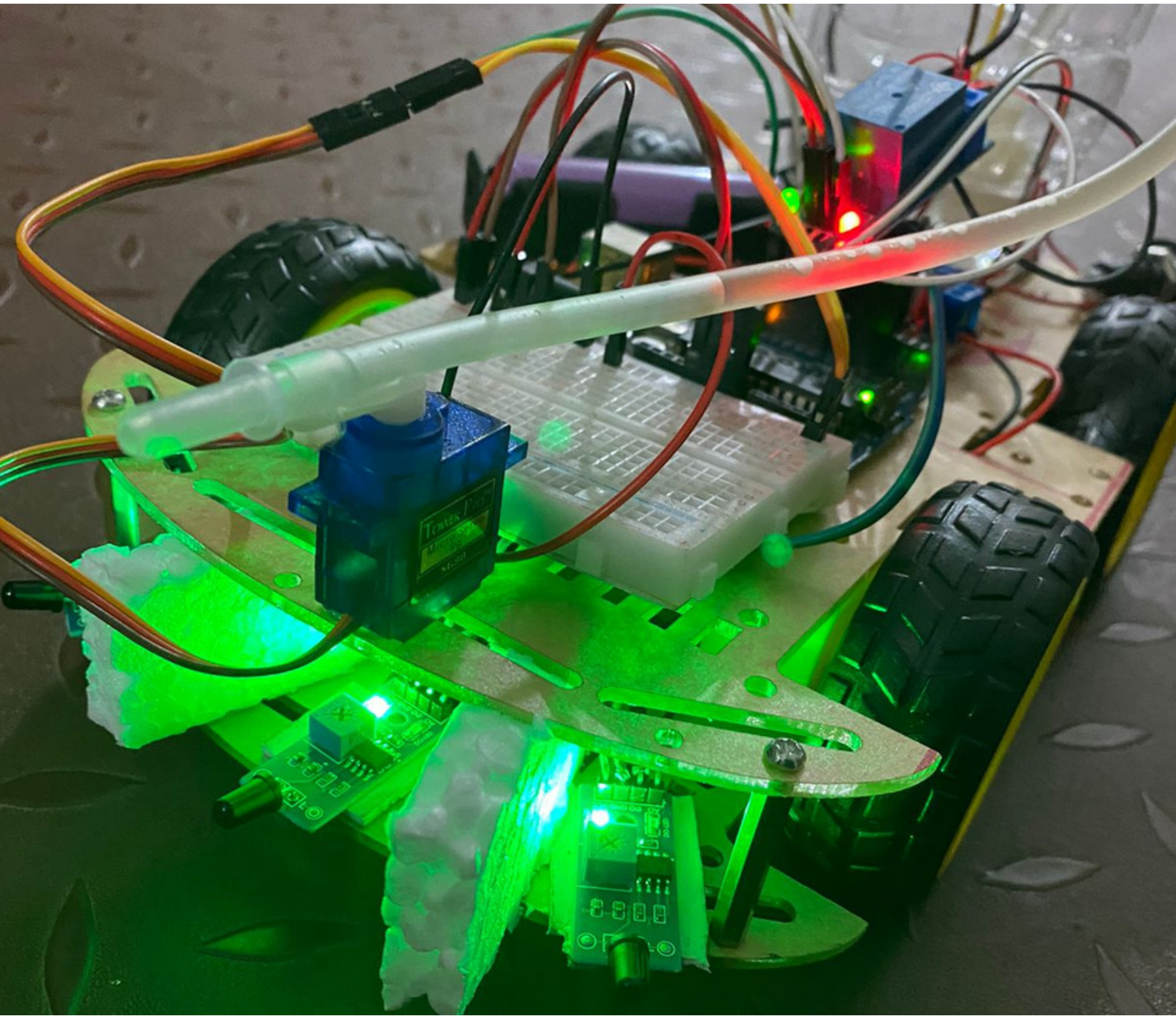


FIRE FIGHTING ROBOT

PROJECT REPORT

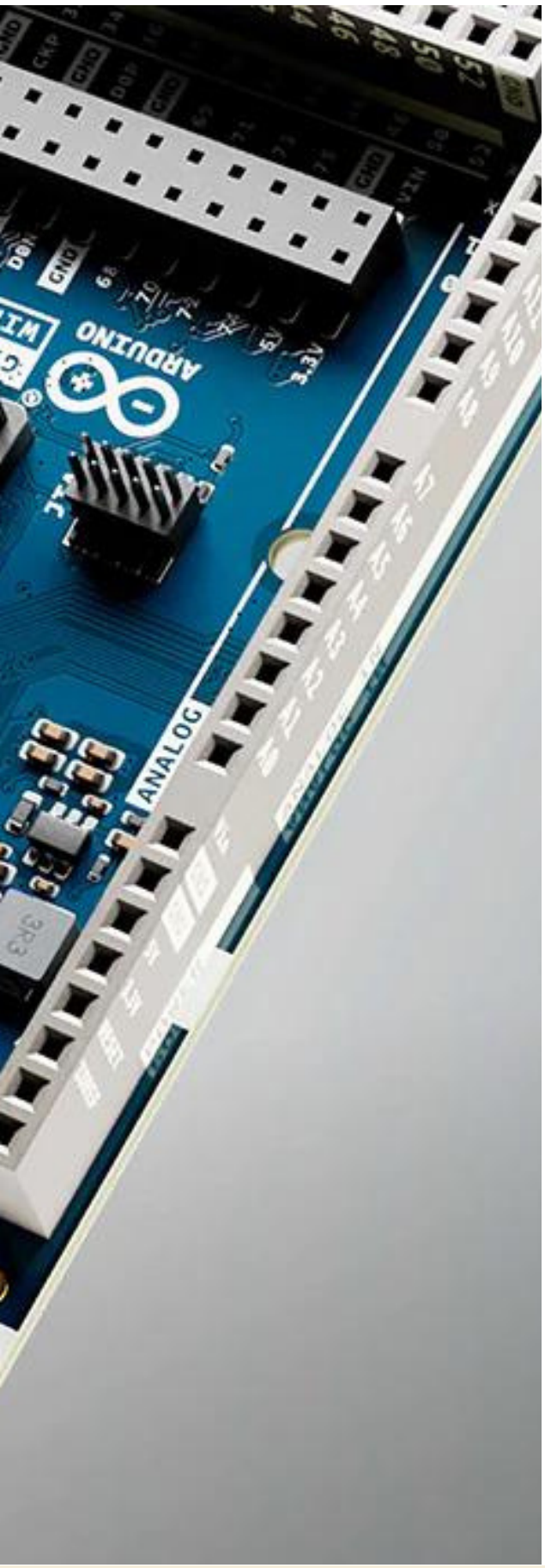
ICT 305 2.0 EMBEDDED SYSTEMS
B.A.L.RASADI
AS2020903

ACKNOWLEDGMENT

I would like to express my sincere gratitude to everyone who contributed to this project. Your dedication and hard work were instrumental in its success. Thank you for your valuable support and collaboration.

I wanted to thank Mr. M.D.R. Perera, Senior Lecturer in the Department of Computer Science at the Faculty of Applied Science, University of Sri Jayewardenepura, for his profound knowledge, which inspired me to complete my project.

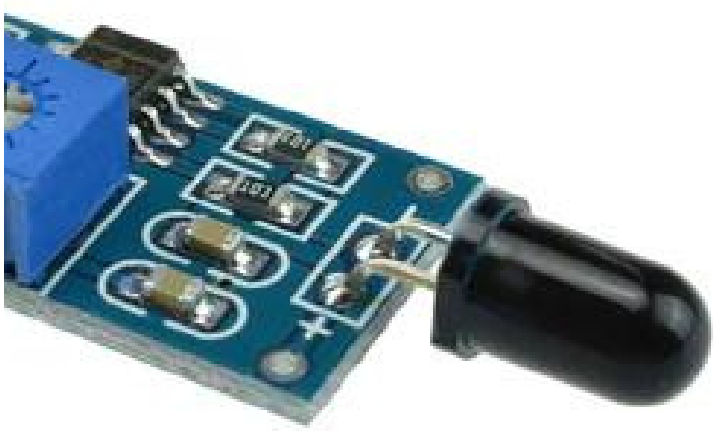
CONTENTS



INTRODUCTION

In a world where the risk of fire incidents is ever-present, technological innovation plays a crucial role in ensuring safety and efficient response. One such innovation is the Firefighting Robot powered by Arduino, a remarkable example of how robotics and electronics can be harnessed to combat fires effectively.

This cutting-edge project combines the precision and versatility of Arduino microcontrollers with a range of sensors, actuators, and mechanical components to create an autonomous robot capable of navigating through challenging environments and extinguishing fires. This technology has the potential to minimize human exposure to dangerous situations and enhance the efficiency of firefighting operations.



In this article, we will delve into the fascinating world of Firefighting Robots powered by Arduino. We'll explore the key components, design considerations, and programming logic required to build a functional firefighting robot. Whether you're a hobbyist, a student, or a professional looking to enhance your firefighting capabilities, this project offers valuable insights into the future of fire response technology. Let's embark on this exciting journey to understand how Arduino can be used to save lives and protect property from the destructive forces of fire.

OBJECTIVES

Fire Detection:
Implement a reliable fire detection system using sensors like flame detectors, temperature sensors, or smoke detectors to identify the presence of a fire.

Fire Suppression:
Equip the robot with a fire suppression system, such as a water pump, fire extinguisher, or fire retardant to extinguish or contain the fire.

Battery Management:
Develop an efficient power management system to extend the robot's operational time and ensure it can function during rescue operations

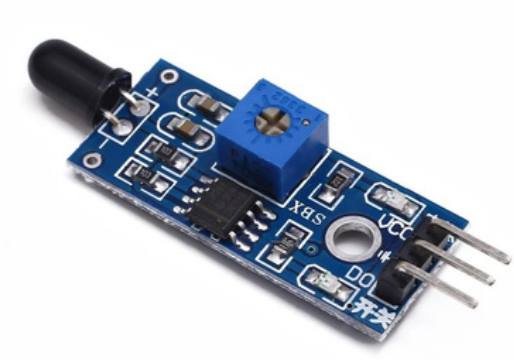
User-Friendly Interface:
Create a user-friendly control interface for the robot, making it easy for operators to interact with and control its functions.

Real-Time Data Streaming:
Enable real-time data streaming from the robot, allowing firefighters to assess the situation and make informed decisions.

Cost-Effective Design:
Aim for a cost-effective solution to make the fire-fighting robot accessible to a wider range of organizations and communities.

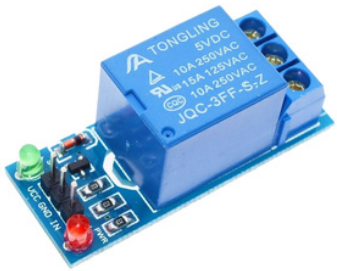
HARDWARE DESCRIPTION

FLAME SENSOR



I used this because, flame sensor is a specialized device designed to detect the presence of flames or fire. Utilizing infrared radiation detection, it identifies the characteristic wavelength emitted by flames. Commonly employed in various applications, such as fire safety systems and robotics, it provides a reliable means of flame detection for prompt response.

RELAY MODULE

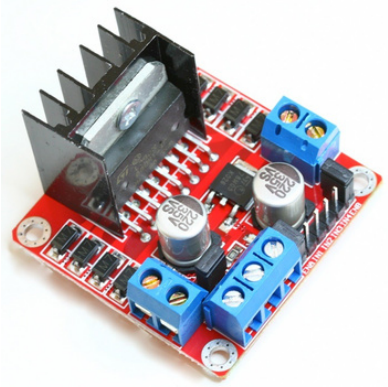


A relay module is an electronic switch that uses an electromagnet to control high-voltage circuits with a low-voltage microcontroller, like Arduino. It acts as an intermediary, allowing a low-power device to control larger loads, making it ideal for home automation, robotics, and industrial applications by isolating control and power circuits.

SERVO MOTOR

I used servo motor to respond to signals from a controller, it moves to and holds a specific position, making it widely used in robotics, automation, and mechatronics for its accurate and controlled motion capabilities.

MOTOR DRIVE

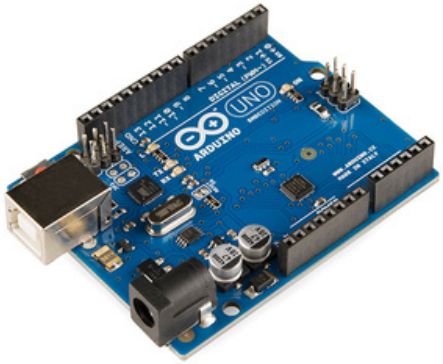


A motor drive is an electronic device that powers and controls electric motors. It regulates the speed, direction, and torque of the motor based on input signals from a controller. Essential in various applications like robotics and industrial machinery, motor drives optimize motor performance, ensuring efficient and precise operation.

HARDWARE DESCRIPTION

ARDUINO UNO

The Arduino Uno board is favored for its user-friendly design, making it accessible for both beginners and experts in electronics. With a versatile range of digital and analog pins, USB connectivity, and a large supportive community, the Arduino Uno is ideal for prototyping and developing diverse projects, from simple experiments to complex innovations.



SWITCH

I used on off switches to control the power that is given to the water pump and the Arduino board.

BATTERY 3.7V

I used batteries to power the circuit and the motor which is in the robot.

MINI WATER PUMP

I used mini water pumps to transport water effectively, mini water pumps are essential for maintaining controlled water flow in constrained spaces. And it is With low power consumption.

HARDWARE DESCRIPTION

JUMPER WIRES

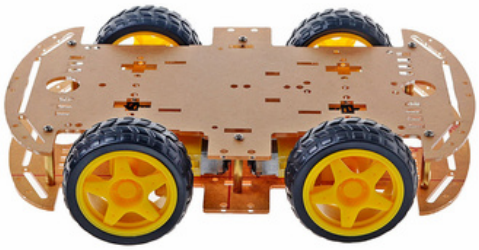
I used Jumper wires for creating temporary connections between components on a breadboard and circuit. Their flexibility and ease of use simplify prototyping, allowing quick adjustments and testing without soldering.

MOTOR

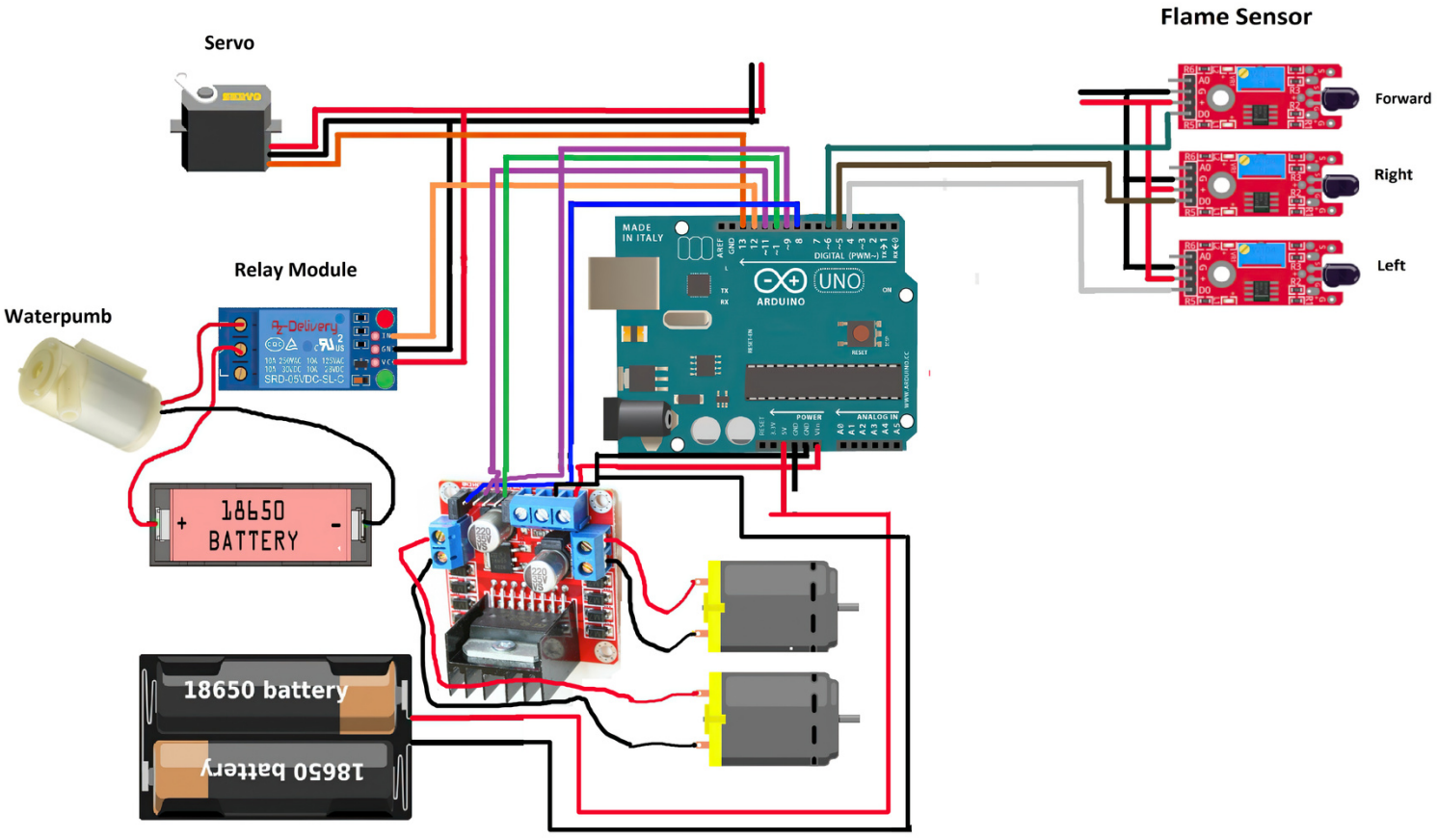
Motors were used in the car chassis on the tyres and in the water pump.

4 WHEEL CAR CHASSIS

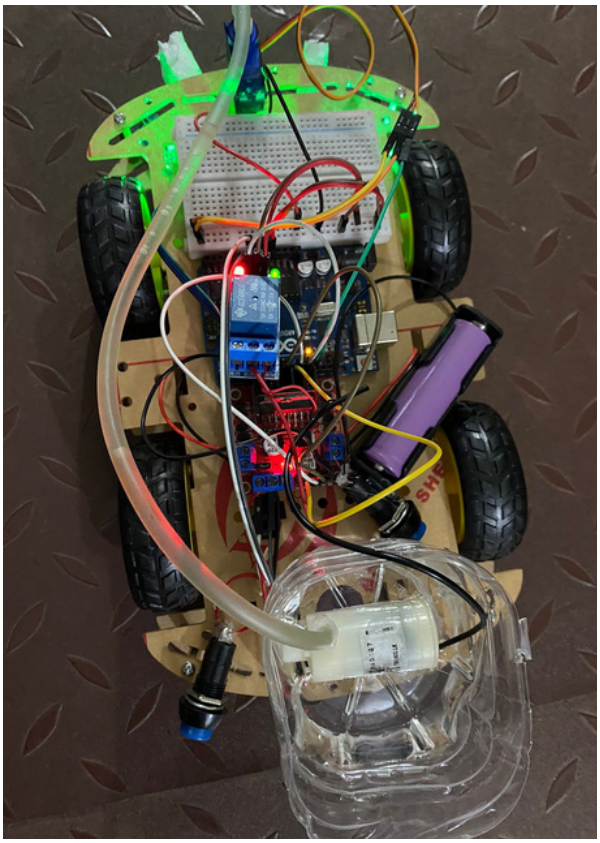
This was used to carry the circuit and the system and also to drive the robot to the place where fire is.

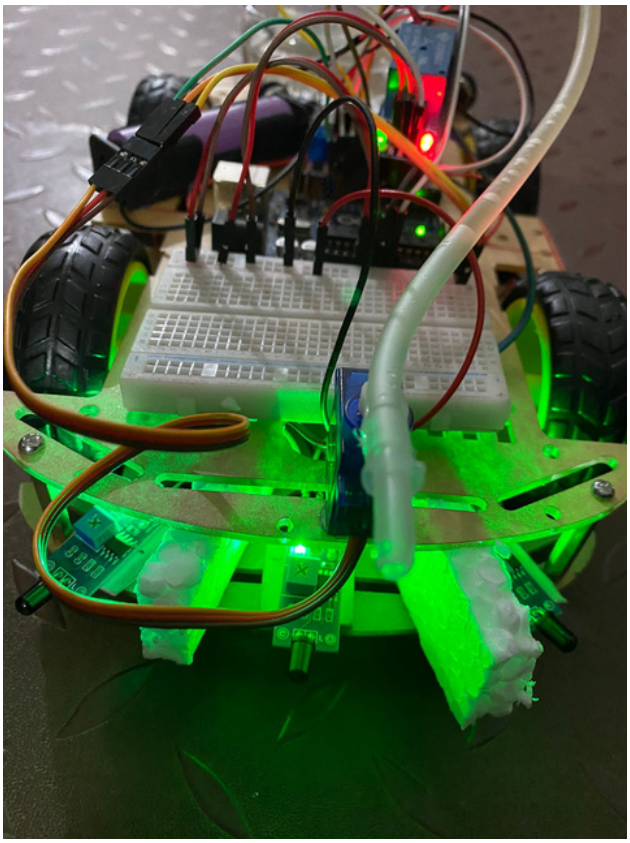


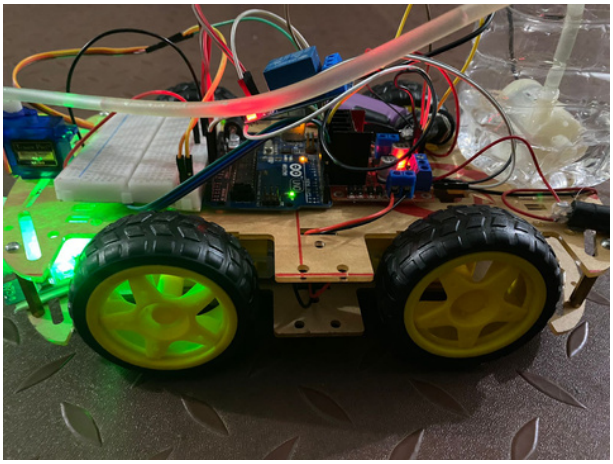
CIRCUIT DIAGRAM

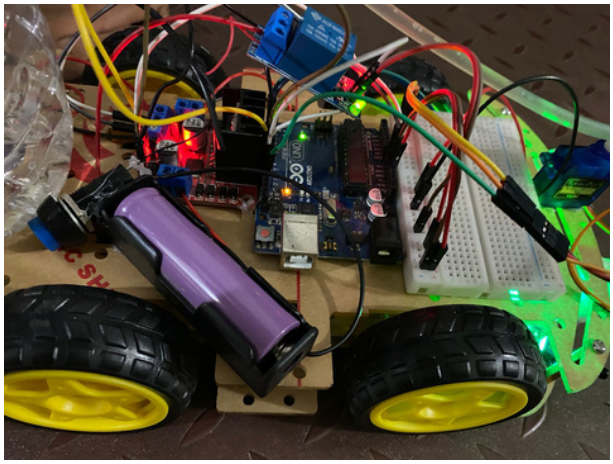


STRUCTURE OF THE PROTOTYPE

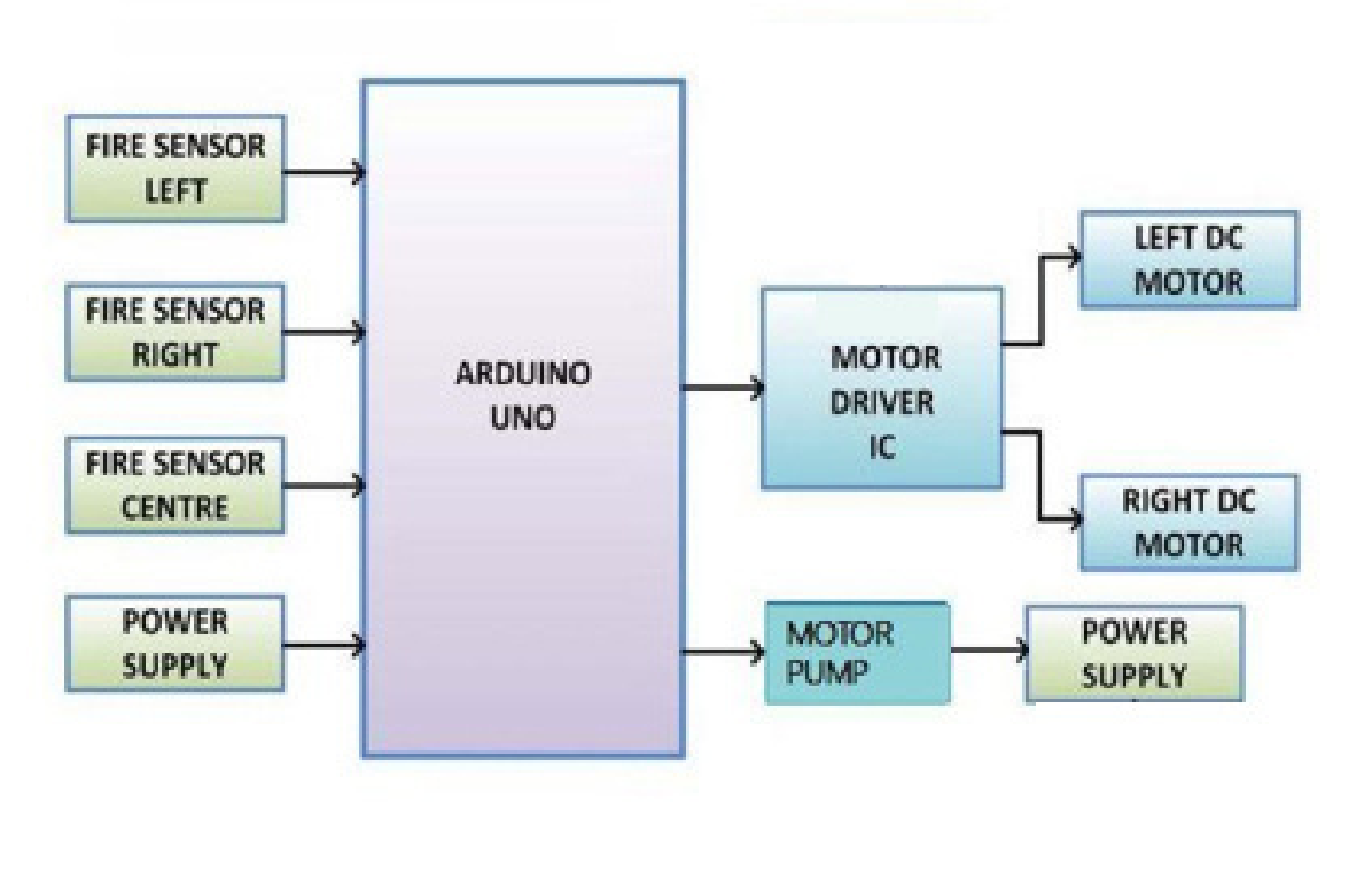








BLOCK DIAGRAM



CODE OVERVIEW

Defined Pins

```
#define Left 4     // left sensor
#define Right 5    // right sensor
#define Forward 6   //front sensor

#define pump 12    //water pumb

// Define motor control pins
#define LEFT_MOTOR_DIR1_PIN  8
#define LEFT_MOTOR_DIR2_PIN  9
#define RIGHT_MOTOR_DIR1_PIN 10
#define RIGHT_MOTOR_DIR2_PIN 11
```

Function for control Flame sensors

```
void initFlameSensor(){
 DDRC &= ~((1 << Left)|(1 << Right)|(1 << Forward));
}
```

Function to initialize motor control pins

```
void initMotors(){
 DDRC |= ((1 << LEFT_MOTOR_DIR1_PIN) | (1 << LEFT_MOTOR_DIR2_PIN) | (1 <<
RIGHT_MOTOR_DIR1_PIN) | (1 << RIGHT_MOTOR_DIR2_PIN));
 PORTC &= ~((1 << LEFT_MOTOR_DIR1_PIN) | (1 << LEFT_MOTOR_DIR2_PIN) | (1 <<
RIGHT_MOTOR_DIR1_PIN) | (1 << RIGHT_MOTOR_DIR2_PIN));
}
```

CODE OVERVIEW

Function of car chassis motor control and fire control

```
void loop()
{
 myservo.write(90); //Sweep_Servo();

  if (digitalRead(Left) ==1 && digitalRead(Right)==1 && digitalRead(Forward) ==1)
  {
  delay(500);
  PORTC &= ~((1 << LEFT_MOTOR_DIR1_PIN) | (1 << RIGHT_MOTOR_DIR1_PIN));
  PORTC &= ~((1 << LEFT_MOTOR_DIR2_PIN) | (1 << RIGHT_MOTOR_DIR2_PIN));
  }
  else if (digitalRead(Forward) ==0)
  {
  PORTC |= (1 << LEFT_MOTOR_DIR1_PIN) | (1 << RIGHT_MOTOR_DIR1_PIN);
  PORTC &= ~((1 << LEFT_MOTOR_DIR2_PIN) | (1 << RIGHT_MOTOR_DIR2_PIN));
  fire = true;
  }

  else if (digitalRead(Left) ==0)
  {
  PORTC |= (1 << LEFT_MOTOR_DIR2_PIN) | (1 << RIGHT_MOTOR_DIR1_PIN);
  PORTC &= ~((1 << LEFT_MOTOR_DIR1_PIN) | (1 << RIGHT_MOTOR_DIR2_PIN));
  }

  else if (digitalRead(Right) ==0)
  {
  PORTC |= (1 << LEFT_MOTOR_DIR1_PIN) | (1 << RIGHT_MOTOR_DIR2_PIN);
  PORTC &= ~((1 << LEFT_MOTOR_DIR2_PIN) | (1 << RIGHT_MOTOR_DIR1_PIN));
  }

  delay(200);//change this value to change the distance
```

CODE OVERVIEW

Servo control function

```
void put_off_fire()
{

 PORTC &= ~((1 << LEFT_MOTOR_DIR1_PIN) | (1 << RIGHT_MOTOR_DIR1_PIN));
 PORTC &= ~((1 << LEFT_MOTOR_DIR2_PIN) | (1 << RIGHT_MOTOR_DIR2_PIN));
 PORTC |= (1 << pump);
 delay(500);

 for (pos = 50; pos <= 110; pos += 1) {
 myservo.write(pos);
 delay(10);
 }
 for (pos = 110; pos >= 50; pos -= 1) {
 myservo.write(pos);
 delay(10);
 }
 PORTC &= (1 << pump);
 myservo.write(90);
 fire=false;
}
```

ISSUES

Sometimes the flame sensors dose not detect fire as it should have.
And sometimes when the fire is from either right side or left side the chassis does not turn as it should turn, it turns overly than required.
It only detects fire within 0.5m.
Also the motor starts running if we cut the power for the Arduino board and keep the power of the motor.

BUDGET

Car Chassis	Rs.	2100
3 x Flames Sensors	Rs.	3 x 200 = 600
Water Pump	Rs.	200
Relay Module 5v	Rs.	140
Motor Drive L298	Rs.	430
Servo	Rs.	360
3 x Battery	Rs.	1800
2 x Switches	Rs.	40
Jumper Wires	Rs.	250
Charging Module	Rs.	120
Water Pipe	Rs.	50
Mini Bread Board	Rs.	150
Battery Holder Cases	Rs.	220
	Rs.	6,460

CONCLUSION

The main target of the system is to detect fire as soon as it starts and find the location through the sensors and extinguish the fire.
As we come to the conclusion of this system we can see that this system is a real time fire fighting robot which will detect fire at anytime and clear it.

The project's primary objectives were met, as the robot demonstrated the ability to operate in diverse environments, offering a valuable asset in scenarios where human intervention is challenging or perilous. The combination of fire detection sensors, autonomous navigation, and a versatile fire suppression mechanism positions the robot as a promising tool for emergency response teams.

FUTURE IMPLEMENTATIONS

If the fire is in a gas station rather than using water we can use a servo operated fire extinguisher.
If we can use a more advanced flame sensor which can detect fire over more distance we can detect fires far from 0.5m.
And also if needed we can add fire extinguisher and water both in the same system.