

Multipurpose Surveillance and Reconnaissance Vehicle

¹Neelesh Srivastava ,²Saurabh Kumar Mitra ,³ Mohammed Faiz ,⁴Sachin Rai ,
⁵Dr. Nandita Pradhan,⁶AmitabhSrivastava

*Deptt.of ECE, United College of Engineering and Management, Naini, Prayagraj.
Dr. A.P.J. Abdul Kalam Technical University Lucknow, Uttar Pradesh, India.*

Abstract: *From a national economic viewpoint, earthquakes are the most destructive category of natural hazards in India. The economic losses to homes and personal property are major manifestations. India is highly vulnerable to earthquakes, in that scenario there is a urgent requirement for development of enhanced surveillance vehicles. In this paper, we describe the design and implementation of a sensor-based robot. With the use and integration of Ultrasonic sensors and PIR sensor on a common coding platform Arduino we were able to create a working disaster relief assisting robot which not only reduces complexity but is easily made and user friendly.*

The logic behind this project is to further improve the area of application of surveillance vehicles by some design changes helping it to move on uneven surfaces also to help in defense purposes but also for rescue missions, in mines, tunnels limited space region so as to reduce the risk of human life, thereby improving and evolving our life dramatically.[4][5]

Key Words: *Arduino ,Ultrasonic sensors , Surveillance vehicles , PIR sensor*

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I. Introduction

There is many different kind of catastrophe in natural and man-made disaster: earthquake, flooding, hurricane and they cause different disaster area like collapsed building, landslide or crater. During these emergency situations, and specially in urban disaster, many different people are deployed (policeman, fire fighters and medical assistance). In these situations, human rescuers must make quick decisions under stress, and try to get victims to safety often at their own risk. They must gather determine the location and status of victims and the stability of the structures as quickly as possible so that medics and firefighters can enter the disaster area and save victims. All of these tasks are performed mostly by human and trained dogs, often in very dangerous and risky situations. This is why since some years, mobile robots have been proposed to help them and to perform tasks that neither humans dogs nor existing tools can do. For this project, we will focused only on robots which will work in a disaster environment of man made structure, like collapsed buildings.

There are several institutes both private and government working on robotics. Currently, Defense and Research Development Organization(DRDO) a Government of India company which is focused to use these autonomous robotsbut it's use is strictly focused and strictly in the defense area. Mostly these robots are brought in use to resolve the conflicts occurring in the border regions. They play a crucial role in determining the location of the infiltrators, also in extra ordinary situations such as aiding as an augmented hand in bomb diffusing. That's where the MULTIPURPOSE SURVELLIANCE AND RECONNAISSANCE VEHICLE(MPRSV) comes in play with the use of basic and easy to use electronic equipments. With the use and integration of these sensors on a common coding platform Arduino we were able to create a working disaster relief assisting robot which not only reduces complexity but is easily made and user friendly.[4][5]

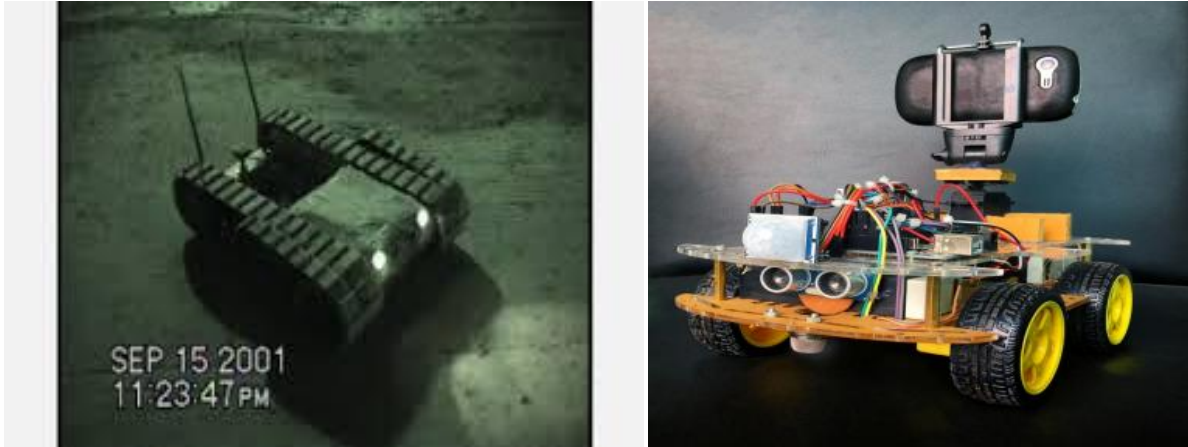


Fig. (a):Packbotrobot Fig.(b):Hardware implementation of Robot

II. HARDWARE USED

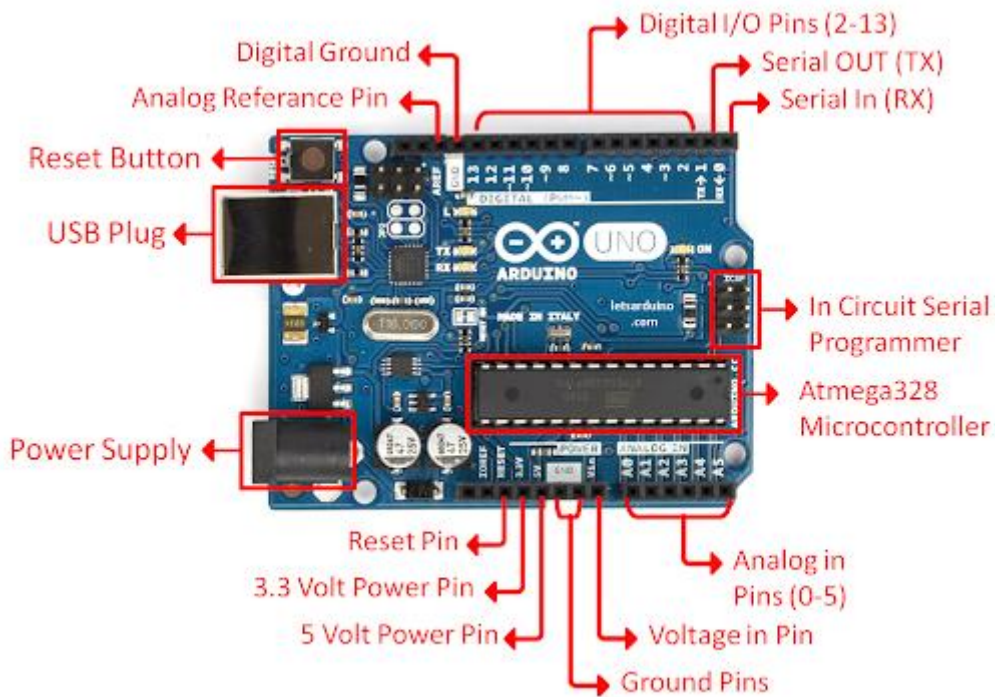


Fig.(c):ARDUINO UNO

III. COMPONENTS REQUIRED

1. ARDUINO UNO R3(Atmega328-P Microcontroller)
2. PIR Sensor(HC-SR501)
3. Ultrasonic Sensor(HC-SR04)
4. L293D Motor DriverModule
5. DC Helical GearMotors
6. RobotChassis
7. LED
8. Buzzer
9. 9VBattery[4][5]

IV. Methodology

Human detection module of the robot is mainly a PIR sensor controlled by an Arduino microprocessor. When a human is present within the range of the sensor (4-5 meters) it creates a detection signal (a digital pin goes high) which is processed by Arduino and a red signal LED is lit on to indicate the detection. The PIR sensor can detect motion and keep signaling (retriggering) but it will stop when motion stops. This is why we

have a camera onboard the robot. The human detection module also has infrared lighting. The purpose of these LEDs isto provide lighting in low or no light conditions for the camera.[4][5]

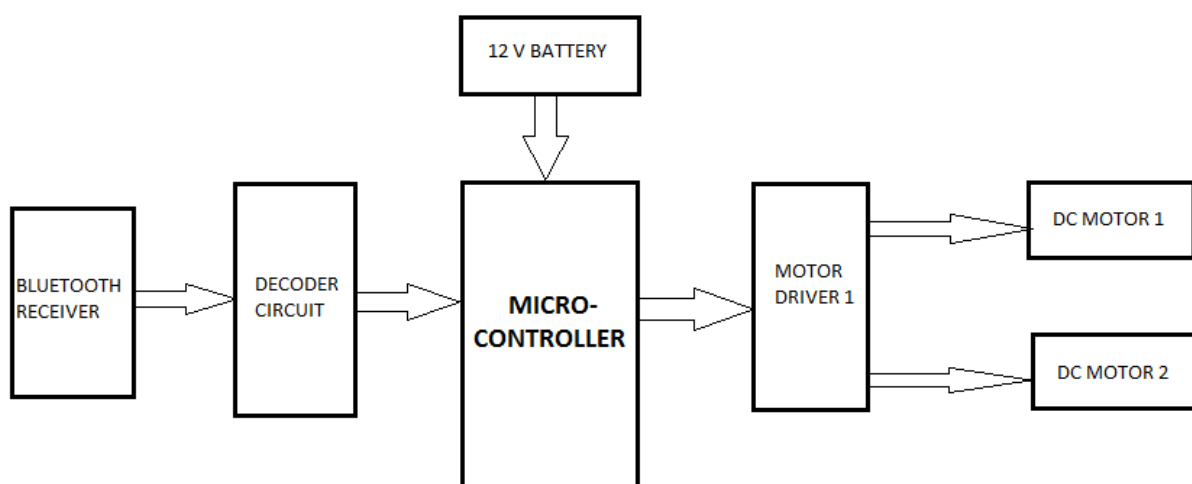
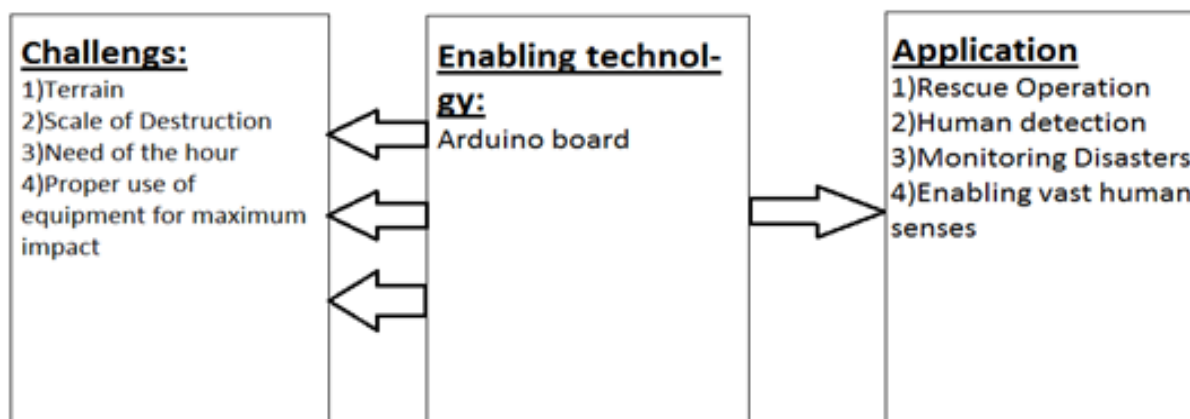


Fig. (d): Block diagram of Robot with sensor

V. System Design

The system architecture of the system design is given below.[4][5]

5.1 PIR SENSOR



Fig. (e):PIR Sensor

The thermal radiation emitted by a human body will be received and manipulated by the PIR sensor in order to achieve a human detection. PIR sensors are passive infrared sensors. They detect a change in the heat and this can be used to detect movement of people. It has digital output and can be directly given to the digital pins, therefore no ADC is needed. It operates at 5V DC the PIR (Passive Infra- Red) Sensor is a pyroelectric device that detects motion by measuring changes in the infrared (heat) levels emitted by surrounding objects.

5.2 ULTRASONIC SENSOR

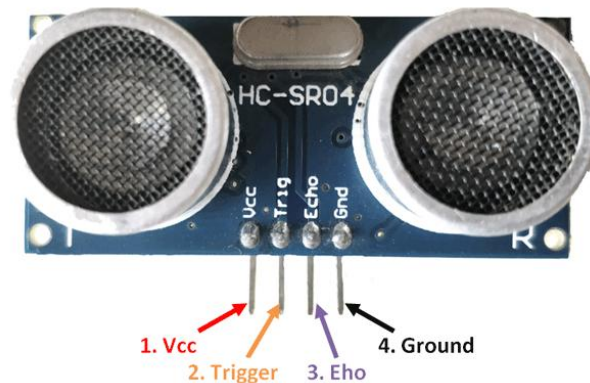


Fig. (f): ULTRASONIC Sensor

This is a common sensor used in mobile robotics because of its low price and ease of use. It is used for basic target classification in term of surface, or basic shapes but has many disadvantages. It is sensitive to air condition, and there are some problems with the echo location when the place or the target has a complex shape. With this sensor only, it is almost impossible to make the distinction between human or non-human presence. Now, it is more and more replaced by the radar, which is more robust and depends less on the environment conditions.

VI. System Flowchart

Fig.(g) shows the flow chart of the developed system. First,the robot will check for navigation instruction from thecontroller.The output of PIR sensor is digital and it will send tocontroller terminal using RF transreceiver. Human presence will be detected by PIR sensor if the value of the sensor is high. After human presence detection by PIR sensor, IP camera will be checked for confirmation. The location and information about the person will send to the recue team after confirmation of detection. After that, PIR sensor will search again for human presence.The data of sensors will be transmitted by the transceiver to controller forprocessing the data.[7][8]

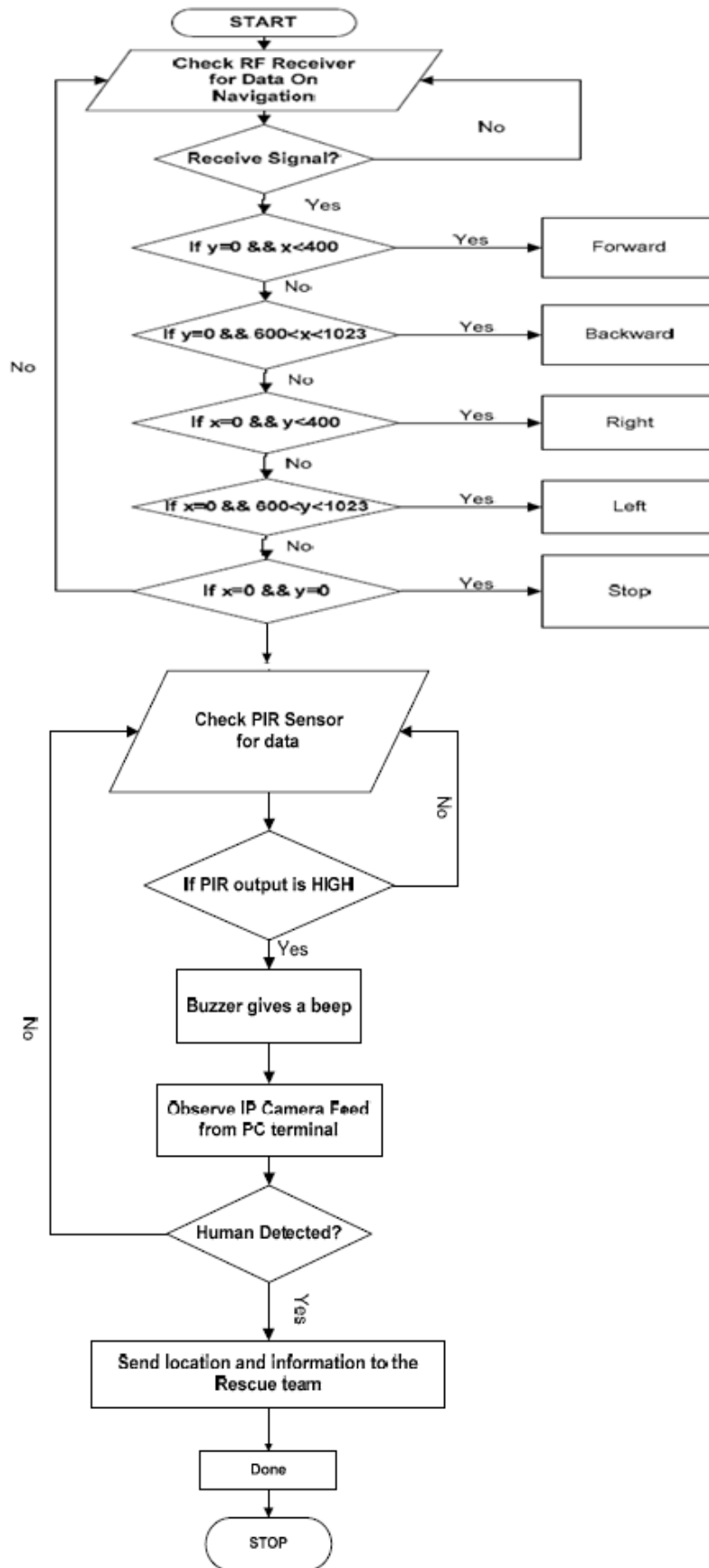


Fig.(g): Flowchart of the system

VII. Robotconfiguration

The inputs to ARDUINO are PIR sensor, Ultrasonic sensor and power supply. The outputs are LED, Buzzer and L293D motor driver module, to which a DC motor is connected. A DC motor is used to move the robot in left, right, forward and backward directions. L293D motor drive module controls the DC motor to move in the direction. The direction of the movement is decided as according to program code written. Human can be detected using a PIR sensor[1]. Human being produces 9 to 10 microns of heat which is detected using this sensor. A PIR sensor's angle of detection is restricted to 180° i.e. except the area below the robot it can sense in all the other directions. The distance up to which PIR sensor can detect is restricted within 20ft.

When we will start the Robot, it will move in forward direction, Once the human presence is detected by PIR sensor it stops for some time and triggers the LED and Buzzer to ON to indicate that there is a presence of a human. The Ultrasonic sensor detects the obstacles other than human beings and get deflected from its current path according to program.[2]

A remotely controlled tracked wheel robotic platform is selected for the main carrier. The reasons for this selection are:

- An autonomous robot can get stuck somewhere in the debris and it may not be rescued by the team because of the lack of manual control.
- A wired control robot is not practical because of the need for a long wire which can tangle anywhere in the debris and the robot can be operational.
- Wireless remote control will have a shorter distance under collapsed building but manual control of the robot is valuable anyway and rescue team can enter the disaster area to some extent and utilize the robot from thereon.
- A tracked wheel platform is selected because wheels are not practical to operate in such disaster areas but tracked robot can move over small obstacles better.

The robot carries a wireless camera which can transmit live video and audio in low light conditions to the rescue team outside the vicinity in a safe place. Live video is transmitted to any Android device (cell phone or laptop) so these can easily be found anywhere in the world. Thus, human detection is easily carried out by the research personnel.[3]

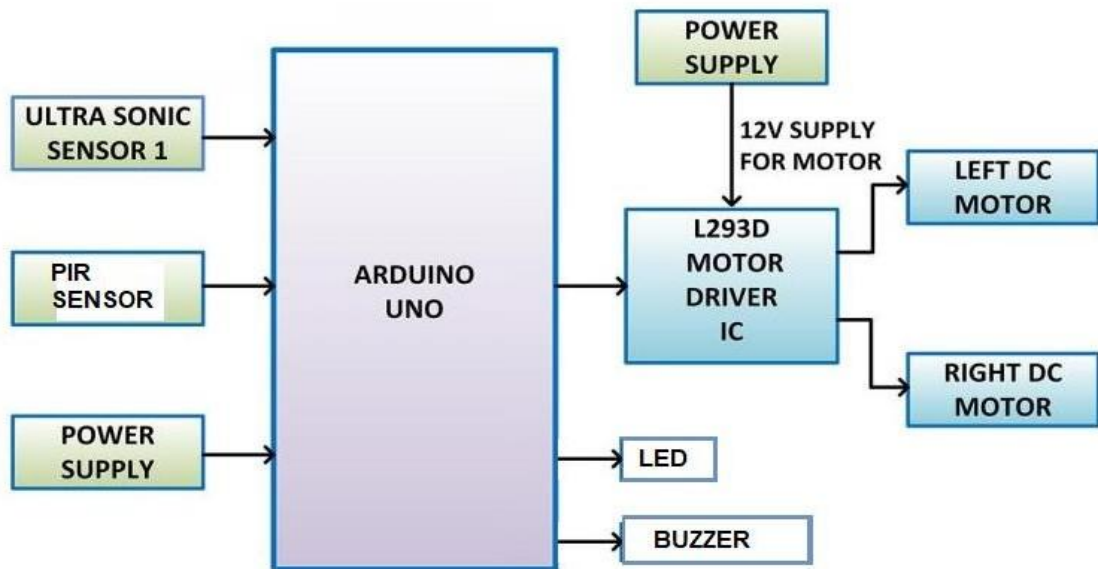


Fig.(h): Block Diagram for ROBOTCONFIGURATION

VIII. Advantages

- This system will be very helpful when it is being deployed practically, using the Arduino IDE software its user interface has become very user friendly.
- In the area of rescue missions and search operation
- In the area where human presence is limited

- providing the technology which was limited for defense purposes

IX. Future Scope

Hardware

After having the infrared camera, the PIR sensor has become almost useless. The infrared camera provide much better information, it is more robust and more reliable. To replace it, another sensor which could be complementary to the IR camera is an infrared non-contact thermosensor used for object temperature measurement. It will be an interesting sensor to distinguish, when a warm object is detected with the IR camera, if it is on body temperature. However these sensors are more expensive than the pyroelectric.

Software

First, it would be useful to add a function in sound detection to detect regular banging. Indeed, in disaster area, sometimes victims are banging on wall or on ground because they can't shout. Moreover sound propagates itself better in structure than in the air. So if the robot could be able to detect regular banging it will have one more useful function for human detection. With the actual sound detection it would be done quite easily by detecting several time a short high noise above a threshold higher than now. Then by adding a counter it would be possible to detect such a kind of sound.

X. Conclusion

A prototype Human Detection Robot working efficiently according to the given scenario. Based on the architecture of main idea on which this prototype robot is working by estimating hurdles and moving according to passage and way of programming through which robot avoids the block position and moves along the open way.

The Robot can move, it covers lot of distance that reduces the use of many sensors or many robots. When the Robot finds a human, it can notify the users by producing continuous beeps. PIR sensor present in the Robot can detect the presence of human up to 7 meters and its area of coverage is 180°. It can detect the human by attaching a visual camera where the image of the intruder can be notified. It is attached with the ultrasonic sensor which determines the distance between the human and can detect the IR image of the object.

Human detection robot can be used at the time of natural calamities to save the lives of human. This can also be used to detect the humans in the war field and for security purpose in the jeweler shops, museums, etc. For our application and compare to existing project, the following sensors were chosen with low-cost and lightweight as main criteria:

- USB camera with built-in microphone
- PIR sensor
- Infrared camera

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