DESIGN AND FABRICATION OF ROBOT FOR ASSISTANCE IN RESCUE OPERATIONS DURING FLOOD

PROJECT REPORT PHASE- II

submitted by

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CERTIFICATE

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ABSTRACT

KEYWORDS: Flood , Rescue Robot, Sensors

Floods are one of the most common natural disasters that can sometime become extremely difficult to control.Rising sea levels, climate change and dependency on river basins or coastlines will increase frequency and probability of flooding in many regions of economic activity worldwide in coming decades.Existing rescue operations risks life's of rescuers and doesn't provide quick response.In the face of increasing frequency and intensity of flood-related disasters, the need for effective and efficient rescue operations has become paramount. In this project, we propose the design and development of a flood rescue robot equipped with a gas sensor, PIR (Passive Infrared) sensor, and ultrasonic sensor to enhance the efficiency and safety of rescue missions.

This is a microcontroller based rescue robot for detecting people who are affected by natural calamities. The advantage of this system is it can be use in water with our smart phone control.It is capable of sensing living bodies, gas levels, distance measuring, presence of obstacles under water and live video streaming.Robot can carry emergency medicine as well as food for the affected people, it can also guide rescue team towards affected area with proper safety warnings.The collected sensor data is processed and analyzed, enabling the robot to make informed decisions during rescue missions, such as adjusting its trajectory or prioritizing areas with higher gas concentration or human presence.

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ABBREVIATIONS

PIR	Passive Infrared Sensor
ROV	Remotely Operated Vehicle
AUV	Autonomous Underwater Vehicle
UAVs	Unmanned Aerial Vehicles
AI	Artificial Intelligence
CBDRM	Community-Based Disaster Management
IDE	Integrated Development Environment
PWM	Pulse Width Modulation
DC	Direct Current
UART	Universal Asynchronous Receiver-Transmitter
SLAM	Simultaneous Localization and Mapping
IoT	Internet of Things

CHAPTER 1

INTRODUCTION

Floods are natural disasters that can result in devastating consequences, including the displacement of people, damage to infrastructure, and loss of life. During such emergencies, rescue operations play a crucial role in saving lives and providing aid to affected communities.However, these operations are often hindered by numerous challenges, including hazardous conditions, limited accessibility, and time constraints.To address these challenges and improve the effectiveness of flood rescue missions, the development of specialized robotic systems has gained significant attention.During the monsoon season on August 16, 2018, Kerala experienced severe floods caused by unusually high rainfall, marking the worst flood the region had encountered in nearly a century.The impact was devastating, resulting in the loss of 483 lives and leaving 15 individuals missing. Extensive evacuations took place, primarily in areas such as Chenganoor, Pandanad, Edanad, Aranmula, Kozhencherry, Ayiroor, Ranni, Pandalam, Kuttanad, Malappuram, Aluva, Chalakkudy, Thrissur, Thiruvalla, Eraviperoor, Vallamkulam, North Paravoor, Challanam, Vypin Island, and Palakkad. The severity of the situation led to a red alert being issued for all 14 districts of the state.According to the Kerala government, approximately one-sixth of the state's population had directly experienced the floods and its associated incidents.Recognizing the intensity of the situation, the Indian government declared that it is a level 3 calamity or 'calamity of a severe nature'.This flood stands as the most catastrophic event in Kerala since the great flood of 1924.

During this flood, a lot of people were trapped in many water-filled places and were not able to escape.They weren't able to find the necessary food and medicines during that time.Hence, our project aims at providing those people with the necessary food and medicines after detecting humans trapped in buildings.Our project also tries to detect amorphous gases that are in the device's path.Along its route, it also offers live video.For these purposes, we are developing an application that can be controlled using our smartphones.The movement of the device can be controlled by this app interface, and it also has other features like gas detection, distance measuring, and live video viewing.

1.1 PROBLEM DEFINITION

We have asked the most severely affected individuals in Kuttanadu and various parts of Kerala, particularly in Chenganoor and Vallamkulam, to gain insights into their hardships and the lack of essential resources they encountered.The majority of the respondents revealed their active participation in collective rescue efforts, expressing their compassion for fellow humans and a high sense of satisfaction from their rescue operations.While the initial respondents had experienced coastal disasters, their exposure to disaster preparedness and drills was limited.The primary respondents to the Kerala flood in 2018 expressed satisfaction with transportation facilities, support from social media platforms, the availability of water and food, as well as assistance from uniformed forces and local self-government bodies.However, as time passed, the quality of services and facilities deteriorated slightly. Additional issues observed in community residences included the absence of mechanisms for detecting individuals in need and community-based early warning systems, as well as insufficient collaboration between the community and government authorities.

The issues mentioned by the affected individuals were extensive. One of the problems they highlighted was their inability to report being trapped during the flood.The areas on red alert lacked power supplies, making it difficult for them to contact the relevant authorities for assistance.Some individuals faced shortages of food and medicine because the floods were unexpected and they had not taken any precautions. Considering the need to provide food and essential medicines in small quantities,we decided to use a small box for this purpose.Although a few rescue robots are available, they are not fully effective in providing food, medicines, or detecting humans.Moreover, the existing rescue robots are costly.Additionally, since this application is seasonal, people are unlikely to invest in expensive devices for these specific needs.Our primary goal is to create a device that meets our requirements, solves our problems, and is cost-effective.

CHAPTER 2

LITERATURE SURVEY

2.1 Shahria T., Zaman K.T., Rabbi S. and Khan M.M.: "Underwater research and rescue robot"(2019)

The authors focused on the development of a robot specifically designed for underwater research and rescue operations.The paper likely discussed the design, development, and functionalities of the underwater robot, which was intended to operate in challenging aquatic environments.The authors explored various aspects, such as the mechanical structure of the robot, the integration of sensors for underwater perception, and the communication and control systems necessary for remote operation.This underwater research and rescue robot is a type of remotely-operated or autonomous underwater vehicle (ROV or AUV) designed specifically for conducting research or rescue operations in an aquatic environment.The objective of the research was to provide a solution that could aid in underwater research and rescue missions.The robot would be capable of performing tasks such as underwater exploration, data collection,and potentially assisting in the rescue of individuals in distress.

2.2 Afridi, A, Minallah N., Sami I., Allah M., Ali Z. and Ullah S.: "Flood rescue operations using artificially intelligent UAVs" (2019)

The authors explored the application of artificially intelligent Unmanned Aerial Vehicles (UAVs) in flood rescue operations. The research focused on leveraging UAVs equipped with advanced artificial intelligence (AI) capabilities to enhance the effectiveness and efficiency of flood rescue missions.The authors proposed an intelligent system that enables UAVs to autonomously navigate through flood-affected areas, identify and locate survivors, and assist in the rescue process.The objective of the research was to demonstrate the potential of AI-driven UAVs in improving the response to flood disasters, reducing human risks, and increasing the overall success rate of rescue operations.By combining advanced technologies such as AI and UAVs, the authors aimed to contribute to the field of disaster management and emergency response.

2.3 L. Liang, X. Wang, and H. Chen: "Design of a wireless communication system for flood rescue robot" (2018)

The paper focuses on the design and implementation of a wireless communication system specifically tailored for a flood rescue robot.The authors address the importance of reliable and efficient communication in flood rescue operations, where real-time information exchange between the robot and human operators is crucial.They propose a wireless communication system that enables seamless and robust communication in challenging flood conditions.The paper discusses the design considerations, hardware architecture, and communication protocols used in the wireless system.It also highlights the challenges faced in establishing reliable communication links in a flooded environment and provides solutions to overcome these challenges.

2.4 R. V. Shinde, S. M. Utkarsh, V. B. Patil, and V. N. Yadav: "Flood rescue robot for effective disaster management" (2017)

The paper focuses on the design and development of a flood rescue robot aimed at improving disaster management in flood-prone areas. The authors address the challenges faced during flood situations, where timely rescue operations are critical for saving lives.They propose a flood rescue robot as a technological solution to assist in rescue efforts and enhance the effectiveness of disaster management.The paper discusses the design considerations, mechanical structure, and functional modules of the flood rescue robot.It describes the integration of various sensors such as ultrasonic sensors, PIR sensors, and gas sensors to enable obstacle detection, human presence detection, and monitoring of environmental conditions.

2.5 N. A. Iqbal, N. M. Saad, and N. B. Muhamad: "Design and development of an amphibious robot for flood rescue mission" (2016)

The paper focuses on the design and development of an amphibious robot specifically intended for flood rescue missions.The authors address the challenges faced during flood situations, where traditional land-based robots may encounter limitations in navigating through waterlogged areas.They propose an amphibious robot capable of operating both on land and in water to overcome these challenges and enhance the effectiveness of flood rescue missions.Furthermore, the paper presents experimental results and performance evaluations of the amphibious robot, demonstrating its ability to navigate through different terrains and perform rescue operations in both land and water environments.It offers valuable insights into the integration of sensors, control systems, and propulsion mechanisms required to overcome the challenges posed by flood conditions.

CHAPTER 3

OBJECTIVES

Our project's objective is to develop a Bluetooth-based robot that assists in rescue operations during floods.The main goal is to detect and locate individuals who are trapped in various areas affected by the flood and provide them with food and medicine on a smaller scale. The gas sensor integrated into the robot is responsible for detecting and sensing any hazardous gases present in the flooded environment. Due to limited physical and financial resources, rural communities can effectively utilise this rescue assistance robot during flood situations. It is crucial to adopt a bottoms-up approach to disaster management, which includes Community-Based Disaster Management (CB-DRM).This approach aims to empower vulnerable communities and transform them into resilient ones, ensuring their active participation and involvement in disaster response and preparedness.The fishing community in particular plays a significant role in rescue operations, but they often spend a substantial amount of time engaged in these activities, highlighting their dedication and commitment to assisting those in need.

Our project focuses on providing users with access to telecommunications and transportation of essential supplies such as food, water, and first aid during flood situations.Our main objective is to locate and rescue trapped individuals by effectively identifying their locations and safely relocating them to refugee camps.During the 2018 flood, many people who were trapped and in desperate need of rescue had their mobile phones die after waiting for days.Relatives of the trapped individuals resorted to calling the police for assistance. However, rescue operations had to be halted at night due to safety concerns for the fishermen operating the boats in strong currents.Police sources also reported that the lack of necessary equipment, such as lights for conducting searches, hindered the efficiency of rescue operations.With the affected people's mobile phones not functioning or running out of power, wireless communication with the control room became the primary means of coordinating rescue efforts, but it too proved to be inefficient.

Considering these limitations and challenges, our project aims to develop an Bluetooth-based rescue assistance robot specifically designed for flood scenarios.This device will be capable of detecting the presence of trapped individuals, determining distances to obstacles, sensing hazardous gases, and even providing first aid through a small box.To facilitate control and monitoring, we plan to create an application interface through which users can manage the device's movements and access relevant information in real-time.By addressing these drawbacks and utilising advanced technology, our goal is to enhance the effectiveness and efficiency of flood rescue operations.

CHAPTER 4

DESIGNING PROCESS

To make a device or a rescue assistance robot, we need to think about or keep some important things at the forefront.This includes making the device float in water under any circumstances and not get under a heavy flow of water.Also, it should be easy for the person who is controlling it with a smartphone to understand the signal visible on the phone.The aim of our project has to be fulfilled, and the device should be able to detect people.The flood rescue robot is designed to assist in rescue operations during flood situations by detecting and locating trapped individuals, ensuring their safety, and providing necessary aid.The robot incorporates various sensors, including a gas sensor, Bluetooth module, ultrasonic sensor, and PIR sensor, to enable effective navigation, communication, and detection capabilities.For designing this the following requirements are considered.

4.1 Selection of material

The material used should be kept free from wetting or should be kept away from wetting.We are using PVC pipe, which helps the whole device float without getting wet.Also, we are planning to use the aluminium sheet to keep the component over the PVC pipe. We have a PIR sensor to sense living bodies and send the signal to the microcontroller. An ultrasonic sensor is used to sense the distance of a target from a robot.A gas sensor is also used for sensing amorphous gas levels.Motor drivers drive the motor for movement as per the instructions from the microcontroller.Wireless connectivity allows the robot to communicate with a mobile phone.Two shafts will provide for the propellers. We are choosing a 12V battery to power up the device and also using a Bluetooth module for the connection to our smartphone.

4.2 Designing the floating mechanism

First of all, we have made point-by-point drawings or outlines of all the components, indicating the shapes and sizes of the materials.The design should also include a protective casing to safeguard the sensors and electronic components.We also made a 3D image of the device prior to making it.Also, we have come to a conclusion defining the shape of the device and how it should be controlled.The design is drawn in ANSYS software.

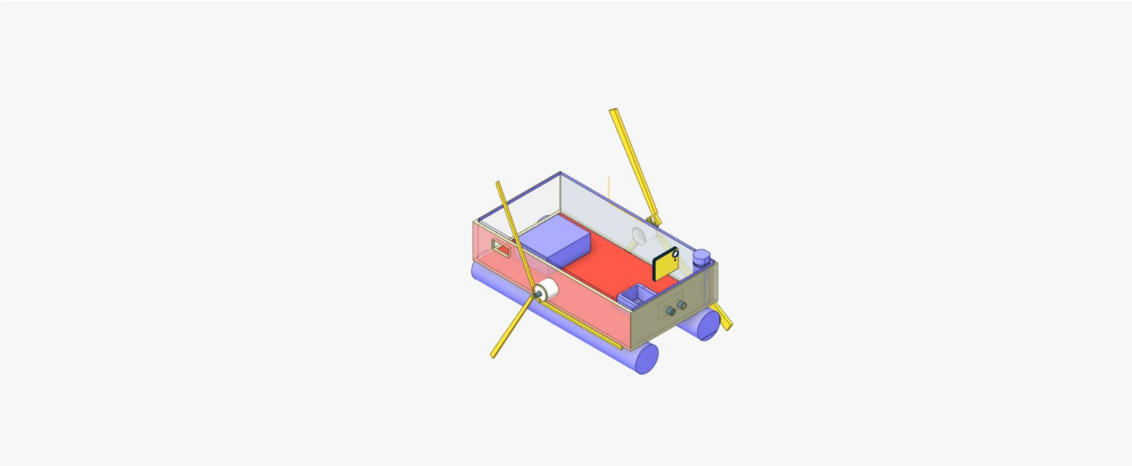

Figure 4.1: Design Layout

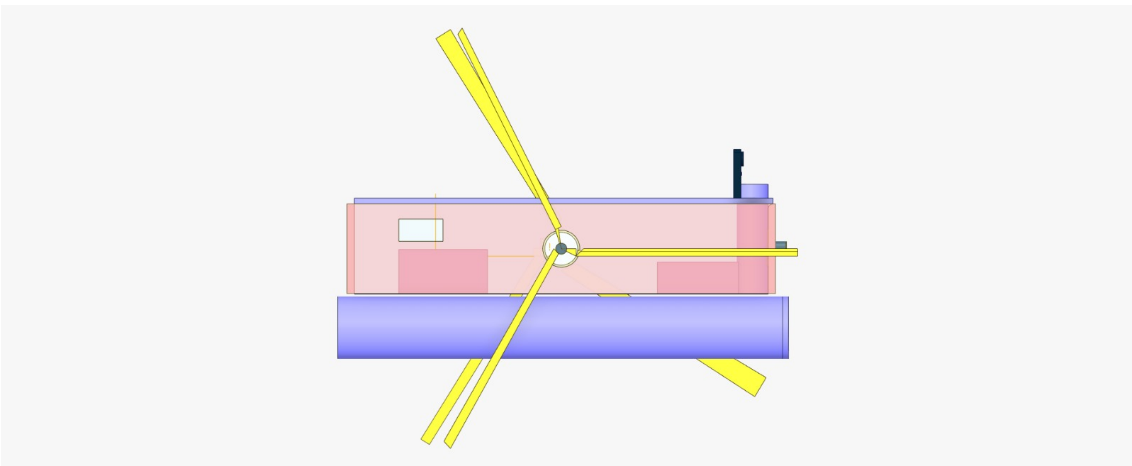

Figure 4.2: Side View

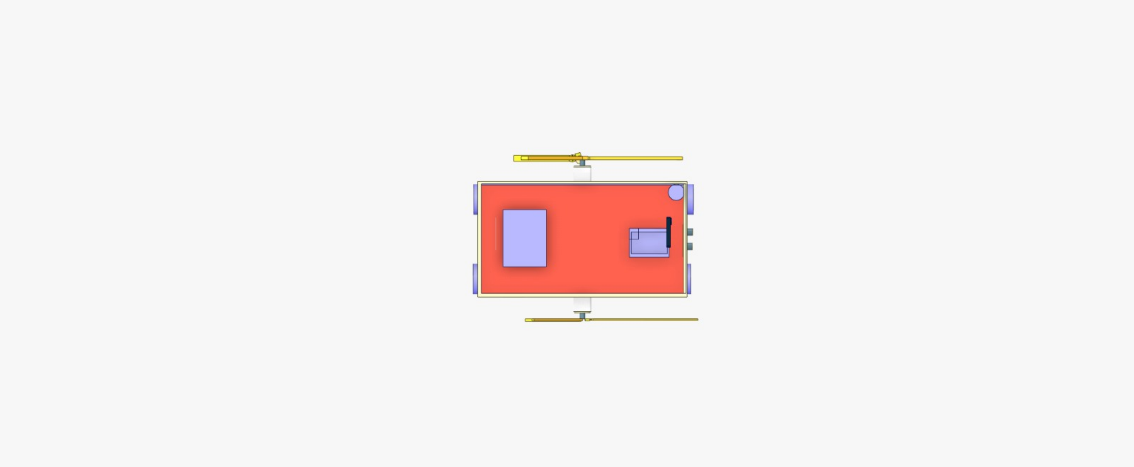

Figure 4.3: Top View

4.3 Testing the instrument

The first step in testing was to test it on water.This should be done after the placement of the aluminium sheet over the PVC pipes and after the placement of all the components over the sheet.The next step in testing is connecting and providing a power supply.After the power-up, i.e., after switching on the battery, we should check whether the components work effectively without fail.Also, we should use premium-quality products for the fabrication.In order to use the device, we should check the signals on our smartphones, as smartphone control is the key to accessing this device.

4.4 Refine and finalize the design

Based on the results of testing, the plan is finalised, and a few alterations, like including a cover for the camera, have been made.It is also guaranteed that the instrument is secure and can be used in an effective way.In general, the steps are decided by how long the houses are situated and at how much distance from the controller and one important thing to consider in designing is how many obstacles there are on the way the device travels.We need to think about how large the area is, how many houses are in that area, and how long the sensors work to sense people.Also, the device should not sink under any circumstances and people should react to the device.Sensors and other components should also not get wet.

4.5 Safety Feature

Incorporate safety mechanisms such as emergency stop buttons or fail safe systems to ensure the robot can be halted or deactivated in critical situations.Implement measures to protect the robot and its components from water damage, such as waterproof enclosures and sealing.

4.6 Control system and software

The robot's control system should include microcontrollers or a single board computer to process sensor data, control movements, and communicate with the rescue team. Develop appropriate software to implement algorithms for obstacle avoidance, gas detection, and human presence recognition.

CHAPTER 5

METHODOLOGY

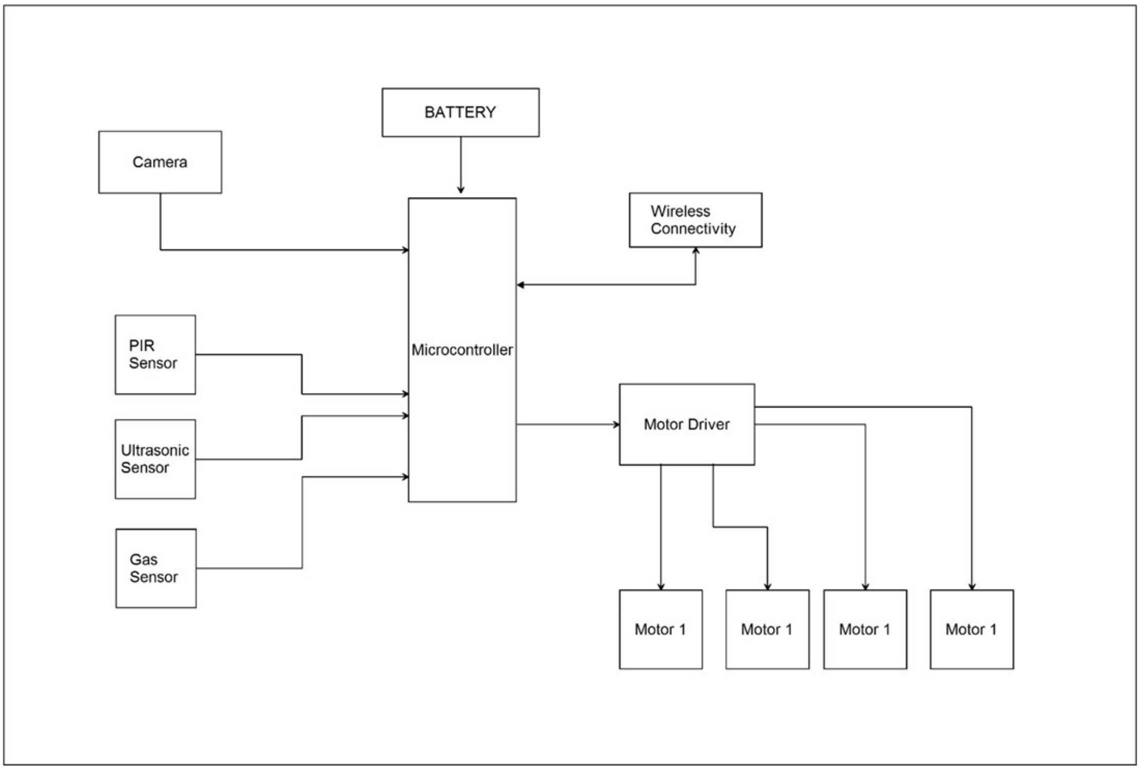

Figure 5.1: Block Diagram

The flood rescue robot integrates various components and sensors to perform its rescue operations.The main components include a PIR sensor, DC motors, gas sensor, Bluetooth module, ultrasonic sensor, and an Arduino microcontroller.The methodology outlines the step-by-step process of designing and implementing the flood rescue robot.

Design and Assembly

Start by designing the mechanical structure of the robot, considering factors such as stability, waterproofing, and mobility.Assemble the chassis, attach the DC motors, and connect them to the wheels or tracks for movement.Ensure the components are securely mounted and protected from water damage.

Sensor Integration

Connect the PIR sensor, gas sensor, ultrasonic sensor, and Bluetooth module to the Arduino microcontroller.Follow the respective datasheets and guidelines for proper wiring and connections.Use jumper wires or a breadboard for ease of prototyping.

Programming

Develop the Arduino code to control the robot's behavior based on sensor inputs.Write code to read data from the PIR sensor for human presence detection, gas sensor for gas level monitoring, and ultrasonic sensor for obstacle detection and distance measurement.Implement algorithms for obstacle avoidance, movement control, and communication via the Bluetooth module.

5.1 Circuit Diagram

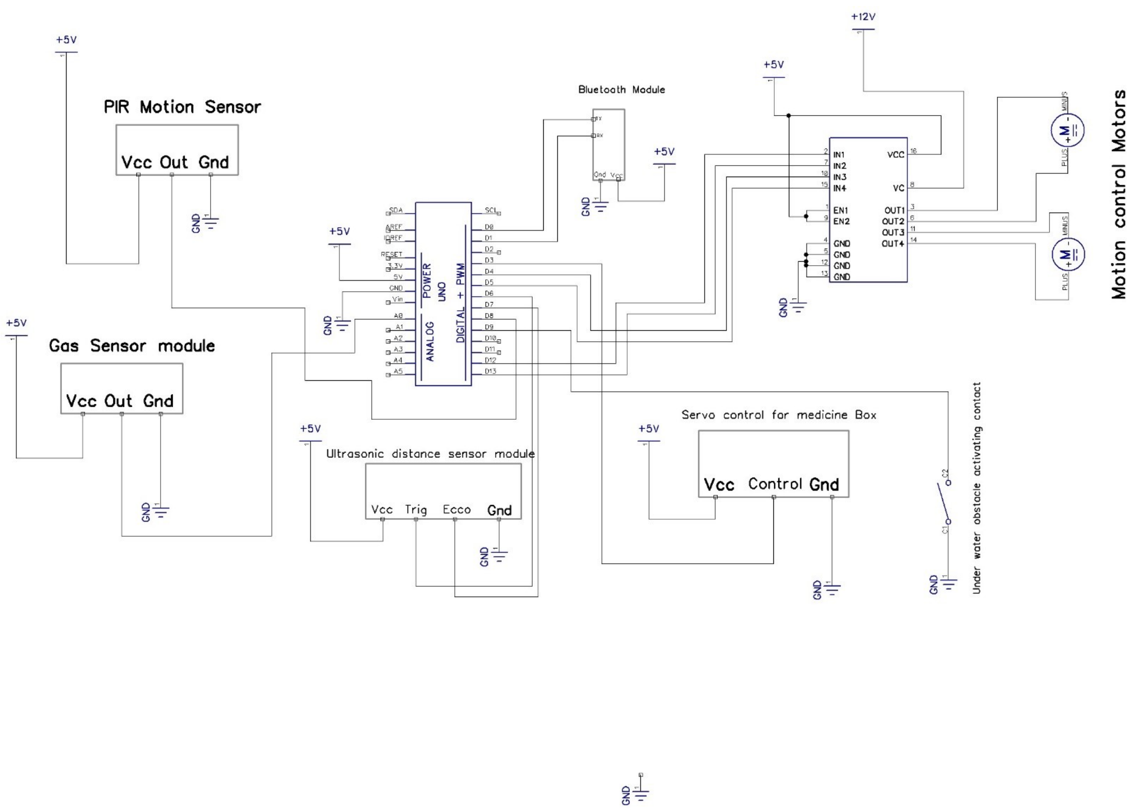

Figure 5.2: Circuit Diagram

The circuit diagram of a flood rescue robot typically includes the following components:

- **Arduino Microcontroller**: The central control unit of the robot, responsible for processing sensor data and controlling the robot's actions.
- **PIR Sensor**: A Passive Infrared (PIR) sensor detects human presence by sensing changes in infrared radiation.It is connected to the Arduino to detect and respond to trapped individuals.
- **Ultrasonic Sensor**: An ultrasonic sensor measures distance by emitting sound waves and calculating the time it takes for the waves to bounce back.It helps the robot detect obstacles and avoid collisions.
- **Gas Sensor**: The gas sensor is used to detect the presence of hazardous gases in the environment.It can be connected to the Arduino to monitor gas levels and trigger appropriate actions in case of high gas concentration.
- **Bluetooth Module**: A Bluetooth module enables wireless communication between the robot and a remote device, such as a smartphone or computer.It allows for data exchange and remote control of the robot.
- **Motor Driver**: The motor driver circuit is used to control the DC motors that drive the robot's movement.It takes input signals from the Arduino and provides the necessary power and control signals to the motors.
- **Power Supply**: The power supply circuit provides the required voltage and current to the Arduino, sensors, motor driver, and other components.It can be powered by batteries or an external power source.

The connections between these components can vary based on the specific requirements and design of the flood rescue robot.Generally, the sensors are connected to the Arduino's input pins, and the motor driver is connected to the output pins of the Arduino.The Bluetooth module is typically connected to specific digital or serial communication pins of the Arduino.

5.2 Components Used

5.2.1 Arduino Uno

The Arduino Uno is a popular microcontroller board that is part of the Arduino family.It is widely used by hobbyists, students, and professionals for a variety of projects.The Uno is based on the ATmega328P microcontroller and offers a simple and user-friendly platform for prototyping and experimenting with electronics.It features a set of digital and analog input/output pins, allowing users to connect and control various sensors, actuators, and other components.The Uno can be programmed using the Arduino IDE (Integrated Development Environment), which offers a simplified programming language based on C/C++.It can be powered via USB or an external power supply, making it versatile and portable.The board also includes built-in LEDs and a reset button for easy debugging and programming. Overall, the Arduino Uno is an excellent choice for beginners and experienced users alike, providing a solid foundation for exploring the world of electronics and programming.The ATmega328 microcontroller on the Arduino Uno is a 8-bit AVR microcontroller with 32KB of flash memory for storing code, 2KB of SRAM for data storage, and 1KB of EEPROM for non-volatile data storage. The microcontroller also includes a range of peripherals, including analog-to-digital converters (ADCs), timers, and serial interfaces, making it a powerful platform for a wide range of projects.

Figure 5.3: Arduino Uno

5.2.2 L298N Motor Driver

The L298N is a popular motor driver integrated circuit (IC) that can control and drive DC motors or stepper motors.The L298 motor driver IC can control two DC motors or one bipolar stepper motor.It provides bidirectional control, which means it can make the motors rotate in both forward and reverse directions.The L298N IC utilizes an H-bridge configuration to control the motor direction and speed.An H-bridge is a circuit arrangement that allows current to flow in either direction through the motor, enabling control over its rotation.The L298N IC utilizes an H-bridge configuration to control the motor direction and speed.An H-bridge is a circuit arrangement that allows current to flow in either direction through the motor, enabling control over its rotation. The L298N

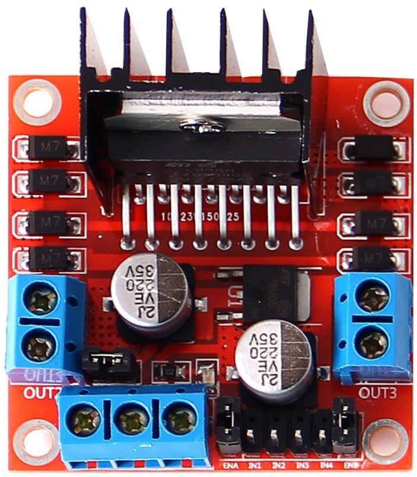

Figure 5.4: L298N Motor Driver

allows speed control of the motors through pulse width modulation (PWM) signals.By varying the duty cycle of the PWM signal applied to the control pins,can adjust the motor speed.The L298N has built-in current sensing functionality, which allows you to monitor the current being drawn by the motors.This feature can be useful for protecting the motors from excessive current or for feedback control in certain applications.

5.2.3 Ultrasonic Sensor

The HC-SR04 is an ultrasonic sensor that is commonly used for distance measurement in robotics and automation projects.It works by sending out an ultrasonic pulse and measuring the time it takes for the pulse to bounce back after hitting an object.The sensor has two main components: a transmitter and a receiver.The transmitter sends out the ultrasonic pulse, which is typically a 40 kHz signal.The pulse is then reflected off of an object and received by the sensor's receiver.The time it takes for the pulse to travel to the object and back is used to calculate the distance to the object. The HC-SR04 sensor has four pins: VCC, GND, Trig, and Echo. VCC and GND are used to power the sensor. Trig is the trigger pin, which is used to send out the ultrasonic pulse, and Echo is the echo pin, which is used to receive the reflected pulse. To use the HC-SR04 sensor, need to send a 10 µs pulse to the Trig pin.This will initiate the ultrasonic pulse, which will bounce off of an object and be received by the Echo pin.The time it takes for the pulse to travel to the object and back can be calculated using the following formula:

Distance = (T * Speed of Sound) / 2

where T is the time it takes for the pulse to travel to the object and back, and Speed of Sound is the speed of sound in air, which is approximately 343 meters per second at room temperature.

Figure 5.5: Ultrasonic Sensor

5.2.4 12V DC Motor

A 12-volt geared DC motor is a type of electric motor that is specifically designed to operate on a 12-volt power supply.It is commonly used in a wide range of applications that require moderate power and precise control over rotational speed and torque.The motor consists of two main components: the DC motor itself and a gearbox.The DC motor is the primary component responsible for converting electrical energy into mechanical energy.It operates based on the principle of electromagnetic induction, where the interaction between a magnetic field and electric current produces rotational motion.The motor is designed to operate on a 12-volt DC power supply, which can be obtained from batteries, power supplies, or other electrical sources.

The gearbox is attached to the motor shaft and serves the purpose of controlling the motor's speed and torque output.It consists of a series of gears with different sizes and arrangements.The gears transmit the rotational motion from the motor to the output shaft, effectively increasing or decreasing the speed and torque according to the gear ratio.The gear ratio determines the relationship between the rotational speed of the motor shaft and the output shaft.By changing the gear ratio, the motor's speed and torque can be adjusted to suit specific requirements of the application.

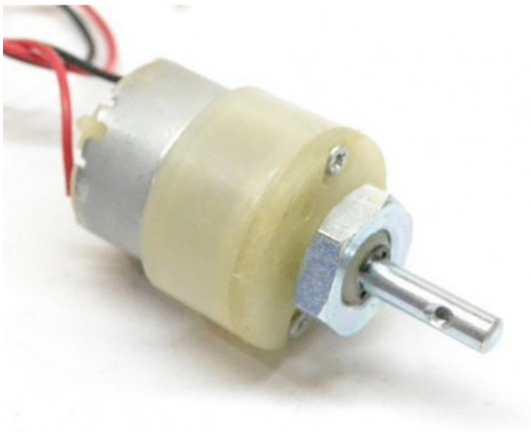

Figure 5.6: DC Motor

5.2.5 Servo Motor

A servo motor is a type of rotary actuator that provides precise control over angular position, velocity, and acceleration.It is commonly used in various applications that require accurate and efficient motion control, such as robotics, industrial machinery, and automation systems.The SG90 servo motor operates on a pulse width modulation (PWM) signal, which is a type of digital signal that varies in its duty cycle.The duty cycle of the signal determines the angle of rotation of the servo motor.Typically, a 50Hz PWM signal is used to control the SG90 servo motor, with a pulse width between 1ms and 2ms.The SG90 servo motor has three input pins: VCC, GND, and SIGNAL. VCC and GND are used to power the motor, typically with a voltage between 4.8V and 6V.The SIGNAL pin is used to receive the PWM signal that controls the angle of rotation of the servo motor. The SG90 servo motor has a rotational range of 180 degrees, which means that it can rotate from 0 degrees to 180 degrees. It also has a torque rating of approximately 1.5 kg/cm, which makes it suitable for small robotic applications.To use the SG90 servo motor, you need to connect it to a microcontroller or other control device, such as an Arduino. You will also need to program the microcontroller to generate the appropriate PWM signal to control the angle of rotation of the servo motor.

Figure 5.7: Servo Motor

5.2.6 PIR Sensor

A PIR (Passive Infrared) sensor is a type of motion sensor that detects changes in infrared radiation in its surroundings.PIR sensors are often used in security systems, automatic lighting systems, and other applications where motion detection is required.The sensor works by detecting the infrared energy emitted by an object.When an object with a temperature higher than its surroundings moves within the sensor's range, the sensor detects a change in the amount of infrared radiation it detects and triggers an action, such as turning on a light or sounding an alarm.

Figure 5.8: PIR Sensor

5.2.7 Gas Sensor MQ135

The MQ135 is a gas sensor that is commonly used for air quality monitoring and pollution detection in indoor environments.It is designed to detect a wide range of gases, including ammonia, nitrogen oxides, benzene, smoke, and carbon dioxide.The MQ135 sensor works on the principle of gas conductivity.It has a small heating element inside that heats up a sensing material, typically tin dioxide, which is sensitive to certain gases. When a gas comes into contact with the sensing material, its conductivity changes, which can be measured by the sensor. The MQ135 sensor has four pins: VCC, GND, AOUT, and DOUT. VCC and GND are used to power the sensor, typically with a voltage between 5V and 7V.AOUT is the analog output pin, which provides a voltage proportional to the gas concentration.DOUT is the digital output pin, which can be used to trigger an alarm when the gas concentration exceeds a certain threshold.

Figure 5.9: Gas Sensor MQ315

5.2.8 HC-05 Bluetooth Module

The HC-05 is a popular Bluetooth module commonly used for wireless com- munication in various electronic applications.The HC-05 module is designed to establish a wireless Bluetooth connection between devices. It uses the Bluetooth protocol to enable communication over short distances, typically up to 10 meters (or around 30 feet). The HC-05 module interfaces with other devices using a serial communication protocol known as UART (Universal Asynchronous Receiver-Transmitter).It supports both the UART data transmission (TX and RX) and control signals. The HC-05 module can operate in two modes: Master and Slave

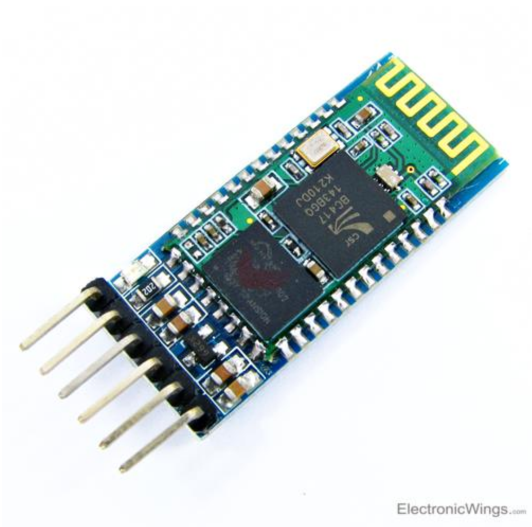

Figure 5.10: HC-05 Bluetooth Module

CHAPTER 6

FABRICATION

The device consists of four motors, motor driver, gas sensor, ultrasonic sensor, and a leave switch at the bottom for underwater defection, PIR (Passive Infrared Sensor) for human detection, a medicine box which can be opened by a servo motor, a 12 V battery as the source of power supply, a bluetooth module for controlling the device using mobile phone.

After connecting the device to the battery, connect the device to the smart phone app. It can be used to control the direction of the device while it is in water.After turning on the device and waiting for two minutes, we can check for gas leakage, human detection, and distance measurement.The medicine box can also be opened and closed using our smartphone, according to our needs.The base is made from aluminium sheet, which was cut into the needed dimensions and packed using packing paper.So as to float the aluminium sheet in water, a base is made with PVC pipes.To prevent water from entering the pipe, the ends of the pipe were closed using end caps, and it was sealed using solvent.Screw holes were made using a drill bit to fix the needed equipment into their positions, and they were screwed to the aluminium sheet.Arduino was used to create an interface for the sensors used in the device.Since fabrication is the process of making the initial design of the model, we have made sure components work efficiently and have been tested.And after that, each sensor was placed in its respective position.The shafts are controlled by motors, which are placed at the centre of the aluminium sheet.

The limit switch is placed at the front, and it is given support as well.In a practical case, a wire from the limit switch is extended so as to place it under water.Every sensor and the necessary components are connected using wires, and we have made sure that the wires are aligned in such a way that they don’t get tangled and are arranged properly.For getting live visuals, a phone holder is attached to the device’s front, and an IP camera is placed in it to provide live visuals.

CHAPTER 7

RESULTS

The flood rescue robot continuously reads data from the PIR sensor, ultrasonic sensor, and gas sensor connected to the Arduino.The PIR sensor detects human presence, the ultrasonic sensor measures distance to obstacles, and the gas sensor monitors gas levels in the environment.Based on the readings from the ultrasonic sensor, the robot determines the presence and distance of obstacles in its path.If an obstacle is detected within a certain range, the robot adjusts its movement to avoid collisions.This is achieved by controlling the motors using the motor driver.The PIR sensor detects human presence within its field of view. When human presence is detected, the robot prioritizes rescue operations in that area.It can alert the rescue team and focus its efforts on reaching and assisting the trapped individuals.The gas sensor continuously measures the gas levels in the environment.If the gas levels exceed a predetermined threshold, indicating the presence of hazardous gases, the robot takes appropriate action.It can trigger an alarm, halt its movement, and notify the rescue team via the Bluetooth module.The Arduino communicates with a remote device, such as a smartphone or a computer, using the Bluetooth module.The robot sends sensor data, including gas levels, obstacle detection information, and human presence detection, to the remote device.It can also receive commands from the remote device to control its movement and actions.

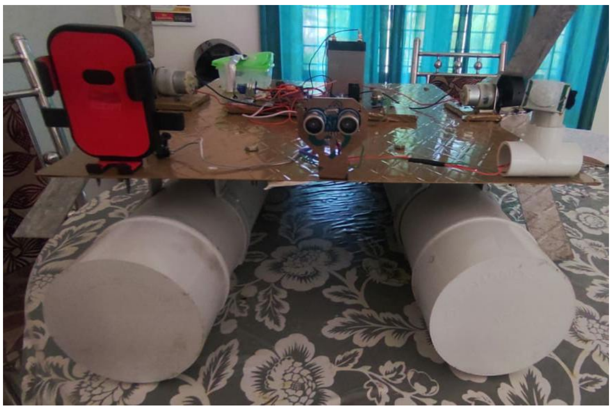

Figure 7.1: Front View

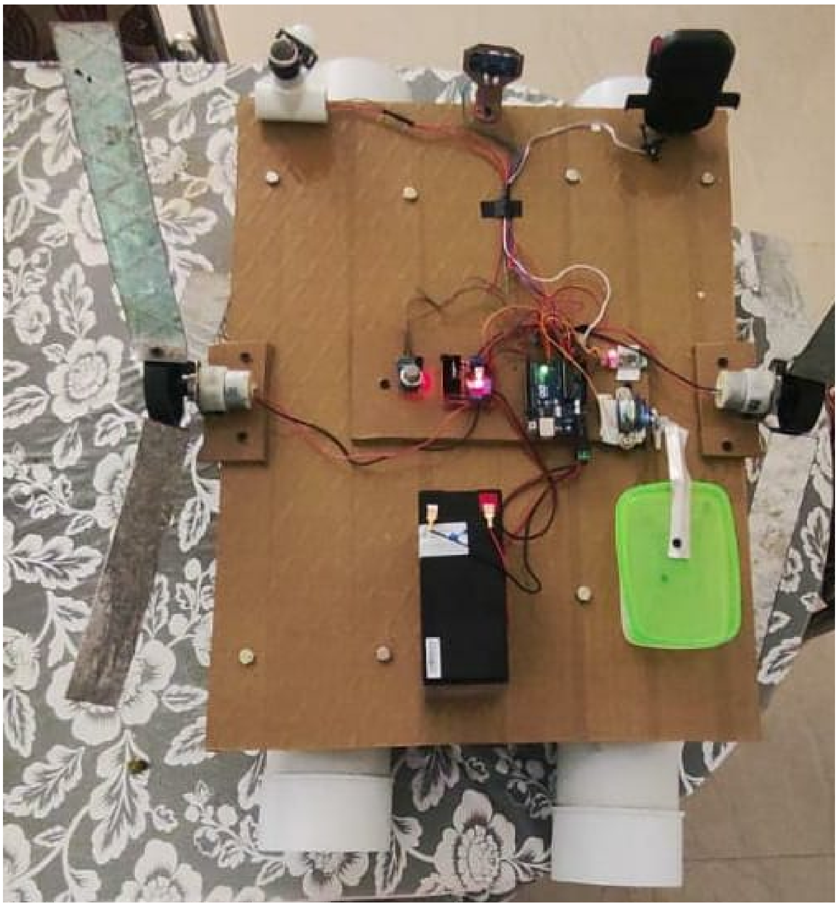

Figure 7.2: Top View

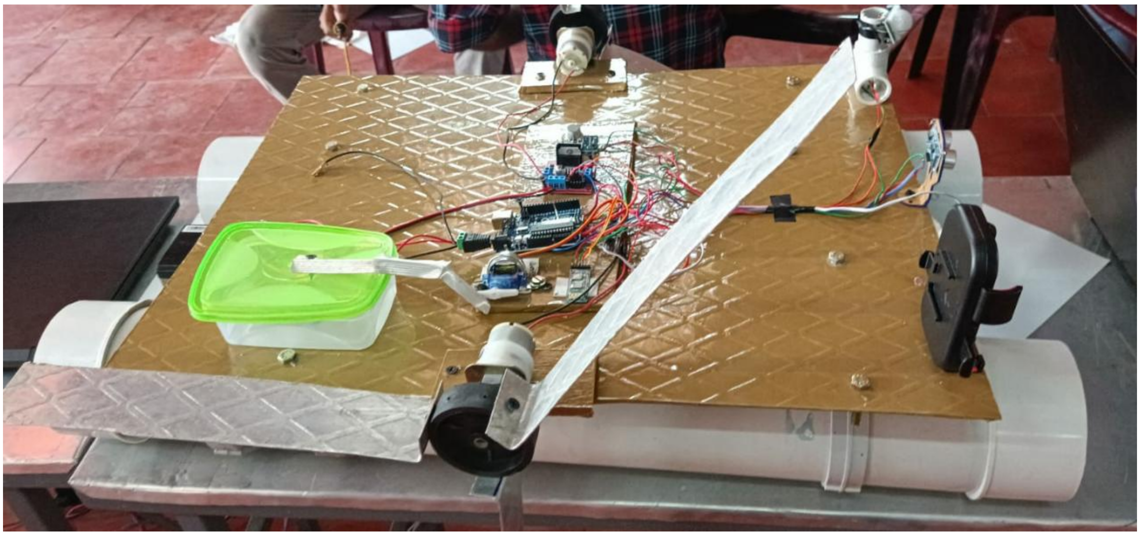

Figure 7.3: Side View

7.1 App Interface

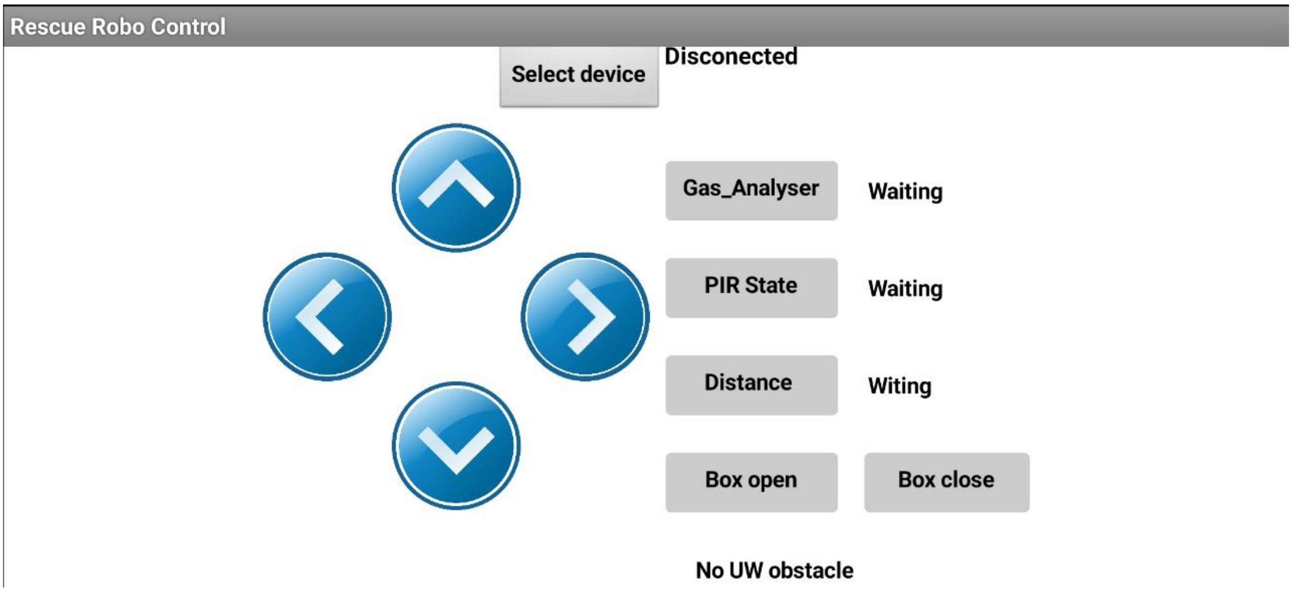

Figure 7.4: App Interface of Flood rescue robot

7.2 App Code Blocks

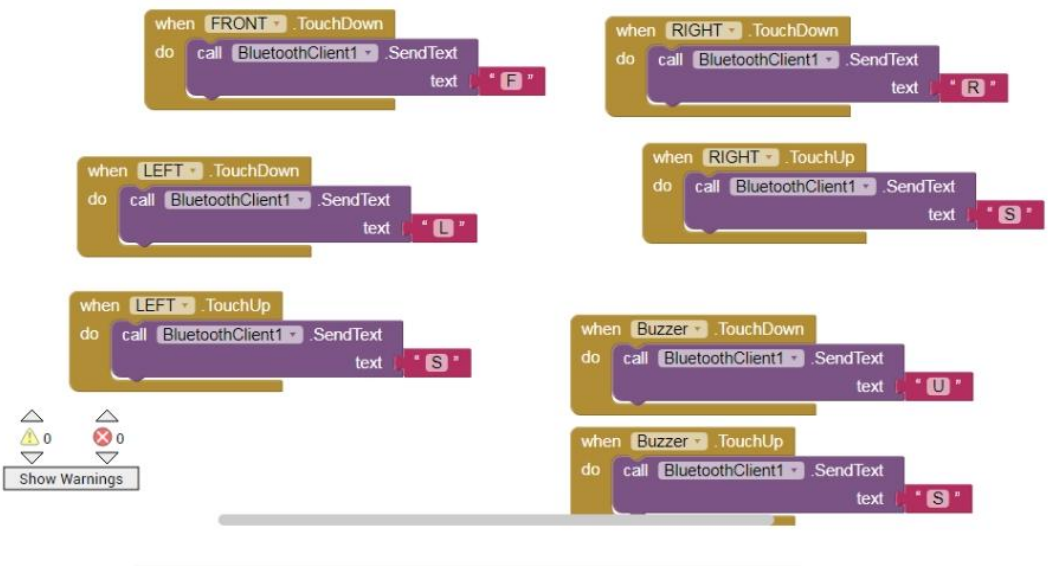

Figure 7.5: Command Block

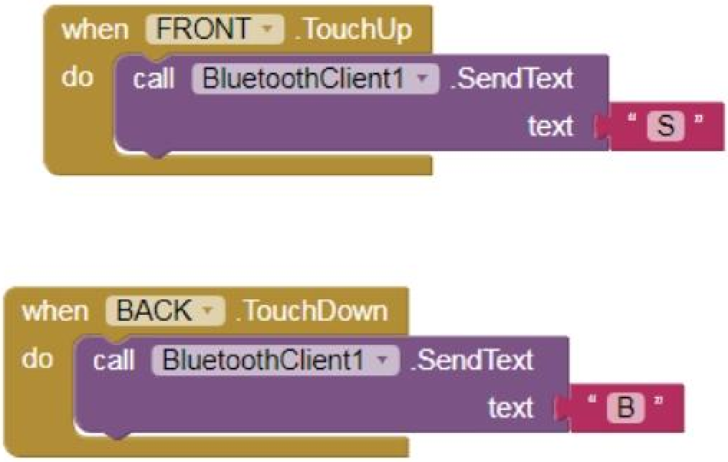

Figure 7.6: Command Block for front& back

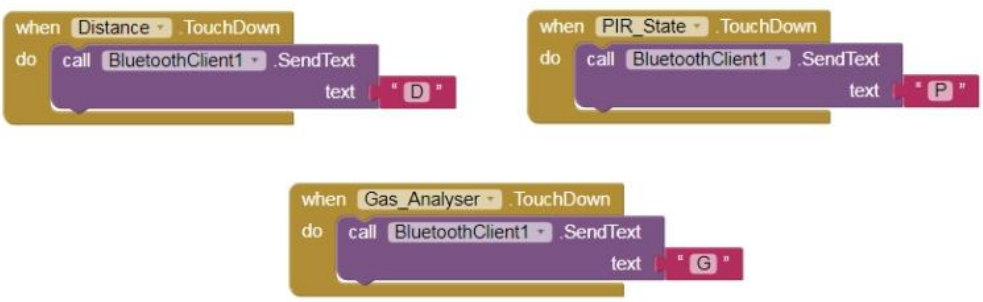

Figure 7.7: Command Block for Sensors

CHAPTER 8

FUTURE SCOPE

The future scope of a flood rescue robot is very promising and can be expanded in various directions.Some potential areas of development and improvement include:

1. **Intelligent Navigation and Mapping**: Implement advanced algorithms for navigation and mapping to enable the robot to autonomously navigate through complex flood environments.Use SLAM (Simultaneous Localization and Mapping) techniques to create detailed maps of the surroundings and plan optimal paths for rescue operations.

2. **Remote Monitoring and Control**: Enhance the communication capabilities of the robot by integrating advanced wireless technologies, such as 5G or satellite communication.Enable remote monitoring and control of the robot's actions, sensor readings, and video feed from a central command center, facilitating real-time decision-making.

3. **Autonomous Rescue Actions**: Equip the robot with advanced AI and machine learning algorithms to autonomously identify and prioritize rescue actions based on situational analysis.Enable the robot to make intelligent decisions, such as assessing the severity of the situation, determining the best rescue strategy, and adapting to changing conditions.

4. **Integration with IoT and Cloud Services**: Explore the integration of the flood rescue robot with IoT (Internet of Things) platforms and cloud services.This integration can enable real-time data sharing, remote monitoring, and seamless integration with existing rescue infrastructure and systems.

5. **Swarm Robotics**: Explore the concept of swarm robotics, where multiple flood rescue robots collaborate and communicate with each other to improve efficiency and coverage in rescue operations. Develop algorithms for coordinated movement, task allocation, and information sharing among the swarm of robots.

CHAPTER 9

CONCLUSION

The main aim of this paper was to construct a "Rescue Robot," which provides the service of rescue operations during flood season.We have designed and developed a model robot that can sense people, distance, obstacles, and various other functions.This is a low-cost service robot that can be designed and used for rescue operations.The development of a flood rescue robot using a PIR sensor, an ultrasonic sensor, a Bluetooth module, an Arduino, a motor driver, and a gas sensor offers a promising solution to enhance rescue operations during flood situations.The integration of these components enables the robot to effectively detect trapped individuals, navigate through obstacles, communicate with rescue teams, and monitor gas levels in the flooded area.Through the successful integration of these components, the flood rescue robot offers an efficient and reliable solution for locating and rescuing individuals in flood-affected areas.Its ability to navigate challenging terrain, detect human presence, communicate with rescue teams, and monitor gas levels significantly improves the effectiveness and safety of rescue operations.

However, further improvements can be made in terms of optimising the robot's design, enhancing the accuracy of sensors, refining algorithms for obstacle avoidance and gas detection, and improving the range and stability of Bluetooth communication.Additionally, rigorous testing and continuous development are necessary to ensure the robot's reliability and effectiveness in real-world flood scenarios.Overall, the flood rescue robot serves as a valuable tool in saving lives during flood emergencies, offering a combination of technology, automation, and efficient rescue capabilities to mitigate the impact of such natural disasters.

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APPENDIX

CODE:

```
#include <Servo.h>
int gas_value=0;
int servoPin = 3;
Servo Servo1;
const int MRH=4;
const int MRL=5;
const int MLH=6;
const int MLL=7;
const int buzzer=12;
const int pir=10;
const int trigPin =8;
const int echoPin =9;
const int underobstacle=2;
int distance;
long duration;
void setup()
{
    Serial.begin(9600);
    Servo1.attach(servoPin);
    pinMode(underobstacle,INPUT);
    pinMode(trigPin,OUTPUT);
    pinMode(echoPin,INPUT);
    pinMode(pir,INPUT);
    pinMode(buzzer,OUTPUT);
    pinMode(MRH,OUTPUT);
    pinMode(MRL,OUTPUT);
    pinMode(MLH,OUTPUT);
    pinMode(MLL,OUTPUT);
```

```
digitalWrite(MRH,LOW);
digitalWrite(MRL,LOW);
digitalWrite(MLH,LOW);
digitalWrite(MLL,LOW);
}
void loop()
{
gas_value=analogRead(A0);
if(digitalRead(underobstacle)==LOW)
{
delay(200);
if(digitalRead(underobstacle)==LOW)
{
digitalWrite(MRH,LOW);
digitalWrite(MRL,LOW);
digitalWrite(MLH,LOW);
digitalWrite(MLL,LOW);
Serial.print('Q');
delay(5000);
}
else
{
delay(1);
}
}
else
{
delay(1);
}
if (Serial.available() > 0)
{
int inByte = Serial.read();
switch (inByte)
```

```
{
case 'U':Servo1.write(90);
break;
case 'Z':Servo1.write(0);
delay(1000);
break;
case 'D':digitalWrite(trigPin,LOW);
delayMicroseconds(2);
digitalWrite(trigPin,HIGH);
delayMicroseconds(10);
digitalWrite(trigPin,LOW);
duration =pulseIn(echoPin,HIGH);
distance = duration*0.034/2;
Serial.print('');
Serial.print(distance);
break;
case 'P':
if(digitalRead(pir)==HIGH)
{
Serial.print("Human Detetcted");

else
{
Serial.print("No HumanDetetcted");
}
break;
case 'G':
if(gas_value > 220)
{
Serial.print("Danger Gas Dettected");
}
else
{
```

```
Serial.print("Safe to stay");
}
break;
case ’S’:
digitalWrite(MRH,LOW);
digitalWrite(MRL,LOW);
digitalWrite(MLH,LOW);
digitalWrite(MLL,LOW);
digitalWrite(buzzer,LOW);
break;
case ’F’:
digitalWrite(MRH,HIGH);
digitalWrite(MRL,LOW);
digitalWrite(MLH,HIGH);
digitalWrite(MLL,LOW);
break;
case ’B’:
digitalWrite(MRH,LOW);
digitalWrite(MRL,HIGH);
digitalWrite(MLH,LOW);
digitalWrite(MLL,HIGH);
break;
case ’R’:
digitalWrite(MRH,LOW);
digitalWrite(MRL,HIGH);
digitalWrite(MLH,HIGH);
digitalWrite(MLL,LOW);
break;
case ’L’:
digitalWrite(MRH,HIGH);
digitalWrite(MRL,LOW);
digitalWrite(MLH,LOW);
digitalWrite(MLL,HIGH);
```

```
break;
default:
}
delay(1000); }
}
```