RESCUE OPERATION DURING NATURAL CALAMITIES BY HUMAN DETECTION ROBOT

A PROJECT REPORT

Submitted by

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BONAFIDE CERTIFICATE

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ABSTRACT

During crises such as earthquakes, tsunamis, bomb blasts, and floods, the loss of human lives is common. To minimize casualties and property damage in urban disasters, various essential services like police officers, firefighters, and medical teams are deployed. Rescue operations are predominantly carried out by humans and trained dogs, often in dangerous and hazardous conditions. In order to make these rescue efforts safer and more effective, the use of mobile robots has been proposed. These robots are designed to detect and communicate with the rescue team, as well as identify and locate survivors. However, previous methods using miniaturized robots with built-in Passive Infrared (PIR) sensors had limitations, such as the risk of the robot getting stuck in the aftermath of a disaster. To address this, an alternative system is proposed using a source of Infrared Rays (IR) instead of robots. This system efficiently detects and rescues alive humans within a short timeframe. Human detection robot which has to be implemented during calamities to find the casualties. Humans can be used for rescuing people in these areas, but due to high risk of earthquakes and building collapses it is not possible to send human rescue teams in these areas. Thus an affordable high technology equipment which makes this risky job quicker and safer is needed for the hour,

it is a simple, yet efficient equipment to indicate casualties and help them with immediate access to first aid.

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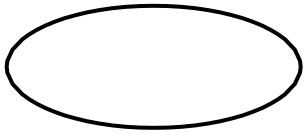
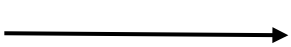
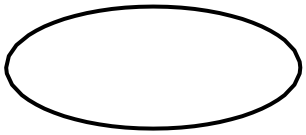
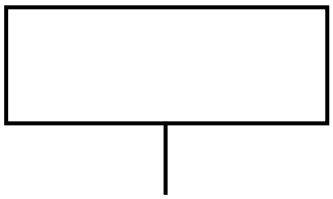
LIST OF FIGURES

LIST OF SYMBOLS

SYMBOL NAME	NOTATION	DESCRIPTION
Class	Class Name Visibility attribute: Type=initial value Visibility operation (arg list):return type()	Class represent a collection of similar entities grouped together.
Association	Class1 — Class2	Association represents a static relationship betweenclasses.
Use Case		A use case is an interaction between the system and the external environment.
Control Flow		A control flow represents the flowbetween the states.

Relational		Relational is used for additional process communication.
Data process/ state		A circle in DFDrepresents a state or process.
Object Lifeline		An object lifeline represents the vertical dimension that object communication.
Message		Arrow represents the message exchanged.

CHAPTER -1

1. BRIEF INTRODUCTION

Natural calamities can upset the financial and social balance of human advancement. In view of high upsurge developments and other artificial structures urban and modern regions are viewed as increasingly defenseless to disasters. These fiascos can be portrayed as common and human incited debacles. Disastrous events contain floods, storms, tornadoes, hedge fire, and quakes and so forth while humans incited fiascos to incorporate transportation mishaps, mechanical mishaps, significant flames, etc. In the majority of the disasters and regular disasters, the salvage groups confronted numerous issues in looking through people groups which were in concern although, it was a hazardous undertaking for them in looking through the people in question. So the salvage robots were concocted it helped the salvage groups. The advantage of the system is to decrease exhaustion and to get to inaccessible territories. Mechanical technology application is utilized for inquiry and salvage since the robot can be sent in risky conditions without putting humans in danger. The author is utilizing the PIR sensor (as a human indicator Wireless communication (as a wireless camera, and Microcontroller.

1.1 DOMAIN OVERVIEW

Human detection robots are intelligent robotic systems designed to detect, track, and interact with human presence in diverse environments. They employ a combination of hardware and software components, including sensors, cameras, actuators, mobility platforms, computer vision algorithms, and machine learning models. These robots aim to enhance safety and surveillance capabilities in settings such as public spaces, industrial facilities, and disaster-stricken areas. By leveraging advanced technologies and algorithms, they autonomously navigate, capture real-time data, and process it to accurately identify and track humans.

1.2 OVERVIEW OF THE PROJECT

The project aims to develop a human detection robot that enhances safety and surveillance capabilities in diverse environments. This involves integrating hardware components like sensors, cameras, actuators, and a mobility platform with advanced software components including computer vision algorithms, machine learning models, and deep neural networks. The robot will autonomously navigate and capture real-time data to accurately detect and track human presence.

CHAPTER 2

LITERATURE SURVEY

A literature review is a text of a scholarly paper, which includes the current knowledge, including substantive findings, as well as theoretical and methodological contributions to a particular topic. Literature reviews use Secondary sources and do not report new or original experimental work. A literature review usually precedes the methodology and results section.

2.1 REVIEW PAPER:

1. **Title: Design of Human Detection Robot for Natural calamity Rescue Operation.**

   Author: Alvin Joseph, Vishal Parmar, V Bagyaveereswaran.

   Year: 2019

   In this paper ,an develop a robot using suitable sensors to detect human being trapped behind a wall or under the rubble which can help the rescue team during natural calamities like earthquakes. The proposed robot model uses a radar sensor through which radio energy signals are sent. These signals on detecting humans will reflect back and will be caught by the receiver. The buzzer will start buzzing once the reflected radio signal is received by the receiver circuit.

2. **Title: UV disinfection robot with automatic switching on human detection.**

   Author: A Vyshnavi , A Manasa, Ch Hamsika, P Shalini.
   Year:2020

This paper propose to Ultra violet (UV) light is used for the purpose of disinfection or sterilization of rooms and surfaces. UV-C is employed as it has germicidal properties, in particular-bacteria and viruses, but it is detrimental to human-beings as well. So, for the purpose of disinfection without human interference, a UV Robot has been designed and implemented that follows a pre-defined path.

3. **Title: Live Human Detection Robot in Earthquake Conditions**

Author: R Kabilan, K Lakshmi Narayanan, M Venkatesh, V Vikram Bhaskaran, GK Viswanathan, SG Yogesh Rajan

Year:2021

The aim of our work human searching device that takes the form of a robotic car and serves as a backup mechanism for saving lives in the event of a disaster. The temperature sensor, in general, detects the thermal image of the human body, and there has been extensive research into human searching with the gas and humidity sensor

4. **Title: Implementation of Human Detection on Robot Prototype Using Admp401 Sensor.**

Author: Ceppy Ari Sugiharto, Decy Nataliana, Niken Syafitri.

Year:2022

In this project the ability of robots to robustly detect and localize what people see and hear is an important task that will be very useful in many robot interactions.

5. **Title**: **Human detector in disaster management.**

Author: R Iyer, Dalesh Patle, Akanksha Pardhi, Akshay Kawase.

Year:2022

The world repetitively suffer from disaster condition like earthquake, gas tragedies and if want to survive we want to take helps from technology because it's very dangerous to come directly face these type of situations so that's why we are focusing on a robot who can make the task easier so human detector plays that kind of role it finds a person in certain areas where risk is there and alarms us if any person detection.

2.2 PROBLEM STATEMENT

- A robot that is small yet effective enough would sneak into disaster conditions like Earthquakes or bomb blasts where we have to identify live human beings as possible to save.

- Our live human detection robot enters the places which the human or bulk machines cannot enter and identifies whether the person is dead or alive and it also reduces the casualties in those disasters.

- It is a user-friendly robot for detection this proposed model is very much useful for the rescue team, at military bases and disaster-affected areas in the disaster environment.

CHAPTER 3

SYSTEM ANALYSIS

3. 1 EXISTING SYSTEM

Existing systems for human detection robots include depth sensing cameras, such as Microsoft Kinect or Intel RealSense, which use infrared technology to measure distances between the camera and objects. Thermal imaging cameras detect heat signatures emitted by humans, even in low-light or obscured environments, commonly used in security and surveillance. Computer vision algorithms analyze visual information from cameras to detect human features like body shape, face, or movement patterns. Deep learning techniques, like convolutional neural networks (CNNs), are often employed for accurate human detection and recognition.

DISADVANTAGES:

1 .Limited Range and Field of View
2. Environmental Interference
3. Cost and Complexity
4. Vulnerability to Adversarial Attacks
5. Cost and Complexity

3.2 PROPOSED METHOD

The rescue robot is carried to the disaster area and connected. The batteries must be completely charged before the operation. Then the robot is powered on and the motor gets activated, which in turn causes the wheels to move. The robot is then moved to the vicinity to search for casualties or humans. Whenever humans are detected within the PIR sensor range, LCD displays 'Human Trace Detected', the LED glows and the buzzer rings all these happen simultaneously. If the LED is ON that means a human casualty is around. The robot stops when the human is detected and moves backward for 10 seconds. PIR sensors can detect humans within a range of 10 meters i.e. 30 feet. The disaster management team makes a consideration plan and enters the calamity area to rescue the victims.

3.2.1 ADVANTAGES:

- Accuracy
- Flexibility
- Real-Time Detection:
- Integration with Robot Control
- Adaptability

CHAPTER 4
REQUIREMENT ANALYSIS

Requirement analysis determines the requirements of a new system. This project analyzes product and resource requirements, which is required for this successful system. The product requirement includes input and output requirements it gives the want in terms of input to produce the required output. The resource requirements give in brief about the software and hardware that are needed to achieve the required functionality.

4.1 FUNCTIONAL REQUIREMENTS

A Functional requirement defines the function of a system or its components.A function is described as a set of inputs, behavior, and outputs. Functional requirements may be calculations, technical details, data manipulation, and other specific functionalities that show how a use case is to be fulfilled. They are supported by non-functionalities requirements, which impose constraints on the design or implementation.

4.2 NON-FUNCTIONAL REQUIREMENTS

Non-Functional Requirements are requirements that specify criteria that canbe used to judge the operations of a system.

Rather than specific behaviors, Non-functional requirements are often called qualities of the system. The non-functional requirements in this system are:

1. The system should be accurate and efficient.
2. The system should be able to meet all user requirements.

4.3 HARDWARE REQUIREMENTS

The most common set of requirements defined by any operating system or software application is the physical computer resources, also known as hardware.

A hardware requirements list is often accompanied by a hardware compatibility list, especially in the case of operating systems.

1. Arduino UNO
2. ESP 8266 module
3. Motor driver
4. DC motor
5. IR sensor
6. PIR sensor
7. Dot board
8. Buzzer
9. LCD Display

1. Arduino UNO

The Arduino Uno is a microcontroller board based on the ATmega328 (datasheet). It has 14 digital input/output pins (of which 6 can be used as PWM outputs), 6 analog inputs, a 16 MHz ceramic resonator, a USB connection, a power jack, an ICSP header, and a reset button. It contains everything needed to support the microcontroller; simply connect it to a computer with a USB cable or power it with an AC-to-DC adapter or battery to get started. The Uno differs from all preceding boards in that it does not use the FTDI USB-to-serial driver chip. Instead, it features the Atmega16U2 programmed as a USB-to-serial converter. Revision 2 of the

Uno board has a resistor pulling the 8U2 HWB line to the ground, making it easier to put into DFU mode. At mega 16U2 replace the 8U2. "Uno" means one in Italian and is named to mark the upcoming release of Arduino 1.0. The Uno and version 1.0 will be the reference versions of Arduino, moving forward. The Uno is the latest in a series of USB Arduino boards, and the reference model for the Arduino platform for a comparison with previous versions, see the index of Arduino boards.

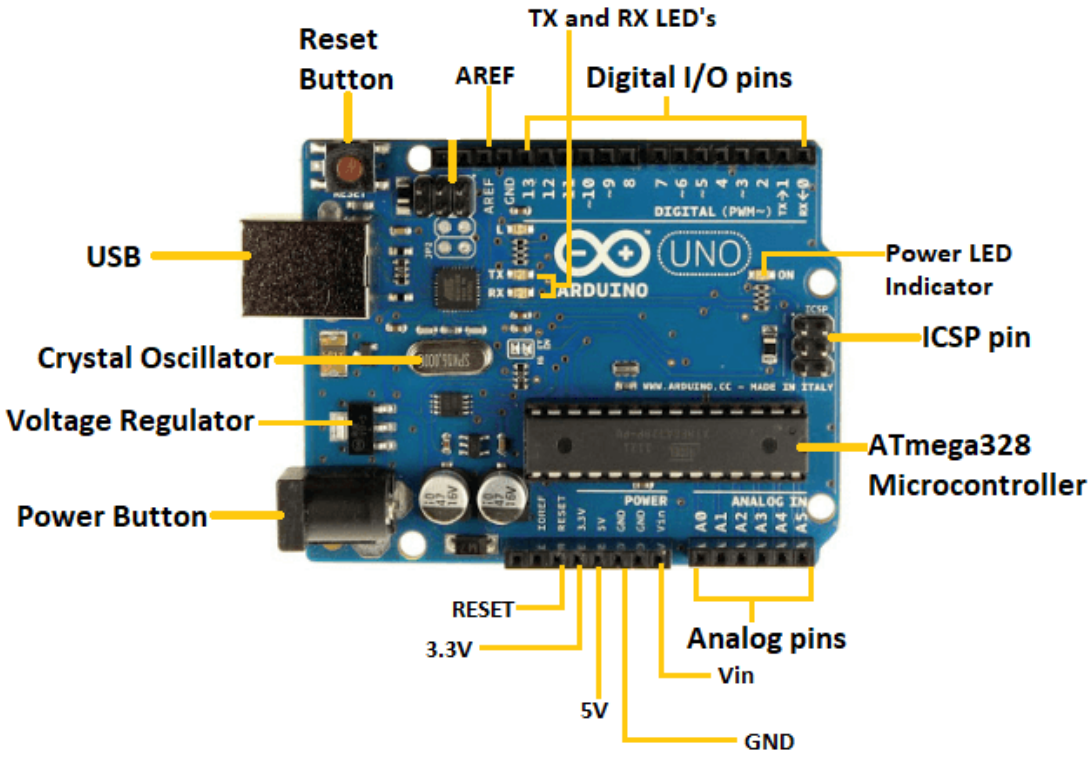


Figure 4.3.1: Arduino UNO

2.ESP 8266 module:

The ESP8266 WiFi Module is a self-contained SOC with an integrated TCP/IP protocol stack that can give any microcontroller access to your WiFi network. The ESP8266 is capable of either hosting an application or offloading all Wi-Fi networking functions from another application

processor. Each ESP8266 module comes pre-programmed with an AT command set firmware, meaning, you can simply hook this up to your Arduino device and get about as much WiFi-ability as a WiFi Shield offers (and that's just out of the box)! The ESP8266 module is an extremely cost-effective board with a huge, and ever-growing, community.

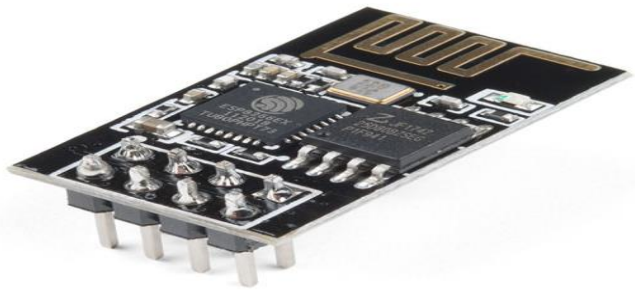


Figure 4.3.2: ESP 8266 module

3. Motor driver:

A motor driver is an electronic circuit or module that provides the necessary control signals and power amplification to drive and control the operation of electric motors. It is commonly used in robotics, automation systems, electric vehicles, and other applications where precise motor control is required. Motor drivers are designed to handle the high current requirements of electric motors. They typically include power transistors or MOSFETs that can handle the motor's current demands, providing the necessary amplification to drive the motor. Motor drivers provide various control interfaces to communicate with external devices and systems.

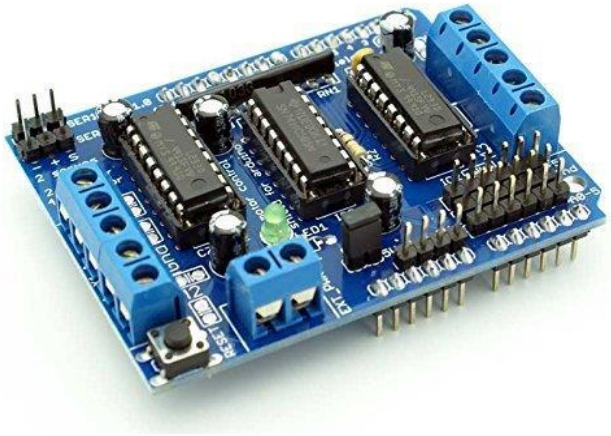


Figure 4.3.3: Motor driver

4. DC motor:

DC motors were the first type widely used since they could be powered by existing direct-current lighting power distribution systems. A DC motor's A DC motor is any of a class of rotary electrical machines that converts direct current electrical energy into mechanical energy. The most common types rely on the forces produced by magnetic fields. Nearly all types of DC motors have some internal mechanism, either electromechanical or electronic, to periodically change the direction of current flow in part of the motor.

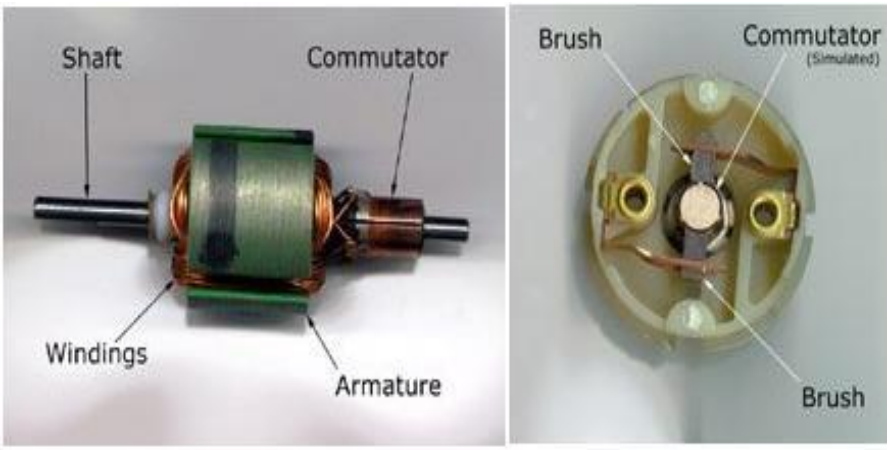


Figure 4.3.4: Dc Motor

5. IR sensor :

An infrared sensor is an electronic device, that emits in order to sense some aspects of the surroundings. An IR sensor can measure the heat of an object as well as detects the motion. These types of sensors measure only infrared radiation, rather than emitting it that is called a passive IR sensor. Usually, in the infrared spectrum, all the objects radiate some form of thermal radiation.These types of radiations are invisible to our eyes, which can be detected by an infrared sensor. The emitter is simply an IR LED (Light Emitting Diode) and the detector is simply an IR photodiode that is sensitive to IR light of the same wavelength as that emitted by the IR LED. When IR light falls on the photodiode, the resistances and the output voltages will change in proportion to the magnitude of the IR light received.

Figure 4.3.4: IR Sensor

6. PIR Sensor :

A passive infrared sensor is an electronic sensor that measures infrared light radiating from objects. PIR sensors mostly used in PIR-based motion detectors. Also, it used in security alarms and automatic lighting applications. The below image shows a typical pin configuration of the PIR sensor, which is quite simple to understand the pinouts. The PIR sensor consist of 3 pins,Pin1 corresponds to the drain terminal of the device, which connected

to the positive supply 5V DC.Pin2 corresponds to the source terminal of the device, which connects to the ground terminal via a 100K or 47K resistor. The Pin2 is the output pin of the sensor. The pin 2 of the sensor carries the detected IR signal to an amplifier from the thePin3 of the sensor connected to the ground

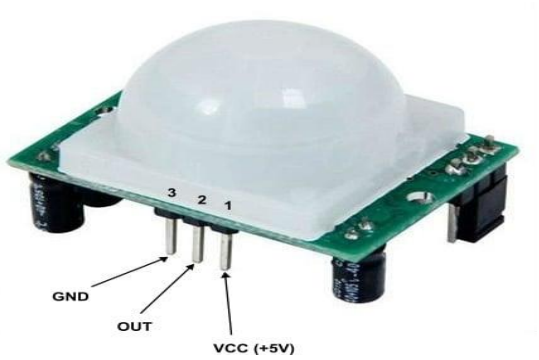


Figure 4.3.5: PIR Sensor

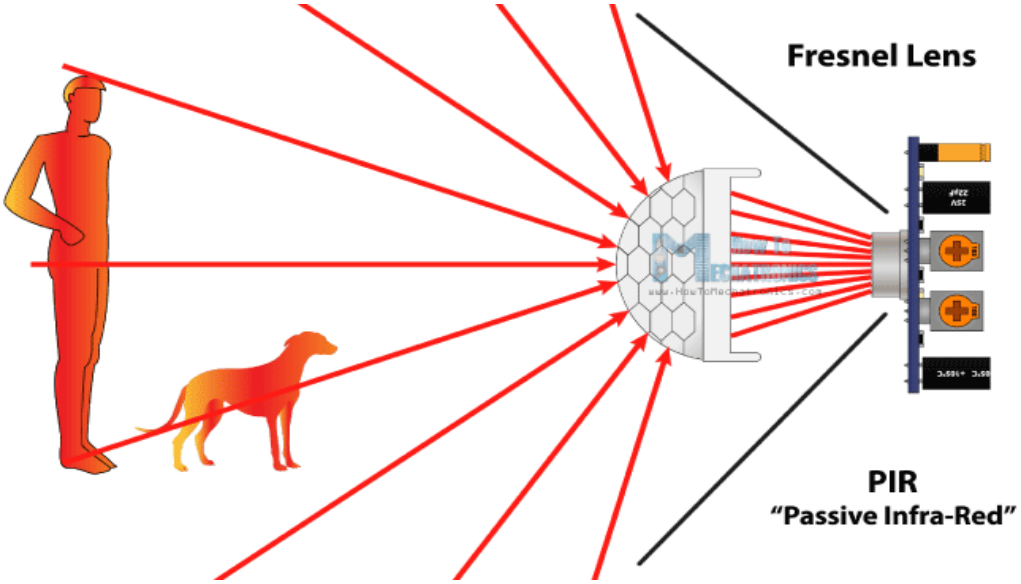


Figure 4.3.6:Detecting human

7. Dot board:

Perfboard is a material for prototyping electronic circuits (also called DOT PCB). It is a thin, rigid sheet with holes pre-drilled at standard intervals across a grid, usually a square grid of 0.1 inches (2.54 mm) spacing. These holes are ringed by round or square copper pads, though bare boards are also available.

Figure: 4.3.7:Dot board

8. Buzzer:

An audio signaling device like a beeper or buzzer may be electromechanical ormechanical type. The main function of this is to convert the signal from audio to sound. Generally, it is powered through DC voltage and used in timers, alarm devices, printers, alarms, computers, etc. Based on the various designs, it can generate different sounds like alarms, music, bell & siren.

Figure 4.3.8: Buzzer

9. LCD Display:

A liquid-crystaldisplay (LCD) flat-panel display or other electronically modulated optical device that uses the light-modulating properties of liquid crystals. Liquid crystals do not emit light directly, instead using a backlight or reflector to produce images in color or monochrome. LCDs are available to display arbitrary images (as in a general-purpose computer display) or fixed images with low information content, which can be displayed or hidden, such as preset words, digits, and seven-segment displays, as in a digital clock.

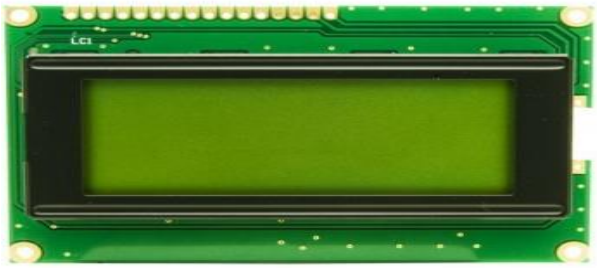


Figure 4.3.9: LCD Display

4.4 SOFTWARE REQUIREMENTS :

Software requirements deal with defining resource requirements and prerequisites that need to be installed on a computer to provide the functioning of an application. The minimal software requirements are as follows.

1. Arduino IDE
2. Embedded C

1.Arduino IDE:

The Arduino IDE (Integrated Development Environment) is a software platform that provides a user-friendly interface for programming and developing applications for Arduino microcontrollers. It is specifically designed to simplify the process of writing, compiling, and uploading code to Arduino boards. The Arduino IDE offers a beginner-friendly environment that allows users, regardless of their programming experience, to easily create and prototype projects with Arduino boards. It provides a simple code editor where users can write their program logic using the Arduino programming language, which is based on C/C++. The IDE supports syntax highlighting, code auto-completion, and error highlighting, which helps users write clean and error-free code.

Figure 4.4.1: Arduino IDE

2.Embedded c:

Embedded C is most popular programming language in software field for developing electronic gadgets. Each processor used in electronic system is associated with embedded software.

Embedded C programming plays a key role in performing specific function by the processor. In day-to-day life we used many electronic devices such as mobile phone, washing machine, digital camera, etc. These all device working is based on microcontroller that are programmed by embedded C.

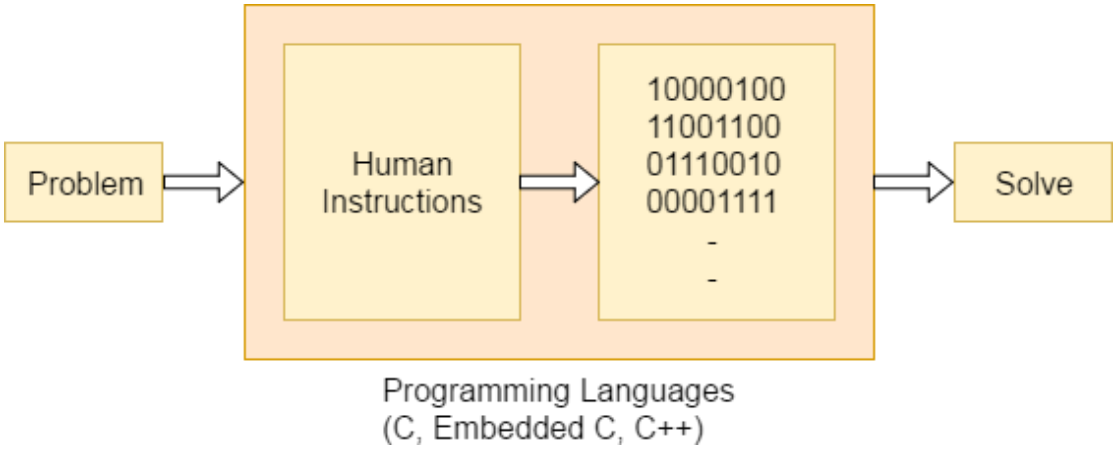


Figure 4.4.2 : Embedded C

CHAPTER 5

DESIGN ENGINEERING

5.1 SYSTEM ARCHITECTURE DIAGRAM

An architecture diagram is a visual representation of a system's components and their relationships, depicted using shapes and lines. It provides a high-level overview of the system's architecture, including external systems or resources, security controls, and performance metrics. The diagram's specific format and details vary based on the system's complexity and requirements.

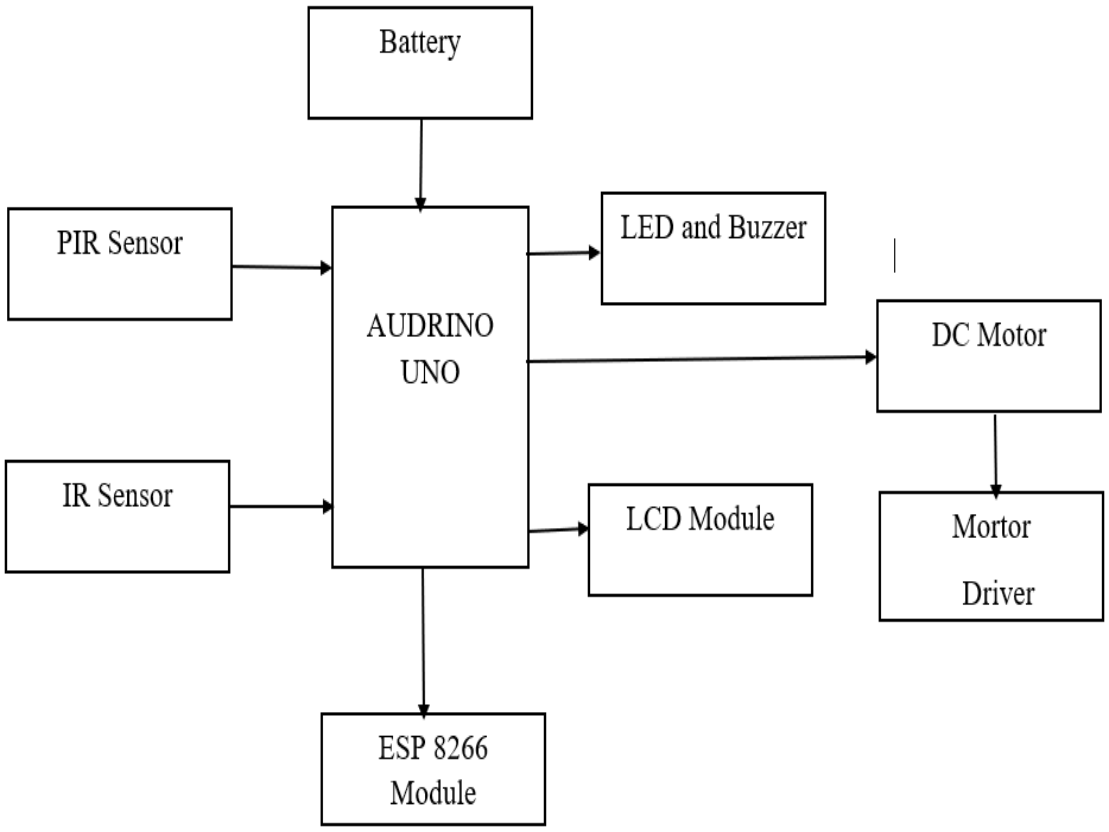


Figure 5.1:Architecture diagram

5.2 DATA FLOW DIAGRAM

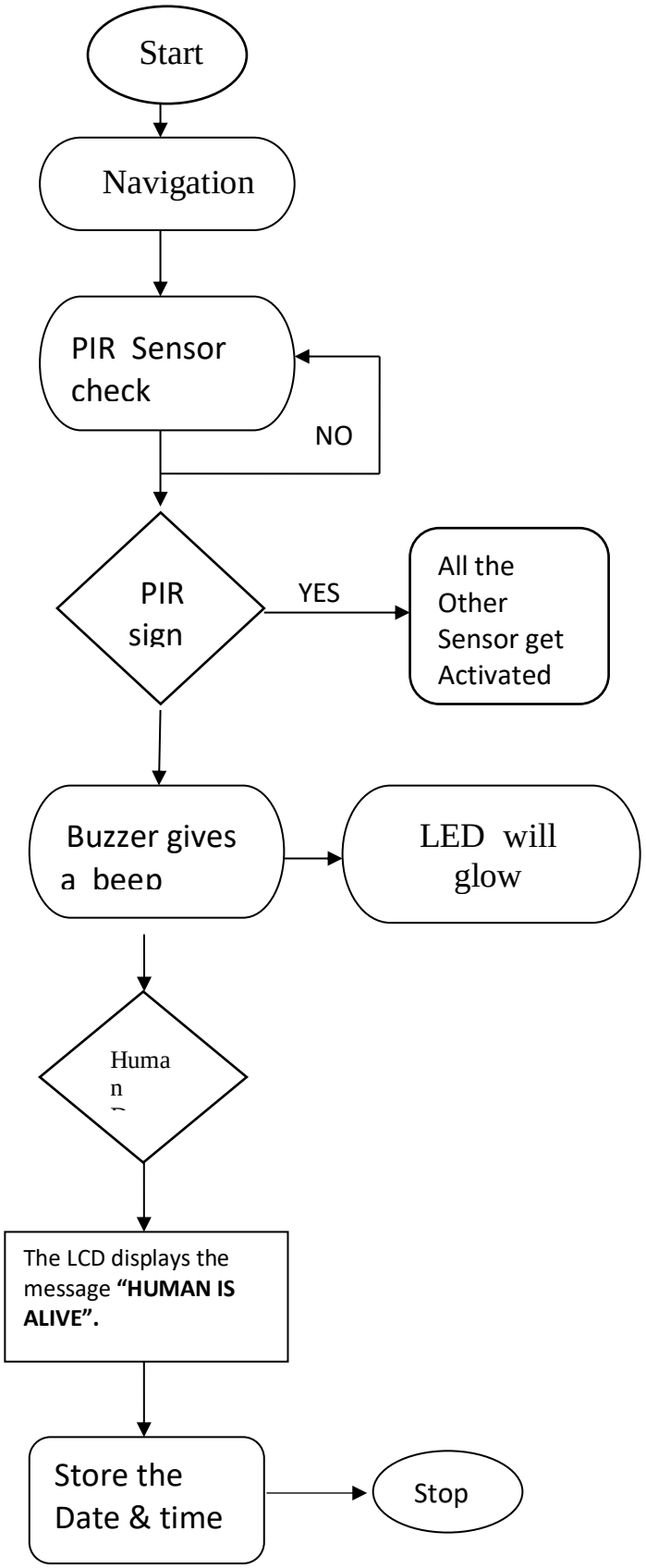
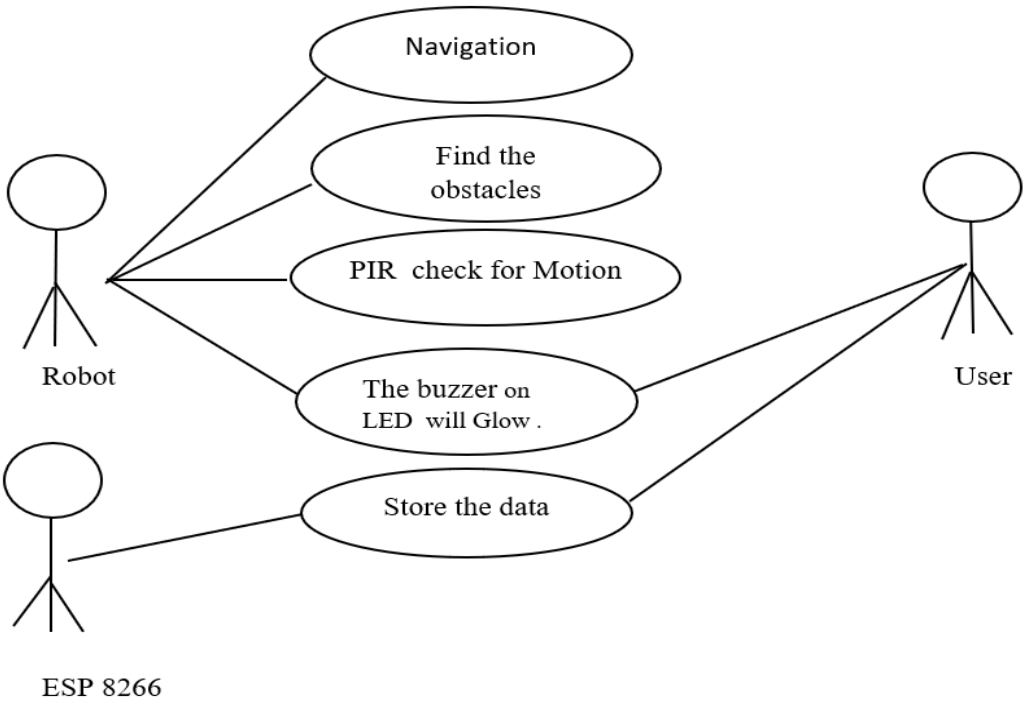


Figure 5.2:Data flow diagram

5.3 USE CASE DIAGRAM

Use case diagrams overview the usage requirement for system. They are useful for presentations to management and project stakeholders, but for actual development use cases provide significantly more value because they describe the meant of the actual requirements. A use case describes a sequence of action that provides something of measurable value to an



action

Figure 5.3:Use Case diagram

CHAPTER 6

LIST OF MODULES

6.1 IMPORTING NECESSARY LIBRARIES

A library is a collection of functions that can be added to your embedded system and called as necessary, just like any other function. rewrite codethatwillperformastandardtask.Withlibraries,youcanimportpre-existingfunctions and efficiently expand the functionality of your code .

6.2 DATA PREPROCESSING:

Data processing is an integral part of human detection in a robot. In a human detection robot, various data processing techniques are used to analyze and interpret the data collected by the robot's sensors. Data processing techniques are employed to fuse the data from these sensors to create a more comprehensive and accurate representation of the environment. Data processing involves extracting relevant features from the sensor data to represent different aspects of human presence. For example, in image data, features like shape, color, texture, or motion patterns can be extracted using image processing techniques. These features provide information that can be used for human detection and tracking.

6.3 MODEL DEVELOPMENT

The deployment of a Human detection robot involves the physical setup and configuration of the robot, as well as the integration of its sensors and software components. Here is a general overview of the model deployment process for a surveillance robot:

1. Hardware Assembly
2. Software Installation
3. Sensor Calibration and Configuration
4. Algorithm Implementation
5. Testing and Validation
6. Maintenance and Updates

6.4 MODEL EVALUATION

The evalution of a human detection robot isto determine its performance and effectiveness in carrying out. The evaluation process involves assessing various aspects of the robot's functionality. Firstly, the performance of the integrated sensors,like PIR sensor , IR sensor , ESP 8266module,buzzer, LCD, LEDis evaluated for accuracy, reliability, and responsiveness.This ensures that the robot can collect and interpret data accurately from its environment.Secondly, the robot navigation and mobility capabilities are assessed to determine its ability to maneuver through different terrains, avoid obstacles, and reach designated locations. The accuracy and efficiency of its movement are crucial for effective human detection . Overall, the evaluation process aims to assess the human detection robot's performance, identify strengths and weaknesses, and optimize its capabilities for efficient human detection operations.

6.5 MODEL DEPLOYMENT

The deployment of a surveillance model involves the strategic implementation of surveillance systems and technologies to ensure effective monitoring and security. Firstly, a comprehensive assessment of the surveillance requirements is conducted, considering factors such as the area to be monitored, potential threats or risks, and specific objectives.

Based on this assessment, appropriate surveillance technologies are selected, including cameras, sensors, and communication systems. The deployment of a surveillance model involves a systematic and iterative process to establish a robust surveillance system capable of meeting the specific monitoring and security needs of the intended environment.

CHAPTER 7

CODING & OUTPUT

7.1 PROGRAM

```
#include <LCD_I2C.h>
LCD_I2C lcd(0x27);
#define pir 2
#define ir 3
#define ir1 4
#define buzzer 7
  const int motorpinFR=5;
  const int motorpinFL=6;
void setup()
{
  Serial.begin(9600);
  pinMode(ir,INPUT);
  pinMode(ir1,INPUT);
  pinMode(pir,INPUT);
  pinMode(motorpinFR,OUTPUT);
  pinMode(motorpinFL,OUTPUT);
  pinMode(buzzer,OUTPUT);
  lcd.begin();
  lcd.backlight();
```

```
  lcd.setCursor(0, 0);
  lcd.print("WELCOME");
  delay(1000);
}
void loop()
 {
   int a =digitalRead(ir);
   Serial.println("IR:");
   Serial.println(a);

    int b =digitalRead(ir1);
    Serial.println("IR1:");
    Serial.println(b);

    int c =digitalRead(pir);
   Serial.println("PIR:");
   Serial.println(c);
   delay(1000);
  if(c==1){
     digitalWrite(buzzer,HIGH);
     lcd.setCursor(0, 0);
     lcd.print("HUMAN IS");
    lcd.setCursor(0, 1);
    lcd.print("ALIVE");
delay(1000);
  }
if(a==1 && b==1)
 {
   int pwm1=3000;
```

```
    int pwm2=3000;
    digitalWrite(motorpinFR,pwm1);
    digitalWrite(motorpinFL,pwm2);
 }
if(a==0 && b==1)
  {
     int pwm1=0;
     int pwm2=3000;
     digitalWrite(motorpinFR,pwm1);
     digitalWrite(motorpinFL,pwm2);
}
if(b==0 && a==1)
{
   int pwm1=3000;
   int pwm2=0;
   digitalWrite(motorpinFR,pwm1);
   digitalWrite(motorpinFL,pwm2);
 }
if(a==0 && b==0)
 {
   int pwm1=0;
   int pwm2=0;
   digitalWrite(motorpinFR,pwm1);
   digitalWrite(motorpinFL,pwm2);

 }
  }
```

7.2 EXPECTED OUTPUT

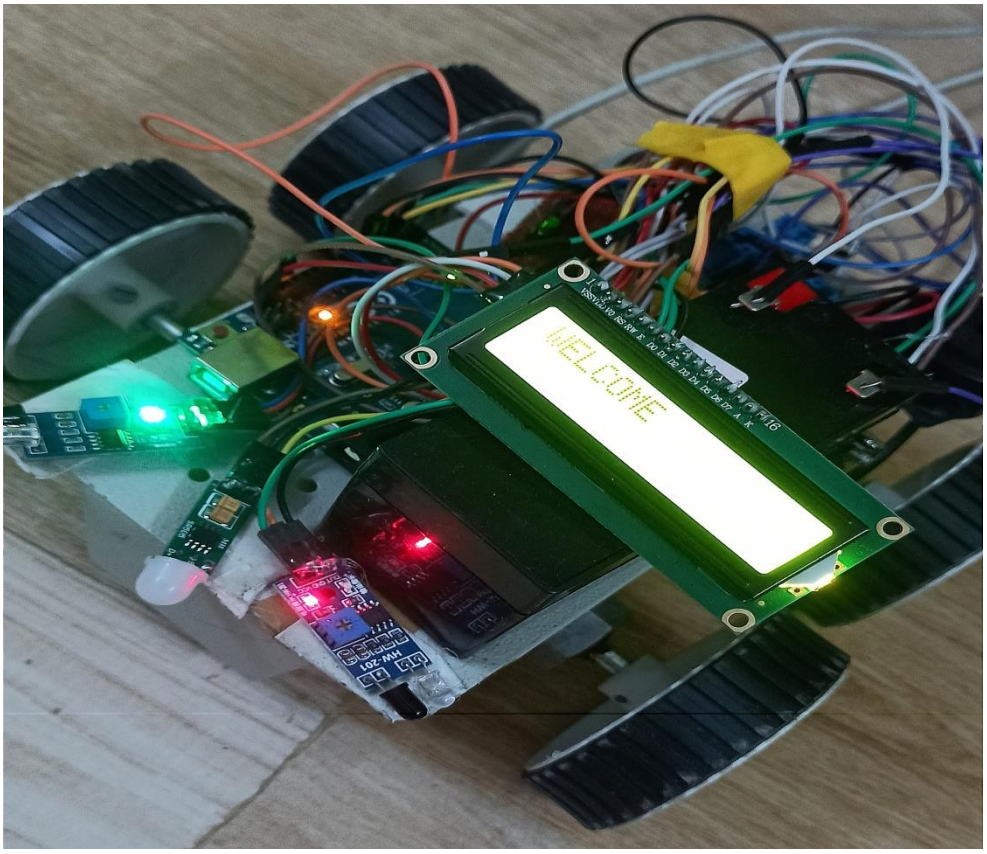


Figure 7.2.1 : Navigate the robot

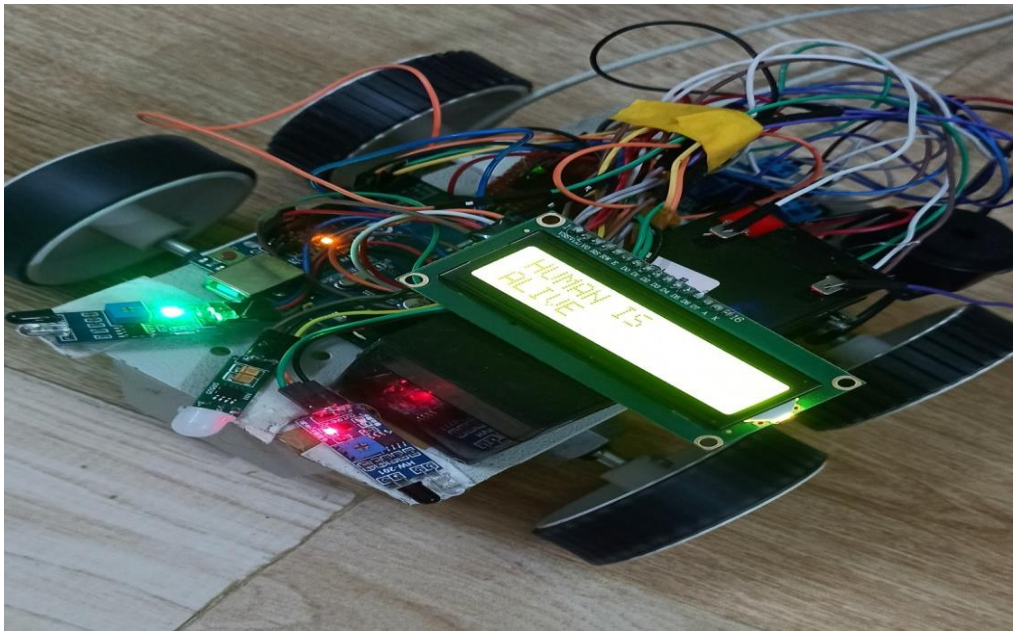


Figure 7.2.2 : Display as Human is alive

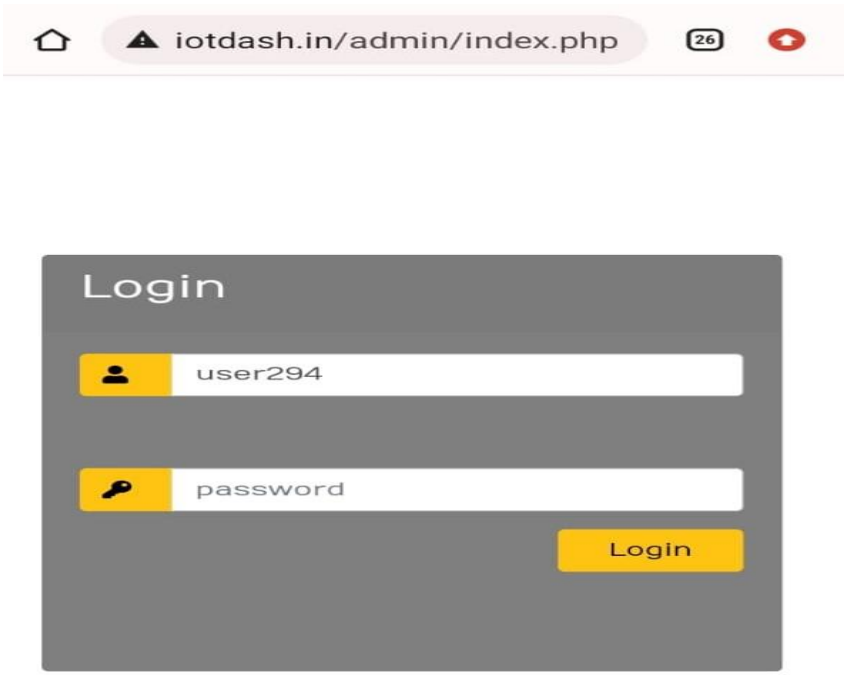


Figure 7.2.3 : Login page

Figure 7.2.4 :Date & time

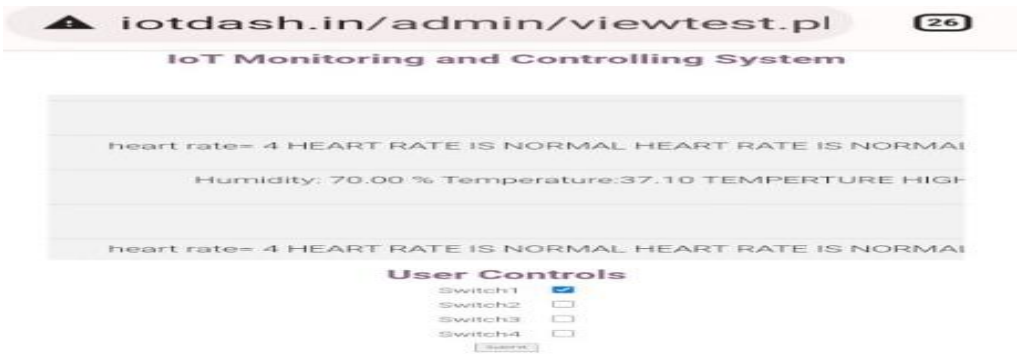


Figure 7.2.5 :Data is stored

CHAPTER 8
CONCLUSIONAND FUTURE ENHANCEMENT

8.1 CONCLUSION

A simple, efficient solution for helping rescue workers in disaster management. As it is a wired robot, it has its limitations. Long USB cables are required, and PIR sensors can detect radiation only from living persons etc. This prototype can be further enhanced by making it wireless using Bluetooth or Wi-Fi technology, an infrared camera can be used for visualizing the entire situation before entering the area.This robot can be further integrated with a software application on computers or smartphones to receive notifications. This solution is very reliable, safe, easy to operate and cost effective. Periodic maintenance is not required.

8.2 FUTURE ENHANCEMENT

In terms of future enhancements, In the future, During the emergency and particularly in urban disasters, this project is in good demand. The disasters will be perceived in an exceedingly faster time and therefore the operation will be there for the stake to assist the victims. The invention of this device is user friendly and advanced in technology. This circuit is mainly used in land rovers by making its movement more effective on trough surfaces and in advance this will also be used in drones applying the same circuit and idea with advanced techniques. This circuit and structure is also used with different ideas, in the war field it helps to locate and hit the living enemy targets and a camera on top gives the sight of view of the current situation ahead. By adding voice command it helps to communicate with receiver end selected officers with the sphere war troops.

It helps to locate the positions of enemy sprocessing through this technique it recognizes the victims with their face recognition and fingerprint analysis technique which is directed to the government database to get the whole information about the victim that is our target of rescue. Features like Ultrasonic sensor, Infrared camera for locating the position of the humans. And a technology consisting of Bluetooth or Wi-Fi can be added for a wireless detection robot.

9 . REFERENCES

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