensor, PIR sensor, Gas sensor ,metal detector and cameras with Raspberry Pi its accuracy is higher than PIC.

3. Proposed System

The point of this project is to build up an implanted intruder's identification framework in border by utilizing IR sensor. There are numerous IR sensors being used today however the sensor that is utilized will

identify the Infrared beams that are transmitted from the human body. There is a need to use PI camera because, we are using PI Camera for detecting intruders.

There are numerous circumstances that happen, so every movement our soldiers can't watch the borders then intruders can enter our border by unknowingly and they may attack. At the point when an unknown person is recognized in the scope of that IR sensor at that point it sends the flag to the raspberry pi and pi camera starts capturing the images. After capturing images, it will compare with database stored in the server, if image is does not match with any image then robot will shootout that person. At that point the protect operation will be quick in identifying the people who are enter unknowingly. Robot will kill the opponents' life.

PIR Sensor

The Pyro-electric Infra-Red (PIR) sensor is an extremely useful device for detecting the presence of a moving body. This is due to its ability to sense the infrared radiation that every living body emits. Part of the appeal of the PIR[1] sensor is its ability to reliably distinguish moving bodies from other objects, as well as from stationary bodies. Its basic mode of operation is to detect the difference in heat signature between two 'segments' in its field of view. The model of the internal structure of a PIR sensor clearly illustrates this operating principle.

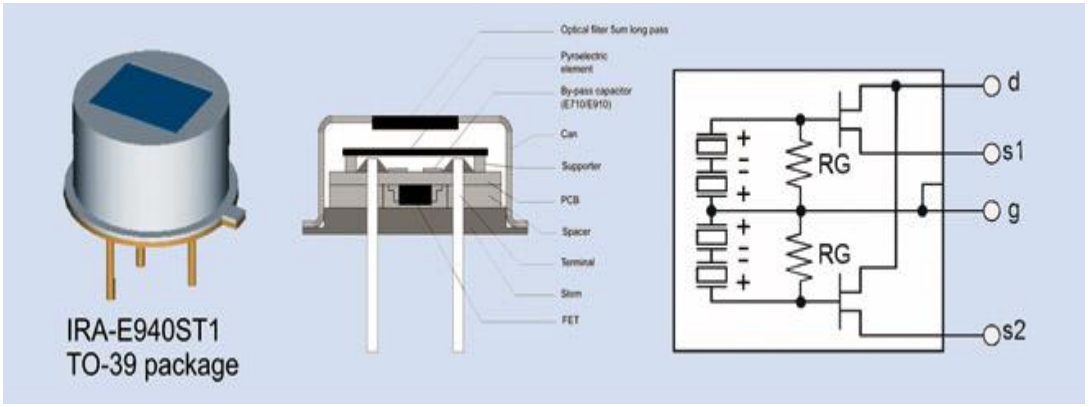


Fig.1 Murata's IRA-E940ST1 PIR sensor

To avoid triggering upon sensing normal temperature variations or disturbances in airflow, a dual-element PIR sensor connects two elements in pairs. These are inverted with respect to each other in terms of polarization. When the two inverted elements are exposed to the same infrared radiation level, they cancel each other out, generating a zero-output signal as a result. This means that the detected body will have to move into or between the two elements' field of view to cause the sensor to generate an output signal. In this way, a dual- or quad-element sensor is able to reject false detections accurately and effectively. By using a dual- or quad-element sensor, it is also possible to detect the direction in which the object is moving. The quad-element sensor has two outputs: this means that it can indicate in which area the movement is occurring (for instance, on the ceiling or on the floor), and at the same time whether the object is moving in the horizontal or vertical plane. The dual sensor can only indicate movement in one axis; for example, the horizontal plane.

When specifying a sensor, the number of elements is only the first consideration. Other important parameters that vary between sensors are frequency response, which determines the sensor's ability to detect low and high speed movements, the angle of the field of view, which will affect the size of the sensor's coverage area and immunity to RF and background noise.

Configuring the Lens

The sensor itself is inefficient if it does not have a lens to focus the radiation. The most commonly used lens type is the Fresnel lens, due to its low losses and small form factor. A Fresnel lens is a compressed plano-convex lens that comprises a set of discontinuous surfaces. The grooves on the lens are arranged facing the PIR sensor. This leaves a flat, dust and weather proof surface facing the outside and protecting the otherwise vulnerable sensor.

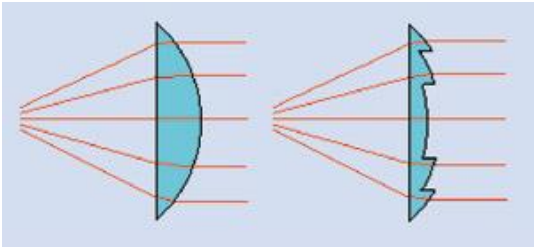


Fig.2 Convex lens (left) and Fresnel lens (right)

The Signal Conditioning Circuit

To be usable, the signal from the sensor has to be amplified and then converted into a digital value for further analysis in software. A typical block schematic for this application is given below. There are several ways to design a circuit to realize this schematic. The two preferred approaches use either discrete analog components, or, in a more integrated implementation, a mixed-signal programmable array such as a Cypress Semiconductor Programmable System-on-Chip (PSoC) device.

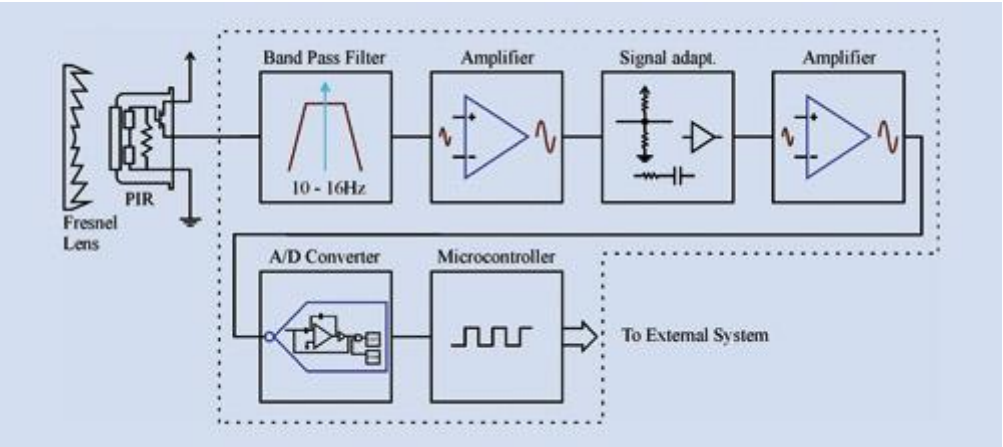


Fig.3 PIR sensor signal conditioning circuit: block diagram

The Discrete Solution

The most common approach to PIR sensor signal conditioning is to design the amplifier and signal conditioning stage by using discrete components such as operational amplifiers, comparators, diodes,

resistors and capacitors. Next in the signal path, a microcontroller with an integrated ADC performs signal identification and also supports connection to a communications interface, such as a radio. This traditional approach occupies a large PCB footprint. But a PIR sensor produces a very low signal level, so it is essential to keep PCB traces short and the design compact to avoid creating unwanted antennas. These can pick up background noise and RF signals, which can cause the device to trigger falsely. If the PIR sensor is connected to a wireless network (for instance, as part of an intruder alarm system), the danger of this is particularly high.

The PSoC Solution

A second approach, which produces a more compact result, is to use a PSoC device from Cypress. The PSoC is a programmable mixed-signal controller with an 8-bit core and a set of analog and digital blocks that can be used to create the functionality needed.

Analog blocks that can be realized in the PSoC include ADCs, DACs, filters, amplifiers and comparators. Integrated digital functions include timers, counters, UARTs, SPI and PWMs. Designers using a PSoC will be able to realize the blocks with far fewer components than in the discrete implementation described above.

Different devices in the PSoC family provide different numbers and types of digital and analog blocks, offer different memory sizes and use different packages. The first step in implementing a PIR sensor with a PSoC device should be to identify the required analog and digital functionality. When the block diagram is defined, an appropriate device with the right number of programmable blocks can be selected.

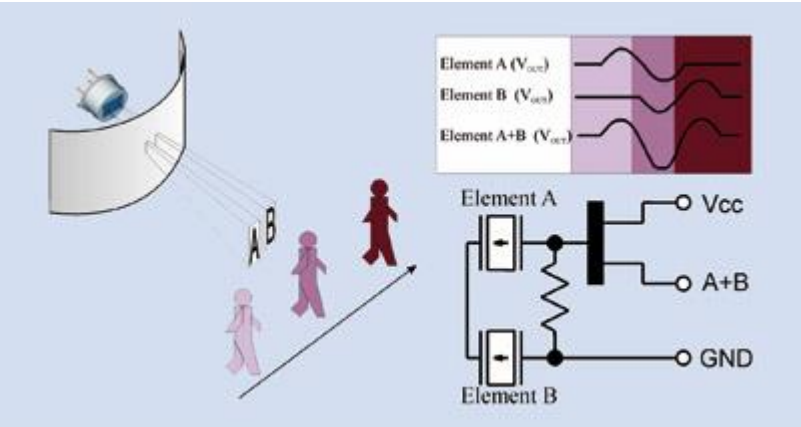
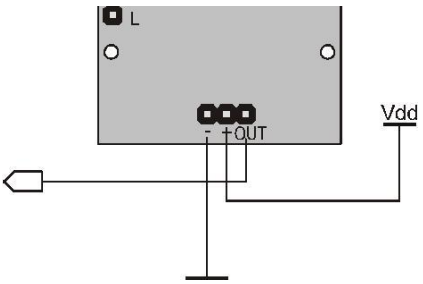


Fig.4 A PIR sensor works by sensing the difference in infra-red radiation between one sensing element and another

Why Use a PIR Sensor

While a number of technologies for motion detection exist, including ultrasonic and microwave radiation sensors, the PIR sensor is popular for its ease-of-setup and high performance. In addition, PIR sensors are inexpensive and draw little power. Future Electronics expects the rate of adoption of PIR sensors to grow fast, with applications such as surveillance and alarm systems, as well as power saving devices, driving increased usage. Future Electronics, a broad line component distributor, can supply every component

required in a PIR sensor system, including PIR sensors, lenses, discrete components, microcontrollers and PSoC devices. Future Electronics' FAEs can provide customers with technical support in the implementation of PIR sensor system designs.



Theory of Operation

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

4. Results and Discussions

The purpose of the proposed system is to provide a cost effective system for rescue of human in border.

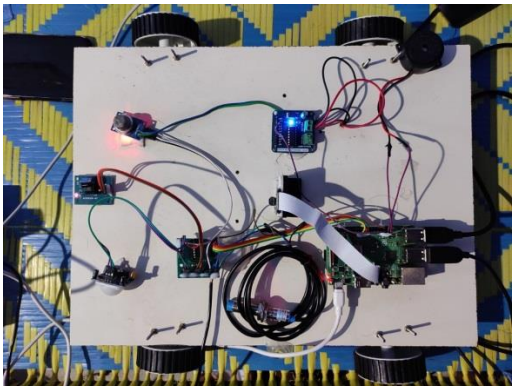


Fig.5 Device Setup

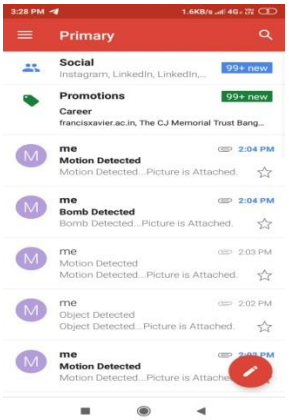


Fig.6 Alert Messages When Detecting the Intruder

The proposed system uses a low cost sensor which is easily available. It is impossible for an individual to visit the border. So, in such situations, the proposed system can be useful.

5. Conclusion & Future Scope

The purpose of the proposed system is to provide a cost effective system for rescue of human in border. The proposed system uses a low cost sensor which is easily available. It is impossible for an individual to visit the border. So, in such situations, the proposed system can be useful.

In the future enhancement can be done by incorporating an IR camera that can exactly capture IR pattern emitted by human body. Furthermore, metal and bomb detector can be used to protect from possible damage

Declarations

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Competing Interests Statement

The authors declare no competing financial, professional and personal interests.

Consent for publication

We declare that we consented for the publication of this research work.

Code availability

The programming code that we have used for this research is available and authors are willing to share when it is required.

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