

Smart Rescue and Surveillance Robot

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Abstract— National security becomes more and more important with the growth of population. A surveillance robot is a potential solution for this issue. In this paper, we present a surveillance robot with human recognition. Robots are very essential in rescue operations like detecting bombs, recognizing suspected terrorists, fire accidents. We built a robot with all these facilities to reduce the human/soldiers life risk. It consists of a robotic vehicle for monitoring the surrounding area continuously. The movement of robot is controlled using an application with Bluetooth connectivity. This system is integrated with IR sensor for obstacle detection, metal sensor for bomb detection, fire sensor for fire detection. As soon as fire is detected, a buzzer is activated and water is sprinkled. We can also capture image using Pi camera, and, compare and analyse the captured image uploaded on AWS server with help of artificial intelligence and machine learning algorithms. Whenever a face is detected, surveillance system runs a face recognition algorithm. If the facial data of the person detected does not match with the pre-stored personal data of soldiers/humans, the system recognizes him as some intruder/unauthorized personnel sends an alert mail to the operator and activates the buzzer.

Keywords: Smart Rescue and Surveillance Robot

I. INTRODUCTION

Security is the degree of protection, which separates the assets and potential threats. Security can be classified into different types; they are information technology security, physical security, monitory security etc.

Robots are used for rescue security and surveillance. Video surveillance systems are widely adopted in the public area, such as airport lounges, book stores, parking lots, etc. In the household, the surveillance robot can be used to help the elderly and children live more safely.

Current robots achieve such goal in the following ways: Firstly, the manufactures offer several sets of software, so that users can change different software for different needs. Secondly, the control arithmetic uses a dominant function, such as video surveillance or abnormal sound alarming, and other integrated function are just an attachment. Thirdly, all the functions run at the same time, but have a low speed for response or a weaker performance. The features of our robot are as follows: sensors have been integrated in the robot and some convenient interfaces for sensors are used such as infrared sensors, fire sensors, metal sensors. In addition, Pi camera is used for image capturing and image is processed in AWS server using AI and ML. On the other hand, the design of both hardware and software has a powerful mechanism, so that the robot itself is able to effectively use all of its sensors and other components at the same time.

II. RELATED WORK

This paper intends to develop a doorbell with security, flexibility and connectivity. With the help of sensor and camera, the system detects motion in front of the door and capture picture which is sent to the user's cell phone along with the picture in the email inbox and a detection message. In addition, a push button for the guest interaction is also considered. The user is able to see what is happening in front of the door in real time sitting on the Internet. A camera module is deployed to capture the picture of the visitor and stream a video on the basis of passive infrared (PIR) sensor and the button. [1]

The paper describes a system for smart surveillance of homes using a PC with on-board camera. The image processing algorithm uses background subtraction to detect motion by fixing certain threshold above which it decides that intrusion is detected. It also uses Gaussian blur to smoothen the high frequency noise which may occur while capturing the images using different conditions. Once motion is detected, the Arduino which has a buzzer connected to it. As soon as motion is detected, the buzzer goes on. Simultaneously, the camera clicks pictures and uploads it to the Dropbox. [2]

The objective of this model is to design an IOT based Fire Fighting Robot which can replace the traditional Fire Protection Robot. This robot will send a fire alert to the cloud which can be easily viewed through an android application. Once the alert is sent the user can call the automatic receiver attached to the robot which will provide live streaming video of the fire location, this is possible by installation of an android application at user's end as well as for the robot. In addition to the alert, the values of carbon dioxide sensor can be used to get an idea of the fire type and then the viewer can manually signal the water pump or CO2 pump to extinguish fire accordingly. [3]

Proposed system uses thermal imaging camera (FLIR) for detection of various objects and infiltrators. FLIR is assigned an IP address and connected through local network to the control centre. Software code captures video and subsequently the intrusion detection. A motor-controlled spotlight with infrared and laser gun is used to illuminate under various conditions at the site. System also integrates sound sensor to detect specific sounds and motion sensors to sense suspicious movements. Based on the decision, a buzzer and electric current through fence for further protection can be initiated. Sensors can be integrated through IoT for an efficient control of large border area and connectivity between sites. [4]

Intelligent Robot for Border Security, identifies trespassers using PIR motion sensor, alerts security personnel by SMS using GSM and captures image of trespassers using camera in android device and mail this image to corresponding email ID using android based

application. It enables security personnel to detect effectively and at low cost to identify an intruder. [5] This paper presents a smart surveillance robot for military application by using Raspberry Pi for security purpose. On field Raspberry pi sends a wireless command which is received by Authorized person on web page and accordingly robot moves. The Video Streaming is done using Raspberry pi camera. The Raspberry pi programming is done in python language. [6]

III. EXISTING SYSTEM

The ordinary border patrol system suffers from intensive human involvement. Recently unmanned border patrol systems consist of high-tech devices, like unmanned aerial vehicles, unattended ground sensors, and surveillance towers equipped with wireless camera. This surveillance system requires security personnel for monitoring designated areas using surveillance cameras, which makes it hard for human to monitor continuously. They require a coherent system that co-ordinates various technologies to improve the system accuracy.

IV. PROPOSED SYSTEM

This paper is designed to develop an approach to rescue and surveillance operations in a system like a Warfield or can be deployed at the national border for safety against intruders, a part of which can be incorporated in a household security system.

This system could be remotely controlled from an android application via Bluetooth. It is implemented to have a live video surveillance. The robot has a Pi Camera to capture the image of a person. The captured image will be uploaded to the AWS server.

In the AWS server, image processing algorithms (with the aid of AI and ML) are used to derive the facial features. If the person is unauthorized, then the system will generate a mail and send to the concerned person and a buzzer is activated.

DC motors are used for robotic movements. We are interfacing a metal sensor to use it as an automated bomb squad. If any suspected material is detected, then it will send mail to concerned team along with an alarm. We have embedded a Fire sensor and automated water sprinkler to our robot to make it a fire fighter robot. We have an obstacle sensor to detect and stop the robot and make movements in a controlled and orderly fashion.

The impact and advantages of military robot are often "lifesaving." The first major advantage and most important feature of robots is that they are capable of performing duties similar to human duties without the actual danger to human lives.

These robots are easily replaceable at a cost, unlike human life. Robots can also endure damage done by bombs or other types of weaponry that would otherwise destroy the human body.

V. SYSTEM MODEL

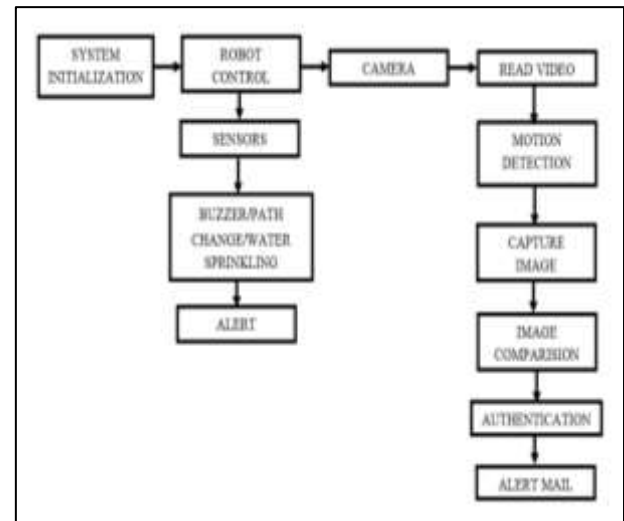


Fig. 1: System Architecture

Our paper consists of three main modules which co-ordinates the entire process.

- Robot module
- Camera module

Above Fig. 1 will give the detailed description of the model.

A. ROBOT MODULE

This unit initiates the entire process of our paper. This unit is designed in a way such that its movements are entirely controlled by Bluetooth. All the sensors namely fire sensor, metal sensor, and IR sensor are attached to this unit. This unit is just made to give the outward appearance of the robot in our demo.

B. CAMERA MODULE

This unit play a vital role in live streaming and image processing. A Pi-camera is fitted on robot module which will monitor the surrounding area continuously. If a face is detected, image is captured and processed using Amazon Recognition. In the next step a mail is sent to alert the concerned person using Amazon Simple E-mail Service.

VI. WORKING PRINCIPLE

The main component in the system are:

- Arduino
- IR Sensor
- Metal Sensor
- Fire Sensor
- Bluetooth
- L293D
- ULN2003
- Water Pump
- Buzzer
- DC Motors

The system's plot begins by switching on the main switch which gives power supply from 12V lead acid battery to the entire system. We have implemented the sensor processing on Arduino and image processing on Raspberry Pi separately so that both processes can be handled

simultaneously. The power supply activates all the sensors and camera. The movement of the robot will be remotely controlled with the help of android application via Bluetooth. DC motors are used for the robot movement. We are interfacing metal sensor which helps to detect suspected materials, if any such materials are detected then buzzer gets activated and an alert message is sent to the concerned person. We have IR sensor to detect any obstacles in the path of robot, if the robot encounters any such obstacle then the robot changes its path and buzzer also gets activated simultaneously. Also, an alert message is sent to the concerned person. We have embedded fire sensor which detects fire, if detected then water sprinkler gets activated along with the alert of the buzzer, and an alert message is sent to the concerned person. Robot has a Camera to capture the image for face detection. Camera is also used for live streaming which can be remotely viewed. The captured image will be uploaded to the AWS server. In AWS server image processing algorithms (AI and ML) are used to derive the facial features. If the person is unauthorized then the system will send an alert mail to the concerned person.

The block diagram of Arduino UNO and its connections is shown Fig. 2. Microcontroller Arduino UNO is the main component to which power supply, Bluetooth, and input/output components are connected. Lead acid battery of 12V is connected which supplies power to the system. Bluetooth is connected to control the movement of robot. IR sensor, metal sensor, fire sensor provides the input. Buzzer, water sprinkler and DC motor acts as output devices.

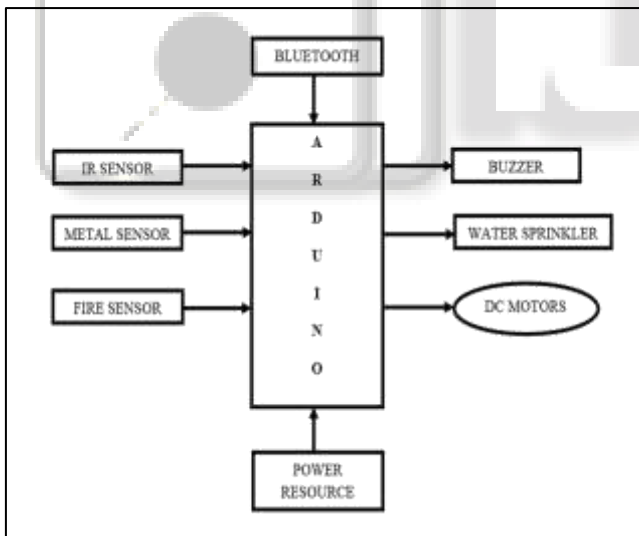


Fig. 2: Block Diagram of Arduino Board

The block diagram of Raspberry Pi and its connections is shown in Fig. 3. Microprocessor Raspberry Pi 3 is the main component used for image processing. Power bank is used to supply power to the Raspberry Pi which activates all the components. Camera is connected to Raspberry Pi which captures the image. Buzzer which gets activated on identifying an unauthorized person is also connected to Raspberry Pi.

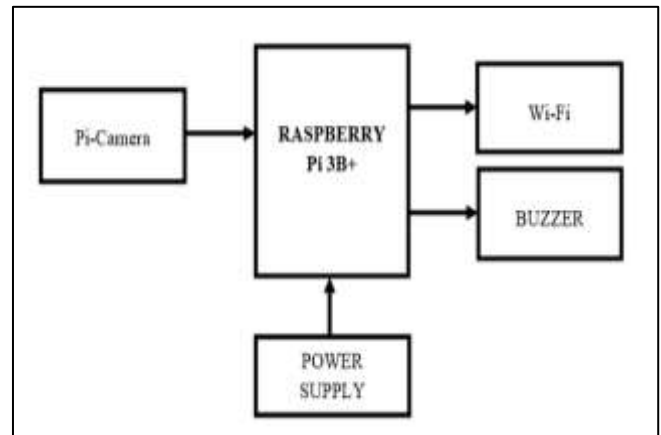


Fig. 3: Block Diagram of Raspberry Pi

The working of the system is represented in the

Fig. 4

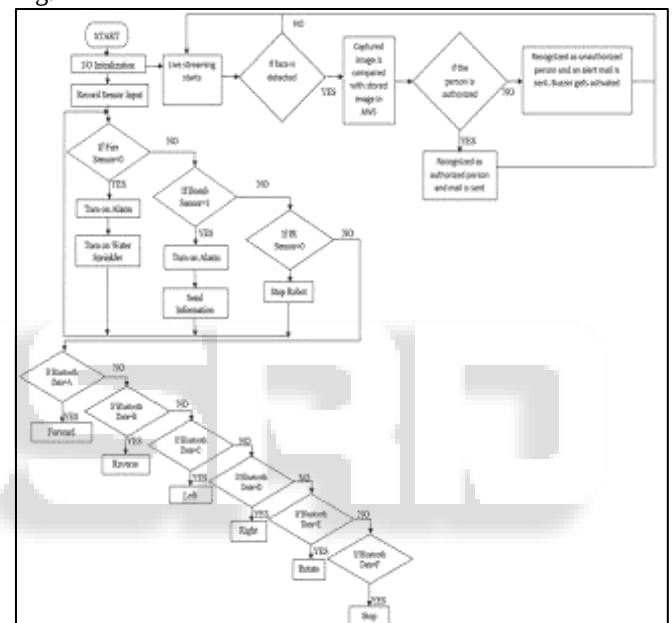


Fig. 4: Workflow

VII. RESULTS

The system effectively detects the presence of any obstacle, fire or metal on its path. Also, with the help of Pi camera and AWS services it can capture image and recognise whether it is authorized or unauthorized person and sends a mail to concerned person.

Fig. 5 below shows an email received by the user for unauthorized person detected. Fig. 6 shows an email received by the user for authorized person detected.

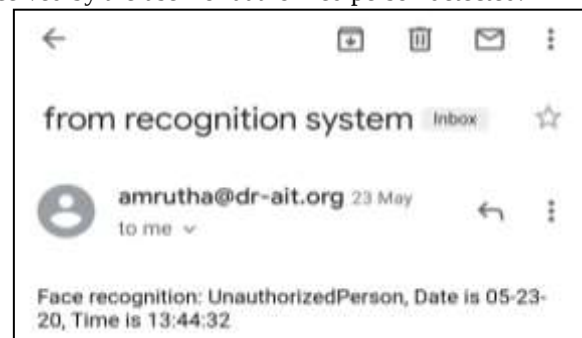


Fig. 5: Email notification for unauthorized face recognition.

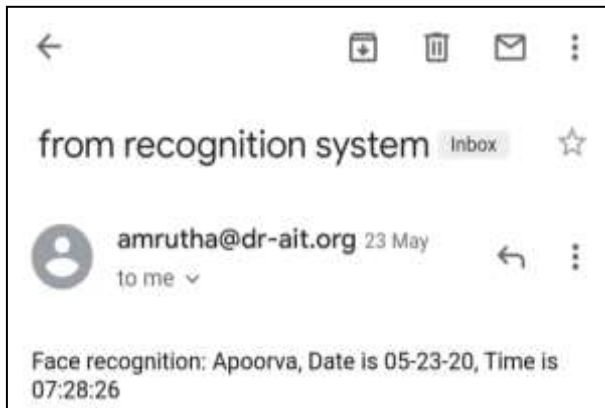


Fig. 6: Email notification for authorized face recognition.

Fig. 7 shows the implementation of metal sensor. It activates the buzzer when a metal is detected.

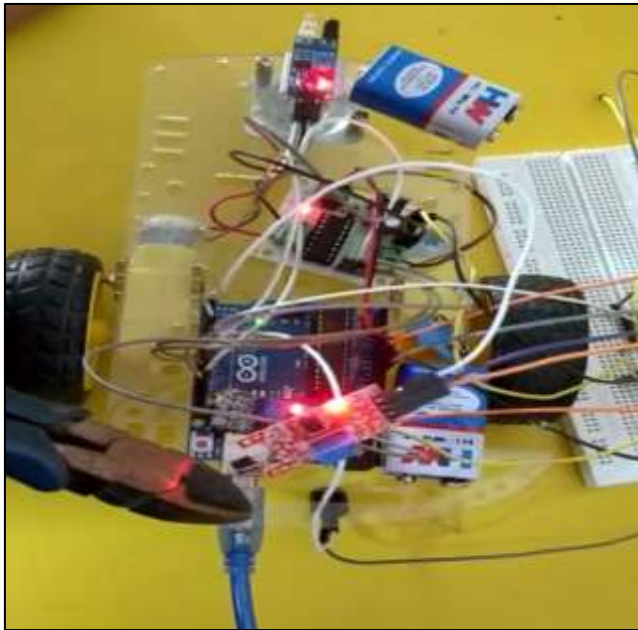


Fig. 7: Metal sensor.

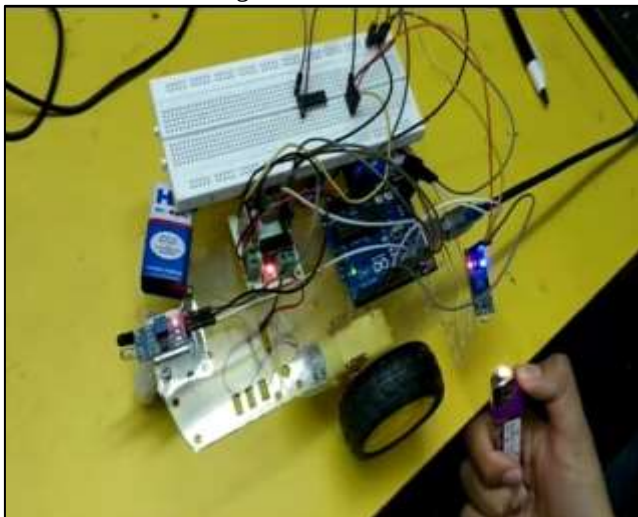


Fig. 8: Fire sensor.

Fig. 8 above shows the implementation of fire sensor. It activates the buzzer when fire is detected.

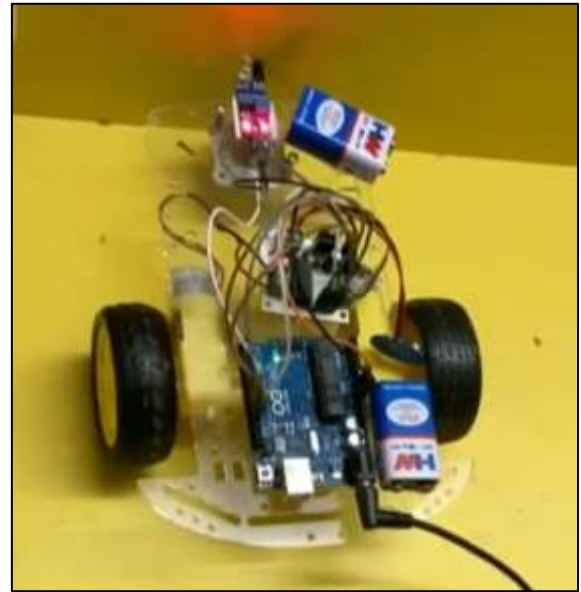


Fig. 9: Obstacle sensor.

Fig. 9 above shows the implementation of obstacle sensor. It activates the buzzer when obstacle is detected and also changes its path.

VIII. CONCLUSION

In this paper, an intelligent surveillance and security solution incorporated into a robot is presented. The robot can be deployed at the national border for safety against intruders, a part of which can also be incorporated in a household security system. With the help of this robot, we know the real time condition of border area without any human resource as such. The surveillance robot gives us live streaming video according and commands can be given accordingly. In a household application, the users will be able to keep an eye on their loved ones at home, if they are busy working in any other place. The surveillance system used for this purpose operates effectively in order to collect various types of information that is required by users. Successful operation by the robot ensures the validity and effectiveness of the system.

This paper offers a lot of scope for adding newer features. Since all image processing is done remotely, there are no resource constraints apart from the bandwidth of the network. We can program the robot such that it can detect objects and reach them on its own. Thus, we can make it completely autonomous. Also, with the presence of GPS navigation and mapping software, the robot has the capability of finding the best route possible to reach a certain location. There is also the option of adding many more sensors like CO detection sensors, LPG detection sensors making is usable multiple purposes like mining, household etc. The possibilities are endless. This robot in its current state provides a platform for further research into improving its capabilities.

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