Human Detection Robot

Sankar Reghunath[1*], Sreelekshmi S. Mony[1], Sreeyuktha M.[1], Saranya R.[2]

[1]Electronics and Communication, NSS College of Engineering, Palakkad, India

[2]Assistant Professor, Electronics and Communication, NSS College of Engineering, Palakkad, India

*Corresponding author's e-mail: sankarraghunath64@gmail.com

doi: https://doi.org/10.21467/proceedings.160.39

ABSTRACT

Natural calamities and disasters such as building collapse, earthquake etc. are some of the most disastrous situations mankind faces and, in such situations, rescuing survivors is the most critical job. From the early 70s, according to the UN, the number of catastrophic events worldwide has quadrupled. When considering disaster response, it goes to the reason that more the help, the better than none. Our proposed work, Human detection robot, can be used in disaster struck areas to detect the presence of humans who are trapped. The rescue team can save a lot of time and effort with the help of these robots. The robot moves in the area controlled by the rescue team. with the help of the live video streaming the rescue team can analyze the situation and plan the rescue operation accordingly. Whenever a person is spotted the robot alerts the rescue team with a message and the current location so that the rescue team can reach there and save the person as soon as possible. Being able to locate individuals quickly can have life-saving implications and result in better outcomes for severe injuries. In the case of a person with a significant leg injury, discovering their whereabouts a few hours earlier could mean the difference between saving their limb or undergoing an amputation that would have long-term consequences. Additionally, the advantages are not limited to humanitarian concerns. If rescue personnel can promptly verify that everyone in a collapsed building has been identified, it will hasten the clearing of roads, removal of the debris, and the community's ability to begin the rebuilding process.

Keywords---Robot, Rescue, Detection, Response

1 Introduction

Due to the unpredictability of natural disasters, we now require robots that can be employed for rescue operations when a disaster strikes. The annual death toll from natural disasters during the past ten years has varied, according to the International Federation of Red Cross and Red Crescent Societies, with a low of 14,389 in 2015 and a high of 314,503 in 2010. More than 100,000 people experience the effects of natural catastrophes annually. Efforts are being made by the government, businesses, and relief agencies to minimize the occurrence of these tragic fatalities. Recently, they have used search and rescue robots as a tool to aid them. Disaster response can benefit significantly from the utilization of drones and robots due to their ability to operate in conditions that are inaccessible to humans, operate continuously without requiring rest, outperform humans in certain tasks, and, most importantly, be replaced. Robots can be deployed to high-risk areas that are often encountered in disaster zones, thereby minimizing the need for human rescue personnel to be exposed to danger. In this paper, we present the design and implementation of a small, quick rescue robot that can work in conditions and places that are challenging for people to access. When fully equipped, the robot will be able to detect human existence among the wreckage of a disaster-stricken area and notify the authorities of the finding along with video footage and location tag of the same.

2 Literature Survey

Using specialized sensors to find people who may be hidden behind walls or beneath debris, the robot proposed in the paper on Innovations in Power and Advanced Computing Technologies is intended to assist rescue teams during natural disasters like earthquakes. The proposed robot model in paper [1] includes a radar sensor that generates radio

Proceedings DOI: 10.21467/proceedings.160; Series: AIJR Proceedings; ISSN: 2582-3922; ISBN: 978-81-965621-9-9

signals that, upon sensing human presence, are picked up by the receiver when they bounce back.
As of paper [2], in order to identify human presence in unattended regions, the system described in the paper "Live Human Detection and Streaming using IoT" uses sensor units. This system then transmits the detected human presence to a receiver via IoT. The system uses wireless technology to gather information about the victims and their surroundings, allowing the rescue crew to watch and assess the situation. The rescue team can then implement the required safety measures and deliver the required equipment to complete the rescue operation.
The research proposal for "Alive Human Body Detection Using an Autonomous PC-Controlled Rescue Robot" [3], calls for the use of a variety of sensors, including pulse, temperature, and PIR sensors, to find afflicted people. The robot also has an IR sensor to help it avoid obstructions in its route. The camera continuously transmits live images, and the suggested system makes use of GPS chips to pinpoint the position of the impacted area where the person is.
The paper [4], "An IoT Concept for Region Based Human Detection Using PIR Sensors and FRED Cloud" describes a technique for identifying and alerting control rooms or administrations about object/human presence in particular areas. This is accomplished by placing PIR sensors in various locations, which are used to identify and notify users when things enter their field of view (FoV). The information is sent to the FRED cloud service, where it can be kept in a local database and accessed as necessary.
The paper [5], "Method for Distinguishing Humans and Animals in Vital Signs Monitoring Using IR-UWB Radar" investigated the use of radar technology to distinguish between humans and animals based on their vital signs. Using an impulse radio ultra-wide band (IR-UWB) radar, the researchers examined the vital signs of dogs, felines, rabbits, and people and presented a system for recognizing the observed living form. After receiving the target echo signal, the suggested system involved eliminating background noise and suppressing direct-current components using an FFT-based FIR filter.

3 Methodology

3.1 Project Components

RASPBERRY PI 3B: The Raspberry Pi Foundation and Broadcom worked together to create a line of compact single- board computers that are popular in the UK under the name Raspberry Pi. These credit card-sized, open source Linux- based computer boards can be utilised in a number of different applications. These robust single-board computers have three generations, and the Raspberry Pi 3 Model B is capable of replacing the Raspberry Pi Model B+ and Raspberry Pi 2 Model.
Additionally, it has Bluetooth wireless LAN connectivity, which makes it a great choice for reliable networking designs.

HC-SR501 PIR SENSOR: It is a three-pin module that passively monitors infrared radiation from nearby objects within a radius of 10 meters. PIR devices are considered passive because they are not emit energy to detect things. All of these technologies use infrared light to detect objects by detecting their emission or reflection. The temperature at that location noticeably changes when an item, such as a human, passes within the sensor's field of vision. It goes from normal to body temperature and back to normal. The sensor transforms the variations in the incoming infrared radiation into equivalent changes in the output voltage to identify this change.

DOPPLER RADAR SENSOR: The Doppler radar works by sending a specific frequency electromagnetic radiation wave from a transmitter antenna in the direction of an object in motion. The radiation wave travels to the receiving antenna after coming into contact with the item. The frequency of the wave shifts from the initial frequency as it bounces off a moving object, though. The" Doppler shift," a frequency change, can be used to calculate the speed of a moving object. MOTOR DRIVER (L293D): A device that can move a DC motor in both directions is referred to as a motor driver, also known as a motor driver IC. The L293D IC is a conventional 16-pin motor driver IC with the capacity to control two DC motors simultaneously utilising a dual H-bridge motor driver IC. A single L293D IC now control two DC motors. The motor driver functions as a low current amplifier, converting the low current drive signal into a high current signal that can operate the motor.

DC MOTOR: Motors operating at 4.5 to 9 volts is the recommended range for the working of robot . With the aid of a motor Driver IC and the H Bridge technology, a basic DC gear motor that rotates in both directions is used in this project. PWM is another method for controlling speed. With readily availability of a wide variety of voltage levels, they are very durable, simple to Use, and control.

GPS MODULE: In order to function, GPS receivers must determine their distance from a number of satellites. The location of the GPS satellites is pre-programmed into them at all times. Radio waves are used by satellites to convey location and time data to the Earth. A receiver can identify the satellites by analysing these signals and figuring out their distance from it using the time it takes for the signals to get to it. Trilateration is a technique that uses data from three or more satellites to establish the location of the receiver on Earth.

PI CAMERA: A direct connection to the Raspberry Pi's CSI port is possible for the Camera Board. A 1080p HD video can be recorded at 30 frames per second on this board, and it can capture photos at a resolution of 5 megapixels. Through the use of a specific 15-pin MIPI Camera Serial Interface (CSI), the camera module is connected to the Raspberry Pi by a ribbon connection with 15 pins. The BCM2835 CPU can only receive pixel data from this interface because it was created specifically for cameras and enables high data rates.

HC-31 BLUETOOTH MODULE: The HC-05 utilizes Bluetooth 2.0 technology to transmit data wirelessly between devices that are within a range of approximately 10 meters (or 10 yards). This module is utilized to link the control app with the robot.

PIEZO BUZZER: An electronic buzzer alarm that goes off when PIR sensor produces high output.

MIT APP INVENTOR: The Massachusetts Institute of Technology currently maintains MIT App Inventor, which was initially a web application integrated development environment created by Google. This tool enables the creation of apps that feature conditions and a button interface that can connect to your project device via Bluetooth. The website has been used to develop an app that controls robot movement.

VNC VIEWER: For controlling local computers and mobile devices, you utilise VNC Viewer. With VNC Viewer soft- ware installed, a device like a computer, tablet, or smart phone can connect to and operate a computer located somewhere else. The system employs this software to control the Raspberry Pi.

RASPBIAN OS: The operating system for controlling the actions and responses of Raspberry Pi module .The software is coded in Python3 language //

3.2 Navigation

Any frequency disturbances in the robot's path are detected by its Doppler radar sensor, which also warns the rescue team so that the robot's trajectory can be changed. The robot can be instructed to steer clear of obstacles in its path using the Doppler radar sensor, which will save time. The working of the sensor is depicted in Fig. 1. It continuously evaluates the possible distance between obstacles and the vehicle while detecting barriers. A camera module that feeds live video is additionally added to this robot. The rescue operator can access the data on a local computer by connecting to other server. Additionally, we can transmit vehicle commands using the website. The robot can be moved left, right, forward, and backward using a DC motor.

Proceedings DOI: 10.21467/proceedings.160
ISBN: 978-81-965621-9-9

Series: AIJR Proceedings
ISSN: 2582-3922

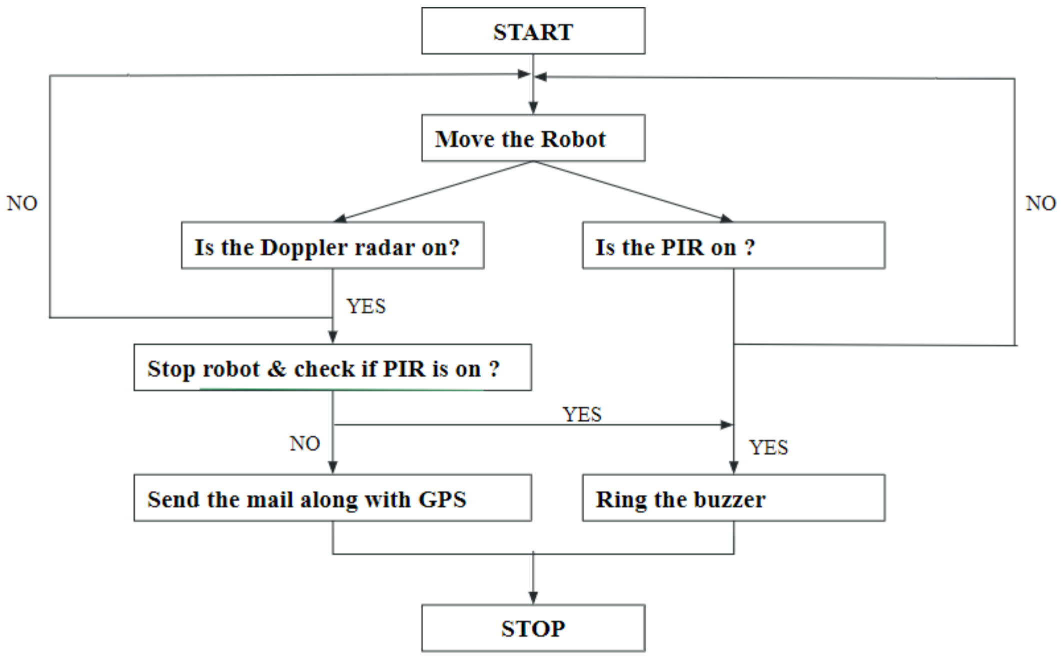

Figure 1: *Robot working algorithm*

3.3 Detection

The sensors are connected to the processor's GPIO pins (Fig. 2). The processor determines whether the PIR sensor has also generated an output before activating the Doppler radar sensor. If the readings on both sensors are high, human presence is definitely there. If there are too many obstructions, it is difficult for the PIR sensor to identify

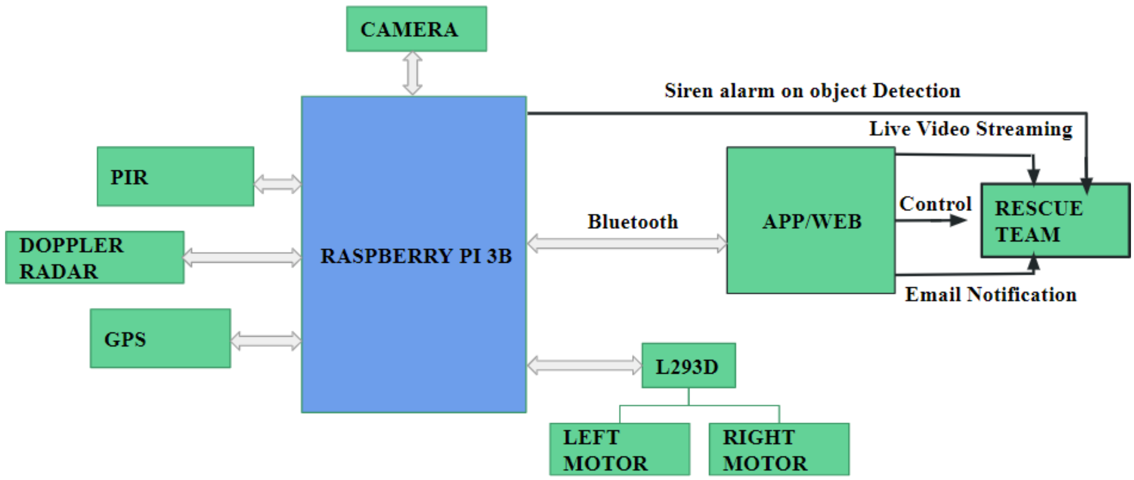

Figure 2: *Block Diagram*

human life from these too many obstructions. So, the rescue crew must be sent right away as soon as the Doppler radar sensor is activated.

3.4 Response

The processor quickly sends an email containing the position (in latitudes and longitudes), the camera footage of the identified spot and an alert message as soon as the human presence is detected. When the PIR is turned on, the buzzer alarm is likewise triggered.

3.5 User Interface

A simple software created with MIT app Inventor can control the manoeuvres of the robot. The system offers a user-friendly interface with all the information needed by the rescue team at the time of rescue operation. Using this app, the locomotion of the robot mainly in four directions can also be done.

4 Results

The proposed method allows us to control the robot vehicle's motions to take it wherever we want it to go. The robot vehicle will move in line with the rescue operator's instructions under this system. The search procedure is performed by the moving robot's sensors, which then send the results as a signal to the Pi module. It then generates preferred output on a monitor and communicates via email with another device via a Wi-Fi module. The video information will be presented simultaneously as the process continues (Fig. 3). The video will therefore provide an estimation of the person's condition as soon as the robot spots them and indicate whether or not they need to be treated immediately away.

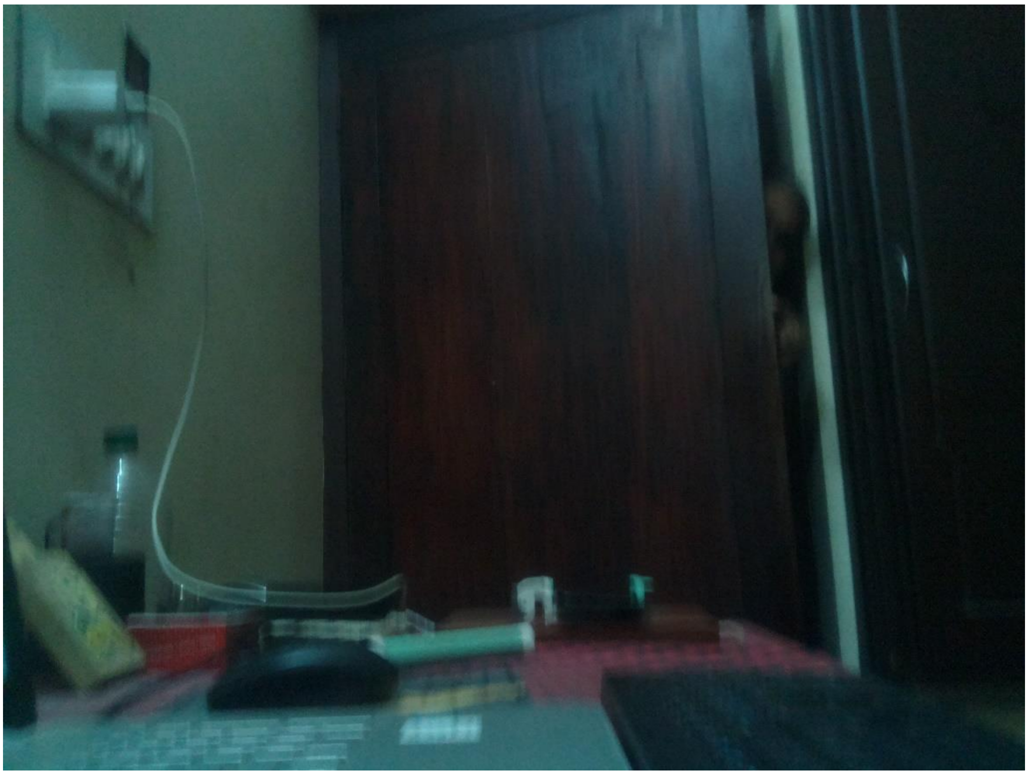

Figure 3: *Human presence detected from beyond a door*

All of this information, including the GPS location, is immediately available to the rescue operation team, allowing them to quickly locate the victims and save their lives. A message that says, "Human Movement Detected," together with a picture of the region and a GPS tag, are all included in the mail that the robot sends to the rescue team (Fig. 4). The robot's navigation is done via a Doppler radar sensor. Robot will halt as soon as Doppler radar finds a person. Doppler radar's high sensitivity will allow people to be recognized by the mere presence of any part of their bodies. It will also be able to locate people who may be hiding beneath debris and notify the authorities that they need to clear any obstacles that may be obscuring their view. An app inclusive of control buttons and live feed visibility is used to control the robot. The result of a demonstration setup of the robot detecting human presence beyond a door is depicted. The resultant output of the camera along with the corresponding GPS in latitudes and longitudes has been received via email.

Proceedings DOI: 10.21467/proceedings.160
ISBN: 978-81-965621-9-9

Series: AIJR Proceedings
ISSN: 2582-3922

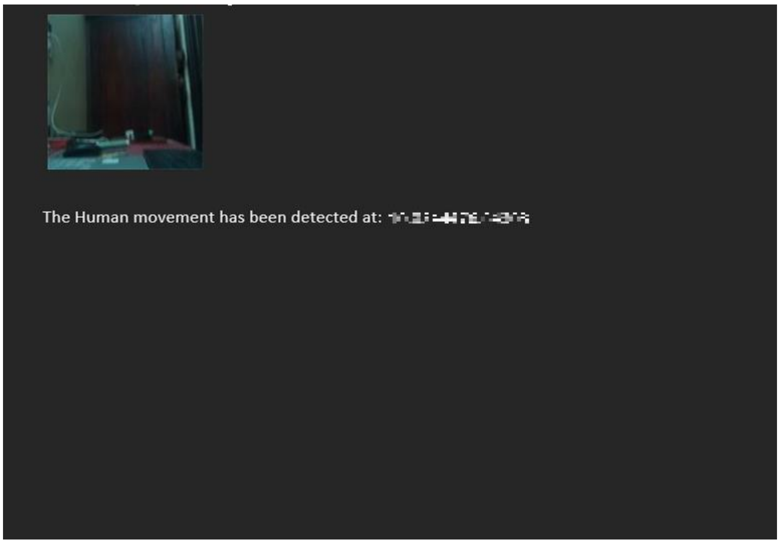

Figure 4: *Mail received on sensor activation*

Overall, the Human Detection Robot software deployment has produced encouraging results and has the potential to significantly help the rescue organization. To increase the system's accuracy and effectiveness, however, additional testing and optimization are required, particularly in real-world settings with variable environmental circumstances.

5 Discussions

This project is a resource of high level of future scope. This robot can be made much more water-resistant with more advanced hardware, better video recording, and stronger networking, enabling it to traverse tsunami or flood-affected areas. By adding new features to its current algorithm, the robot can be changed to carry out more tasks, including measurement calculations and assimilation of delicate qualities like soil alkalinity, etc. The robot can be entirely automated. The robot will therefore function independently, and the rescue crew simply needs to monitor its actions on the live video feed. It could be enhanced to produce more advanced locomotive equipment, including caterpillar tracks or robotic arms for extraterrestrial study. Swarm optimization is a technique that allows a group of these robots to work together and complete tasks as a single entity. The usage of similar robots is also possible in the event of nuclear or biological dangers. It is challenging to conduct rescue efforts due to the area's toxicity. where there is a risk of severe injury to a human rescue team. For broader and safer coverage and detection, the same technology can be used with drone systems and higher- performance cameras. By enabling more complex algorithms, identification of the living being using IR-UWB radar sensor can also be implemented in this system making the robot totally autonomous and upgraded.

6 Conclusion

The sensor system that is being demonstrated can be used to find people in various areas and under rubble left behind by earthquakes and other natural disasters. The members of the rescue squad cannot realistically cover the entire region in a short period of time. In this scenario, our suggested model is useful. Doppler radar's great sensitivity will make it possible to identify people simply by the presence of any portion of their bodies, and bodies beyond debris will be identified and alerted for prompt removal of obstructions covering the body. More information will be provided by the mail system, along with the location and photographs. Once supplied with the necessary modifications to its hardware, this working prototype is a technology with a broad range of applications.

7 Publisher's Note

AIJR remains neutral with regard to jurisdictional claims in institutional affiliations.

How to Cite

Reghunath *et al.* (2023). Human Detection Robot. *AIJR Proceedings*, 304-310. https://doi.org/10.21467/proceedings.160.39

References

[1] A. Joseph, V. Parmar and V. Bagyaveereswaran, "Design of Human Detection Robot for Natural calamity Rescue Operation," 2019 Innovations in Power and Advanced Computing Technologies (i-PACT), Vellore, India, 2019, pp. 1-5, doi: 10.1109/i-PACT44901.2019.8959959.

[2] Bendre, Varsha, Priyanka Ugale, Mayuri Maske, and Amruta Patil. "Live Human Detection and Streaming using IoT."

[3] Neha, Aiman, and Baswaraj Gadgay. "IoT Based Rescue Robot for Alive Human Detection and Health Monitoring System.

[4] Sabat, Naba Krushna, et al. "An IOT concept for region based human detection using PIR sensors and FRED cloud." 2019 IEEE 1st international conference on energy, systems and information processing (ICESIP). IEEE, 2019.

[5] Wang, Pengfei, et al. "Method for distinguishing humans and animals in vital signs monitoring using IR-UWB radar." *International Journal of Environmental Research and Public Health* 16.22 (2019): 4462.