DESIGN OF A COST EFFECTIVE REAL TIME INTRUSION DETECTION SYSTEM USING PIC MICROCONTROLLER

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Abstract-Prevailing security systems poses restrictions to the prevention of various catastrophic activities. Previously, people used personal guards to secure a given area. Further, with advancement in technology, it wasn't efficient just to use humans for the security. Hence various electronic equipment was deployed in order to help security guards. Security alarms were used to notify in case of security threat. But, using alarms had two limitations associated with it: first, many false alarms used to distract guards and secondly time factor as sometimes guards may reach the scene after the crime. These problems may be solved by installing security cameras to monitor the area. Nevertheless, this is not the most efficient solution as it causes waste of resources and increases cost. The development of robotic security and monitoring systems for indoor environments, such as factories, offices, or home settings, has gained increasing attention in recent years. With the emerging technologies, we are moving live in a world which is equipped with Smart objects. The demand of today's scenario is that we move on to smart intrusion detection system from what was existed a year ago or two. Also, we need to consider the cost term for making the project suitable for market and affordable to everyone from an industrialist to a worker in industry. This paper proposes the design of an advanced intrusion detection system. The pre-existing location aware system has been integrated with a multitasking autonomous mobile robot to demonstrate the proposed smart robotic intruder detection system. Two more sensors, fire sensor, and metal detector are deployed to sense fire and metal respectively.

I. INTRODUCTION

This paper presents a new design approach for robotic intrusion detection system with added functionality. Security has been a consistent issue of concern from ancient times until present time. Security as a whole is a very broad term. This article focuses on the security of a specific region that may be home, industry or some high alert regions like government offices. Various methodologies have been employed in order to prevent security threat. During an era of kingdoms, emperors used to employ armed forces to keep an eye on enemies. The Same system continued till present, now government or industrialist or high profile people hire guards for protection. However, the weaponry has advanced and various technical tools are installed to help humans for better

protection against people trespassing security. Security alarms were introduced to alert people in case of criminal activities, but there have been the cases of false alarm. Also, there must be sufficient time for a security person to reach the crime site which may not be the case for every catastrophic activity. Then the era came from CCTV cameras that were used for video surveillance and sends the signal to a particular set of monitors. Hence, by using CCTV cameras we can monitor a region remotely through a PC and act accordingly. Nonetheless, this solution augments the installation cost. Robotic intrusion detection system is an effective and affordable technology for security purpose.

In this paper, a new approach for detecting intruders in a specific area using an autonomous robot is proposed. Intrusion detection in an unmanned area can be effectively done by an automated system. Previous robotic intrusion detection system proposed a monitoring system using motion sensors and camera to capture images, analyze the same using pre-stored data and transmit the result to monitor.

This article intends to explore the functionality of existing intrusion detection system and provide an enhanced autonomous design. This work presents the design of a multi-tasking robot for intrusion detection as well as fire detection. The proposed system uses a PIR sensor in order to sense the presence of an intruder and a low-cost camera in order to acquire a picture of the individual needed for image processing. Additional, other sensors include temperature sensor works as fire sensor to detect the presence of fire in the area and metal detector to detect weapons in case armed intruder. Having detected a sign of an intruder, the robot immediately moves to the location and check whether the visitor is armed, in a case of armed visitor it has a facility to shoot at site. If a guest is unarmed it checks for the authorization with help of image processing technique. It sends the detail of authorized person with one-word message conveyed by him/her. In the case of unauthorized person, it asks for the ID if the guest has the requisite information robot will text the details to an owner if not it'll send a warning message. GSM module is used to transfer the information and

ZigBee is used for the controlling the robot through PC. The action of a robot can also be controlled while working on a computer in control room. PIC microcontroller is programmed using MPLAB to achieve the design of intended real-time intrusion detection system.

II. SENSING

Three sensors are used in this design:
•   PIR sensor to detect humans.
•   Temperature sensor to sense fire.
•   Metal Detector

PIR SENSOR:

   The passive infra-red sensor is used to sense motion of any arriving person.
Reasons, why PIR sensor is used, are following:
• Precise response to human motion helps to detect an intruder.
• Range can be adjusted to body temperature.
• Range can be varied according to the change in
• Low power consumption as every electronics design needs to consider the power factor.
• Work based on IR radiation makes PIR sensor proficient for intrusion detection compared to other motion sensors.
• External power source is not needed as IR radiation itself produces power requisite to activate the sensor.

   Due to above specifications, PIR sensor finds good application in security systems. The range of the PIR sensor is up to 3-7 meters at a detection angle of 110 degrees which is perfect for the application explained in the paper.

TEMPERATURE SENSOR:

   IC LM35 is used as a temperature sensor in this paper.
Purposes of using this device are following:
• It does not require any external calibration or trimming.
• Provides accuracy of ±¼°C at room temperature.
• Accuracy over temperature range −55°C to 150°C is ±¾°C.
• Output of LM35 is voltage, scaled linearly with the measured temperature, which is 10 millivolts per 1 degree Celsius. This can be directly fed to the microcontroller input. Considering above mentioned specifications and its lower cost this component is suitable for the application. It is deployed in this design to sense abnormalities in surrounding temperature to accomplish the fire sensing facility.

METAL DETECTOR:
   The metal detector is used in this design to detect weapons in case of some armed person tries to enter the secured region. The range of metal detector is 0-4mm. High sensitivity, anti-shock and water resistant and fast frequency response, high repeatability accuracy, high anti-interference performance, big

output power, working stability, reliable, and short change process make it suitable to use in this application

III. CONTROL SECTION

   The heart of this design is PIC16f877a microcontroller. PIC microcontroller is programmed using MPLAB to achieve the design of intended real-time intrusion detection system. Inputs of the microcontroller are the outputs of PIR sensor, Temperature sensor, and Metal detector. Also, a keyboard is connected to the controller for password verification in case of an unauthorized person. The output of the controller is connected to Motor driver to drive the robot, LCD to display output of temperature sensor and PIR sensor. Also, GSM and ZigBee modules are deployed in collaboration with PIC controller to achieve efficient communication and on-site control of a robot.

IV. MATLAB SECTION

   MATLAB refers to Matrix laboratory. This software is used to provide a platform for image processing. VIALS JONES framework detects the variety of object classes but initially, it was motivated by the problem of face detection and this problem is solved by the face detection in the form of an image. Recognition of face can be easily done by a human but computers work under strict constraints and instruction. for face detection face should look straight to the camera without tilting it either side N no. of people in digital videos or images can be identified by the analysis and comparison pattern termed as face recognition. In this fast moving world, face recognition has become a very important part of many surveillance systems, image, and video indexing systems, biometric and security. Face recognition algorithms extract facial features and compare the result with the database for the best match.

   The technique requires the combined function of computer vision to extract discriminative information from facial images, or techniques for model learning and pattern recognition to model the face appearance and to classify them.
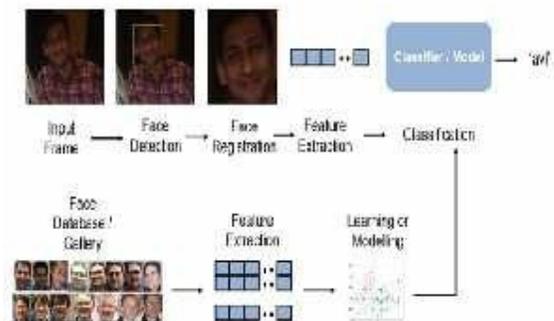

Figure 4.1 Face Recognition Workflow

Steps in the face recognition workflow:

- Lower half
    1. Face database/gallery- it is used to store the different classes of an image of a person to be recognized.
    2. Feature extraction- processing step to store the discriminative information about each face in a compact feature.
    3. Learning or modeling- a machine learning algorithm is used to fit a model of the appearance of the faces in the gallery so that discrimination between faces of different people in the database can be achieved. The output of the image is stored in the next stage called classifier, a model that is used to recognize input images.

- Upper half
    1. Input query image- The input image that is to be recognized.
    2. Face detection algorithm- It is used to find where the faces are located in the input image.
    3. Crop and resize and normalize the face to match the size and pose of the image used in the face gallery.
    4. Feature extraction - processing step to store the discriminative information about each face in a compact feature.

- On combining the learning or modeling of lower half and feature extraction of the upper half, the output is obtained which is a label or indicator to signify which person from the database, the gallery, the query image belongs to.

    If the correlation is more than 0.5 then the cross correlation is 1 which means the query image is authorized otherwise the query image is unauthorized.
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V. COMMUNICATION SECTION

For establishing real-time communication among robot and the owner two communication modules has been employed: GSM and ZigBee.

GSM:

GSM (Global System for Mobile Communications) comes under the second generation of a digital cellular communication network. It is basically a standard set by ETSI (Europian Telecommunications Standard Institute) for the use of 2G communication networks. GSM offers services like data transport via GPRS (General Packet Radio Service) along with full duplex voice telephony. The key feature of GSM why it is used in this design is SMS i.e. Short Message Service. GSM has been used to send text messages from Robot to the owner.

ZIGBEE:

IEEE standard of Zigbee is 802.15.4. Its specifications for a high-level communication protocol is used to create personal area networks with small, low-bandwidth needs, low-power designed for small scale projects which need the wireless connection. ZigBee module is installed to establish communication between PIC microcontroller and face recognition system.

VI. RESULT

1.When any person comes in the range of PIR sensor, the value of PIR will pop up to 1 and hence, proceed to the next stage of security check.

Fig. 6.1 Object Within The Range Of Pir Sensor

2. In the next stage of security check the system check for the metal. If and metal is detected it creates the threat alarm.

Fig. 6.2 Object Detection

3. Simultaneously and another sensor continuously monitors the temperature of the area. If it anywhere finds the rise in temperature then water pumping gets started to extinguish the fire.

Fig.6.3Temperature Detection

4.   After all the security check it comes to face recognition part where it recognizes the authorized person. If the face matches with the database image, the system lets the person access the area.
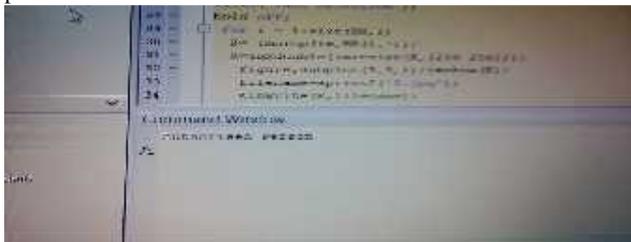

Fig. 6.4 Face Recognition

And if not then ask for the ID/password
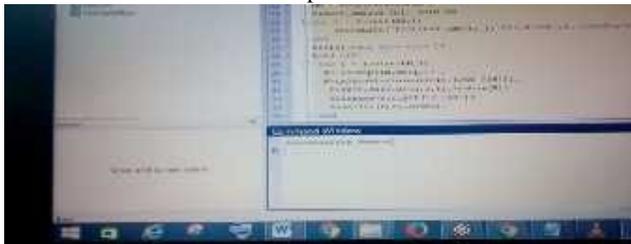
Fig. 6.5 Verification

5.   Since the robot is automatic it do everything without any external control but it send the SMS to the control room or owner of the area about the visitor

Fig.6.6 Acknowledgement

VII. CONCLUSION

In this paper, the robotic system is designed to detect the intruder and simultaneously monitor the temperature to avoid and extinguish the fire.

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