

Alive Human Detection Robot for Rescue Operation

Rakesh Yadav¹, Prakash Gupta², Deepakkumar Gupta, Umesh Mohite⁴

Computer Engineering Department
VIVA Institute of Technology
Mumbai, India

¹rakeshyadavno1@gmail.com, ²prakashgupta2786@gmail.com, ³dipugupta0930@gmail.com, ⁴umeshmohite2311@gmail.com

Abstract—In the current technological world, the technologies are evolving day by day. In the modern world, there is continuous development of skyscraper buildings & dwellings, which increases the risk of losing life by natural calamities and man-made disasters. During earthquakes, landslides, and building collapse, a lot of times, humans are trapped under debris and it becomes impossible to detect their presence by the rescue team. There are some cases where it is impossible for rescue teams to reach certain locations in affected areas. The Proposed system is a raspberry pi based human detection robot, which is used to detect live human beings trapped under debris in a affected environment. The robot navigates through the zigzag path and it is controlled by an android application. The set of sensors assembled to the raspberry pi are Microwave radar sensor, Ultrasonic sensor, Temperature sensor and Gas sensor. The Microwave radar sensor is also used to detect the human being behind the obstacle. The Temperature sensor is used to detect the temperature and Gas sensor is used for gas leakage respectively. And the camera module is used to analyze the current scenario.

Keywords- Alive Human Detection, Microwave Radar Sensor, Natural Calamities, Ultrasonic sensor, Web Camera

I. INTRODUCTION

In the current era, natural calamities like Earthquakes, building collapse or manmade disasters often occur and they cannot be stopped. They cause a devastating change among humans and material. Hence, many times humans are buried under the detritus and it becomes impossible to detect their presence. Places where the disaster has occurred it's quite difficult for rescue teams to cover. Since the area is quite big for rescue workers to cover it. Almost all the proposed models were developed using a microcontroller and some set of sensors which commonly includes PIR sensor, Ultrasonic sensor and IR sensor. PIR senses the temperature of its environment and checks for any changes that are present. The Ultrasonic sensor and IR sensor are used for proper navigation of the robot in the affected zone.

II. RELATED WORK

To solve the problems faced by rescue teams many solutions have been proposed over the years by the researchers. Different systems have been developed using various techniques such as use of RF technology with PIR sensor[1], Pulse Rate[2], buzzer/alarm[4], live stream[6], ZigBee transceiver with PIR sensor[7], PLC systems[8], SMS through GSM technology[9], LCD display what GPS receiver[10]. Almost all the systems use PIR (Passive Infrared) sensor as common. But PIR sensors have limited detection range, hence a greater number of supporting sensors are required for the development. PIR sensors do not work properly without light or in dull light conditions. They are also affected by the climate change and high temperature.

Zia Uddin, et. al. [1] has developed a PIR sensor based semi-autonomous mobile rescues robot which is able to find live human beings from an unreachable disaster area. Joystick & RF technology is used to control the semi-autonomous robot and communicate with the control station Ultrasonic sensor

is used for obstacle detection and for navigating the robot. And it has a gas sensor used to detect gas leak inside the affected area. IP Camera is integrated to analyze the conditions which will assist human detection with the highest chance of success in such a situation. The first process is the use of a PIR sensor that detects humans & second is an IP camera which is to confirm the presence of humans in those areas. Because of the two levels human detection system the system is reliable for rescue missions. The microcontroller is programmed using C language and ARDUINO IDE. The system provides good results and it is cost effective. Since it has a joystick mechanism, hence it is handy to use.

Murulidhara T C, et. al. [2] proposed the design and implementation of the Unmanned Vehicle using ARM7 microcontroller along with web camera, pulse sensor and temperature sensor to detect the affected human beings in disaster environment. IR sensor is included in the model to avoid obstacles in its navigation path. The vehicle navigates through the debris automatically to check the presence of human life. As soon as it detects the presence of humans, it checks the accident person's pulse rate, body temperature and sends this data along with GPS location information to the base station through ZigBee Transceiver. ZigBee is used to send & receive data between robots and control units. The base station receives the longitudinal and latitudinal location of affected humans through ZigBee Transceiver and displays this information on monitor to speed-up the rescue operation. The hardware design consists of low cost, easily available & reliable components.

Rahu Krishna K, et. al. [3] proposed an autonomous robotic vehicle that is able to move in the affected area and identifies living people. It has sensors that detect the presence of the human being and indicates the presence to the user. As the

human body emits thermal radiation, which is received & manipulated with the aid of PIR sensor to detect human presence. Once the human is located, it immediately gives and audio & visual alerts to the authorities. The PIR sensor is assembled on a robot which can operate in the areas which are prone to earthquakes. The robot has a 3-wheel geared driver & DC motors attached for forward, reverse, left & right actions. The controlling device of the system is a Microcontroller to which RF receiver, PIR sensor & DC motors are connected. The remote control has control buttons interfaced to RF transmitter. Whenever a button pressed, the data related to that button transmitted through RF transmitter to microcontroller. The microcontroller processes this data and acts accordingly and sends required control signals to the robot's motor drivers. PIR sensor is constantly checked for human presence and if it gets any reading it sends to a controller. The controller alerts through buzzer if human presence is detected.

Sabyasachi Bhowmick, et. al. [4] designed a simple Robot that detects humans in a new way. System has inputs that are a PIR sensor, Ultrasonic Sensor, IR sensor. Ultrasonic sensors & IR sensor used for navigation of the Robot. PIR Sensor detects the heat of humans. RF transmitters are used to send the information of human presence & receive the information through the receiver circuit. Next receiver immediately generates output which turns the buzzer/ alarm and it displays ON. While testing the robot, many obstacles were placed in the path and the ROBOT detected those obstacles successfully and the Ultrasonic Sensor was able to detect its path every time. In the second part when a human was in the range of 4 ft. of the PIR Sensor, after getting the reading PIR sensor stops the robot and starts analyzing the output and turns RF transmitter ON. On the other hand, the RF receiver received the transmitted signal showing an output to the LCD as 'Human Detected'.

Saravana Kumar K, et. al. [5] proposed a robot which is used to detect humans to overcome robbery and to enhance security measures. The robot has a receiver side and the transmitter side. The transmitter is an ATMEGA328 microcontroller PIR sensor that takes the input of a microcontroller, and an Obstacle sensor. The outputs are displayed on RF transmitter & L293D motor drive module, that is connected to DC motor. The DC motor is used for moving the robot in all directions. PIR sensor detects the presence of humans. The PIR sensor has limited range up to 12ft and has an angle of rotation 180 degree. At the receiver end is an ATMEGA328 microcontroller. Its input & output are buzzer and a RF receiver. After receiving the signal by the RF receiver, it notifies the Arduino. Arduino sends a signal to the buzzer, which makes the buzzer to sound continuous beeps. This beeping shows that there is a human to the rescue team. This system is capable of detecting the presence of humans in the range of 10-12ft successfully.

III. PROPOSED SYSTEM

The system flow diagram of the proposed model is presented in Fig.1. It facilitates how the system will ideally work in actual.

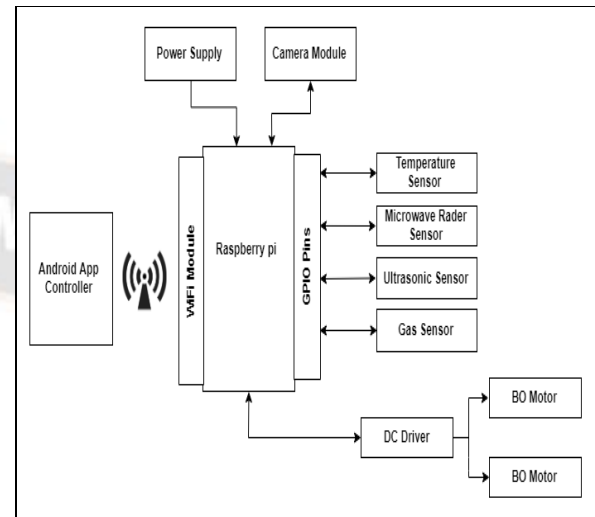


Fig.1 System Flow Diagram

The above fig 1 represent the System flow diagram of the proposed system. According to the diagram, the Raspberry Pi is assembled with set of sensors which include Temperature sensor, Microwave radar sensor, Gas sensor and Ultrasonic sensor. The raspberry pi is provided with a power supply and whole model is controlled using controller which is an android app. The app and robot are connected using Wi-Fi. To get the live streaming of the current scenario, a camera module is also connected to the robot.

1. Raspberry Pi

The raspberry pi is a single-board computer based on Broadcom BCM 2711 system on chip. It has a 1.5 GHz CPU on board. It uses a 64-bit quad-core cortex A72 ARMv8 architecture-based CPU. The raspberry pi version features 1GB of RAM. It uses an SD card to store the OS. It has a USB port through which a USB microphone is connected and speech input is given. It has a CSI port through which Pi camera is connected. The Raspberry PI features a 3.5 mm universal headphone jack for audio out.

2. Microwave-radar Sensor

Microwave Radar sensors have increased detection range and can work properly in dark environments also. A microwave radar sensor works by emitting microwave signals. These signals return to the sensor at constant intervals. If it detects motion, the readings of these signals change. As soon as the microwave radar sensor knows about the change in return time of the signal, it sends the message to the user that human is detected while considering other parameters.

3. Ultrasonic Sensor

ultrasonic sensor is an instrument that is used to measure the distance of objects that come in its part. It emits sound waves which are reflected back from the objects. It calculates its

distance by measuring the laps between sending and receiving signals.

4. MQ6 (Gas) Sensor

The MQ-6 detects concentrations of gas which can be from 200 to 10000ppm. It is an analog resistance sensor for output. This sensor has a high sensitivity and gives fast response. And has a very simple drive circuit.

5. DTH11(Temperature) Sensor

DTH11 is a humidity measuring sensor. It is a substrate that holds moisture with the help of electrodes on its surface. It converts the signals from electrodes and sends it directly to raspberry pi.

IV. IMPLEMENTATION AND ALGORITHM

The proposed system is a Microwave Radar sensor based human detection robot which can detect live human being from an unreachable point of the disaster area. The robot is assembled with some set of sensors which include Microwave radar sensor, Ultrasonic sensor, Temperature sensor, Gas sensor etc. Android technology is used to control the robot and communicate with control point. Ultrasonic sensor is used for obstacle detection and it decides the navigation path of robot & gas sensor is used to detect gas leak inside the building. Camera is also integrated in the model to observe and analyze current scenario through live streaming on mobile. It will facilitate human detection in reliable manner with highest probability of success rate in this kind of situation.

Microwave Radar sensor has increased detection range and can work properly in dark environment also. A microwave radar sensor works by continuously sending out microwave signals. These signals return to the sensor in consistent intervals. If motion occurs, the timing of these signal changes. As soon as the microwave radar sensor knows about the change in return time of the signal, it sends the message to the user that human is detected while considering other parameters also. The proposed system is also lashed with live streaming feature which will facilitate the operation to a greater extent of success. The proposed system will give better results as compared to all previous solutions. It will greater performance measures and high accuracy.

V. RESULT

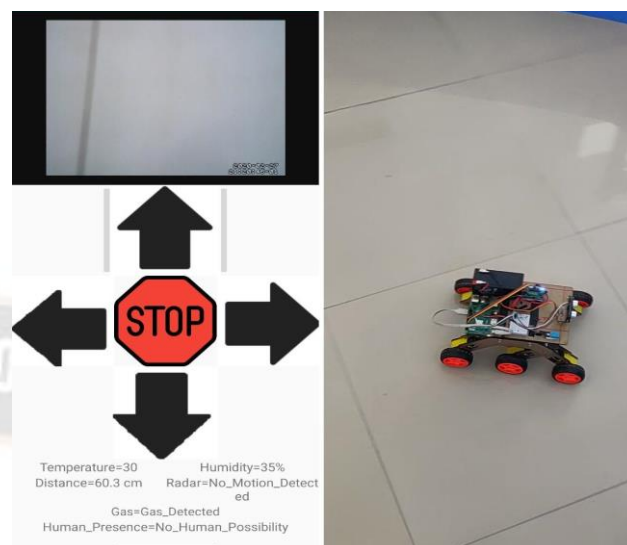


Fig.2. No human possibility

In the above fig. 2 the robot is functional and connected with the android app whose readings can be seen in the left part of the image. The control mechanism is there for the navigation of the robot. And below that the readings of the current scenario are displayed which includes current temperature, gas detection, distance etc. According to the image, since the current environment is steady and there is no human presence around the robot, hence we are getting the readings of microwave radar sensor as “No_Motion_Detected”. As a result, the output is “No_Human_Possibility”.



Fig 3. Human possibility

In the above Fig 3 the environment changes, and there is a human around the robot. The camera module streams the current scenario and shows its output in the upper half of the app interface. As soon as human performs some movement, the robot captures the motion and changes the reading of

microwave radar sensor to “Motion Detected”. As a result, we get output as “Possibility_of_Human”.

VI. ANALYSIS TABLE

Paper Name and comparison factors	Obstacle Detection	Live Streaming	Gas Detection	Find Alive Human Behind Walls
Search And Rescue System For Alive Human Detection By Semi-autonomous Mobile Rescue Robot[1]	YES	NO	NO	NO
Unmanned Vehicle To Detect Alive Human During Calamity[2]	YES	YES	NO	NO
Wireless Human Detecting Robot[3]	YES	NO	NO	NO
Alive Human Detection Robot For Rescue Operation	YES	YES	YES	YES

Fig 4. Analysis table

VII. RECENT RESEARCH

Sr. No	Papers	Objectives / Research Gap
1	Search and Rescue System for Alive Human Detection by Semi-autonomous Mobile Rescue Robot. [1]	They have developed a PIR sensor based semi-autonomous mobile rescue robot which is able to find live human beings from an unreachable disaster point. It is two level detection system & cost effective. It has a joystick mechanism, hence handy to use.
2	Unmanned Vehicle to Detect Alive Human During Calamity. [2]	They proposed the designed the robot using ARM7 microcontroller along with web camera, pulse sensor and temperature sensor to detect humans in disaster environment. They also used GPS module to get the location information through ZigBee Transceiver.
3	Wireless Human Detecting Robot. [3]	They proposed an autonomous robotic vehicle that moves in the earthquake prone area and helps in identifying alive people. The system is wireless robot which can be mobilized. The system can monitor the environment in real time. The controller alerts through buzzer if human presence is detected.

Fig 5. Table of Recent Research

VIII. CONCLUSION AND FUTURE SCOPE

The system is able to detect the human beings in calamity-affected zones effectively. The robot is able to navigate at all possible locations in the disaster-affected field. It detects living humans from the unreachable point. It also detects the

human behind the obstacle. With the help of ultrasonic sensor systems, it is able to avoid collisions which enhance the working capability of the robot in extreme conditions. The system is helpful in reducing the risk of life of a rescuer and it also eliminates the physical presence of rescuers at the affected site. The rescuer will only have to operate the robot using an android app controller. Rescuer will also be able to see the live streaming of the current scenario in the same app through the camera module. The system gives positive results as soon as it detects a living human in its working range. The system gives better and reliable results. Since the system needs lots of power supply instead of using batteries it can have solar power source. High pixel camera can be used for more clear and proper streaming.

ACKNOWLEDGMENT

We would like to express a deep sense of gratefulness towards the Department of Computer Engineering of Viva Institute of Technology for their constant support motivation and valuable suggestions. This work that we have been able to present is because of their timely guidance and encouragement.

REFERENCES

- [1] Zia Uddin, Mojaharul Islam, “Search and Rescue System for Alive Human Detection by Semi-autonomous Mobile Rescue Robot” International Conference on innovations in science engineering and technology, 2016.
- [2] Murulidhara T C, Kanagasabapathi, Siva S Yellampalli, “Unmanned vehicle to detect alive human during calamity” International Conference on Electrical, Electronics, Communication, Computer and Optimization Techniques, 2017.
- [3] Rahu Krishna K, Merrra A, Nikhil Mathew, “Wireless Human Detection Robot” International Journal for Research in Applied Science & Engineering Technology, 2017. Indoor Environment” IEEE Transactions on Consumer Electronics, Vol. 63, No. 3, August 2017. IEEE 2017.
- [4] Sabyasachi Bhowmick, “An Approach to Design a Simple Human Detecting Robot for Cost Effective Home Security System as well as Various Rescue Missions” Communications on Applied Electronics (CAE), 2015.
- [5] Saravana Kumar K, Priscilla P, Germyia K Jose, Balagopal G, “Human Detection Robot using PIR Sensors” International Journal of Science, Engineering and Technology Research (IJSETR) Volume 4, Issue 3, March 2015.
- [6] M.Brem Kumar, D.Manikandan, M.Gowdem, D.Balasubramanian, “Mobile Phone Controlled Alive Human Detection Using Robotics” International Journal of Advanced Research in Computer Engineering & Technology (IJARCET), 2015.
- [7] Mr. S.P Vijayaragavan, Hardeep Pal Sharma, Guna sekar.C.H, S.Adithya kumar, “Live Human Detecting Robot for Earthquake Rescue Operation” International Journal of Business Intelligence, 2013.
- [8] Mohit Bais, Kanupriya Madan, Ankit Bharti, Prof. Prity Yadav, “Alive Human Detection Robot” International Journal of Scientific Research in Computer Science, Engineering and Information Technology, 2017.
- [9] Shwetha R, Dr. Chethan H K “Automatic and Manual controlled Alive Human Detection Robot during disaster

- management” International Journal For Technological Research In Engineering, 2014.
- [10] Geetha Bharathi, Dr. S. Sudha, “Alive Human Detection in Disaster zones manually controlled robots” International Journal of innovative Research in Computer and Communication Engineering, 2015.
- [11] Shuddha Chowdhury, Mahmud Rafiq, “A Proposal of User Friendly Alive Human Detection Robot to Tackle Crisis Situation” 12th International Conference on Control, Automation and Systems, 2012.
- [12] Krashna V. Panpaliya, Gauri N. Zade, “Detection of Alive Human body in Military area” International journal of Scientific and Engineering researches, 2015.
- [13] <https://kosnic.com/pir-vs-microwave-sensors/><https://kosnic.com/pir-vs-microwave-sensors/>.

