# Personnel Detection System for Security Sensitive Areas

Mir Jamal ud din

MS Scholar
University of Lahore, Pakistan

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*Abstract* - **Personnel detection deals with the avoidance and detection of unauthorized persons from crossing a defined perimeter. It is required now in various organizations which face security issues. Now a day's detecting unauthorized persons crossing a boundary is a security concern for individuals, corporate organizations as well as having an international scope. Personal detection system to support covert work in an office environment has been developed by using sensors, RFID, microcontroller and various other communicating devices. It provides confirmation when a building or area is/was empty and indications of personnel entering/re-entering the office or area where the system has been deployed. The device is composed of infrared sensors that are connected to a microcontroller. System uses RFID on one hand for the authentication of employees who have the RFID tags. This system is able to inspect and control a comprehensive database that is able to notify the user whether the person entering the building is authorized personnel or not. While on the other hand it uses infrared sensors to detect non employees entering the area. The SMS of detection is directly sent to the administrator of the system.**

*Keywords* - **Covert work, PIR Sensor, RFID, Security solution, Sensor Network**

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## I. INTRODUCTION

Security nowadays is a major issue around the world. In the past few years peoples were hired to guard the some specific areas. The owners and the organization invested descent amount of money for obtaining the services of security companies. Security companies were started up with the sole purpose of providing guards that were responsible to provide security. However, most of the time, these security guards or personnel are just performing monitoring duties. For this, the security companies all over the world charge huge amounts of money. But still the world remained insecure. To cut lose this situation, Personnel detection systems are used to secure the premises and to cut down the monitoring cost.

## II. PERSONNEL DETECTION SYSTEM

Personnel detection can be accomplished using several sensors of multiple modalities namely, acoustic, seismic, passive infrared (PIR), magnetic, electrostatic, RF, chemical, video and thermal imaging. Personnel detection system deals with preventing, detecting and then responding to stop unauthorized persons from crossing an established boundary. This personnel detection system is useful in ensuring the security of sensitive areas. Personnel detection system is designed to
- Restrict any kind of un-authorized access to a specific area.
- Make the area secure so that it is un-accessible for common people.

The system is designed specifically for covert areas that demand high security.  We have to design such a system that provides authenticity and integrity of data by using different components.

## III. BACKGROUND

Sensor Networks is a sub domain of networking field in Computer Science. Recent developments in this field have been quite remarkable but still a lot remains to be accomplished. One of the most useful applications of his field is security applications. In security systems, sensors have been used as standalone modules. This approach has proved to be efficient in a few limited scenarios. This is so because although there are various sophisticated sensors present, their scope gets limited when they are as stand-alone devices. Use of cameras in co-ordination with the sensors also has been widely deployed, but that too limits the mobility of a security operator.

Making a parameter secure and detecting any unauthorized personnel crossing a particular boundary has been and will be a prime concern for security officials. The most conventional use of this technology is using the concept of "electronic trip wires". This approach uses infrared sensors, seismic sensors, ultra sonic sensors, magnetic sensors and/or lasers. Whenever an intrusion is detected in their field of operation, the remote user/operator is notified of the event. These trip wires can be used to form a network that would provide more accurate results.

The one drawback in this approach is the lack of ability of sensors to cover a region of 360 degrees. Second major disadvantage is that once a trip wire has been triggered, it has to be replaced manually o be used again. As can be imagined, this is a major drawback of such a system.

So there is a need for such a security system to be developed that would be reliable, robust and would prove to be energy and cost effective. Data fusion, although a complex phenomenon, has proved to be more useful as it authenticates the data collected from various nodes. To keep this simple, certain technologies such as RFID could be used side by side, which would accomplish

the goals for the operator i.e. authenticate then data, keep data fusion simple and easy and provide more flexibility and mobility for the users of the system

## IV.   OBJECTIVES

Following are the objectives for the system
- The system would be able to provide a security solution by integrating the RFID and Sensors to support covert work in an office.
- This personnel detection system could provide information of when the building was empty.
- Indication of entering and re-entering of personnel.

System maintains and checks a database that keeps record of all the personnel present in the building. A modular interface could be developed for a mobile phone. Deployment of the sensors by developing a module to allow the user to disable sectors. We will use a smart phone interfaced directly with the wireless sensor network.  PIR sensor detects whenever a person enters the building. Upon detecting the presence of a person by the sensors, a message is sent to the user/operator of the system, notifying the entry of a person. RFID module is able to detect whether the person entering the building is an authorized personnel or not. It maintains and checks this information through a database running at the server station.

## V.   EXISTING TECHNOLOGIES

### Passive Infrared Sensor

We have used PIR sensors to detect personnel. PIR sensing systems are passive systems, and respond to power sources (like human Body) from within their organized area. We had use PIR sensor as a wall switch for the sensing mechanism of personnel entering a specific area.

### Reason for using PIR Sensor

Every object radiates a definite set pattern of infrared radiation. The PIR sensors work on this principle by measuring the infrared radiations from the objects within their own operation field. Whenever a person passes through the field of these sensors, certain changes would occur in the radiation pattern. These can be easily detected and used for further operations.

PIR sensors are less power consuming. So, when they are deployed, they can be easily kept in working state at all times. Additionally, unlike electric trap wire circuits, they do not need to be manually reset. The coverage area or field of operation of PIR sensors is very wide i.e. 110~140°. Achieving a region of 360° operating field becomes very easy.

The common IR sensors work in pairs, i.e., one part is the transmitter and the other is the receiver. Their principle of working is that they must be placed parallel to each other, at exact 90°. Their alignment is most critical. If there is any error in alignment, however small, the sensor becomes useless. This is because the transmitter part emits an IR beam that is received at the other end. If any object passes through this line or cuts through it, this event would be notified. That is why if they are not in line of sight to each other, proper detection would not take place.

The PIR sensors do not face the line of sight problem; neither do they operate in pairs. Rather they can cover an area of complete 360°, providing increased efficiency. To achieve a complete 360° operating field, only five PIR sensors would be enough. Placing them around a periphery enclosure, keeping a constant distance between them would achieve the objective. Any personnel entering the parameter would be localized within 38° of the coverage area. These sensors provide a range of up to 10 meters which in almost all cases serves the purpose of personnel detection.

Another important feature of PIR sensors is that their sensitivity can be manually controlled by the user. So occurrence of false alarms can also be reduced by manually adjusting this feature.

### RFID

The other technology used side by side in our system with Sensor Networks is RFID technology. Radio frequency identification (RFID) is a generic term that is used to describe a system that transmits the identity (in the form of a unique serial number) of an object or person; wirelessly by transmitting signals over radio waves. It's grouped under the broad category of automatic identification technologies. [AIM Organization, 2011]

### RFID systems

Three main components of RFID are
- Tags have the identifying data embedded in them
- Readers read the tags or they can write data over a tag.
- A back-end databases compares the data read by the reader to ensure the identity

Every object or person that needs to have an identification is allotted a tag

### GSM technology

Our system utilizes short message service through global system for mobile (GSM) communication technology as a medium of communication. In order to integrate the GSM modem with the microcontroller, AT commands are sent from microcontroller to the GSM modem. These commands can be used to control the dialing function, SMS function, and GSM modem switching OFF. [Liu Liu, Rong Sun .et al, 2010]

## VI. OPERATION THEORY

PIR sensor module contains crystalline elements which are able to produce electric charge when they are exposed to infrared radiations. The changes in the voltage are caused due to this phenomenon, which are then measured by a built-in amplifier. The specialty of this device is that it has a Fresnel lens. This Fresnel lens focuses the infrared radiations onto the crystalline element. Whenever motion is detected in the detection field of the sensor, the sensor gives a high signal on its output pin. Further, this signal can be forwarded to the microcontroller to perform advanced functions on it. Detection of motion is done by checking any sudden changes in the ambient IR patterns.

In the main system, RFID module and Sensor module are working side by side. RFID is used for the employees and sensor module is used to sense any outsiders. When the RFID tag is detected by the RFID Reader, the tag number is checked in the maintained database of RFID module. If the entry is present, the message of "AUTHORIZED" is send to smart phone via GSM modem. Same process repeats with sensor module. When any intruder is detected, a message of "INTRUSION DETECTION" is send to smart phone via GSM modem.

The system is developed in two modules. First one uses the PIR Sensors and the second module uses the RFID module. When an employee is about to ent5er the building, he will have to swipe his tag against the reader. Upon detecting the tag, reader sends its data to the computer server. The server checks this received data in the database and decides whether the tag is valid or not and then notifies the operator.

In the second scenario, whenever a person enters or tries to enter the premises, the sensor detects the presence and sends an interrupt to the microcontroller. Microcontroller, in turn, sends a pre-programmed message to the user through GSM modem. In the main System, RFID module and Sensor module are working side by side. RFID is used for the employees and sensor module is used to sense any outsiders. When the RFID tag is detected by the RFID Reader, the tag number is checked in the maintained database of RFID module. The database checks if the person that is entering the building is authorized or not. After deciding upon the authorization of the personnel, further subsequent checks can be performed such as checking the number of entries for any particular person.

The sensor module, upon detecting the presence of a person in its coverage area, sends an interrupt to the microcontroller. Upon receiving this interrupt, the microcontroller sends a message of detection to the user's mobile phone.

## VII. CONCLUSION

Security is of great concern to many in business world today no matter which industry or which nationality they belong to. In support of the business surveys various specialized personnel may have access to an office environment outside of normal working hours so that their work is not observed. For example, a survey involving data stored on the PC may require imaging secret contents of the hard drive or an investigation on financial matters may require discreetly copy paper files. In both scenarios, it is important that work be done underground without the knowledge of other employees, either not to alert others under investigation or to prevent damage to the reputation of those whose equipment or records are examined.

Since these missions are usually ad-hoc and often carried out on short notice, it is generally impossible to access the building security systems to confirm when a particular field is empty or when other employees enter the area. therefore, it can be difficult to avoid detection and following the time available is often limited based on a worst-case scenario, i.e., a time window between the time when latest employees of the normal is expected to leave and the very first employees can come to work.

Our project was initially designed to achieve security and to assist the covert operation in the office environment. Our system has achieved its aim in the way that we can check the no. of entry and exit of personnel and also through sensors system can detect any personnel in a particular area.

Goal of our system was to provide a security solution by integrating the RFID and Sensors to support covert work in an office. This personnel detection system could provide information of when the building was empty. And also indication of entering and re-entering of personnel.

## VIII. FUTURE WORK

This work lays the basis for many areas of future development. In the following paragraph further recommendations will be laid out in relation to our system

1. A module can be developed to allow the use of profiling building, which once in the sensors in a system should be able to show patterns of occupancy of the building or area.
2. Secondly, another module can be developed to allow user to disable sectors in a building. This can be used if it believes that the sensor is faulty or prevent some of the sensors, which selectively allows the user to work on or access to the area covered by one or more of the sensors.
3. RFID can be allowed to send SMS to system administrator whenever a valid/invalid tag is read by RFID reader. This would provide a better solution of security in terms of mobility.

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