A

Mini project report

On

“Fire Fighting Robot With SMS and Call Alert”

Submitted By

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Mr. Jishan Sajid Shaikh **T190115046**

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Submitted to

Savitribai Phule Pune University, Pune

In the partial fulfillment of the requirement for degree of

Bachelor of Engineering

In

Electronics and Computer Engineering

Under the guidance of

Miss. S. S. Lavhate

DEPARTMENT OF

ELECTRONICS AND COMPUTER ENGINEERING

Loknete Dr. Balasaheb Vikhe Patil (Padmabhushan Awardee)

Pravara Rural Engineering College, Loni – 413736

Tal. Rahata Dist. Ahmednagar, (M.S.), India

2023–24

Loknete Dr. Balasaheb Vikhe Patil (Padmabhushan Awardee)

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DEPARTMENT OF ELECTRONICS AND COMPUTER ENGINEERING

Certificate

This is to certify that project report entitled

Fire Fighting Robot With SMS and Call Alert

SUBMITTED BY

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The students of TE Electronics and Computer Engineering during the academic year 2023–24.

This project report embodies the work carried out by the candidate, toward the partial fulfilment of third year degree course in Electronics and Computer Engineering conferred by the Savitribai Phule Pune University.

Miss. S. S. Lavhate	**Dr. S. A. Shaikh**	**Miss. S. S. Lavhate**
PROJECT GUIDE	**PROJECT CO-ORDINATOR**	**HOD ECE**

QUALITY POLICY

Institute Vision

Enrich the youth with skills and values to enable them to contribute in the development of society: nationally and globally.

Institute Mission

To provide quality technical education through effective teaching-learning and research to foster youth with skills and values to make them capable of delivering significant contribution in local to global development.

Department Vision

Promote effective teaching learning in the fields of electronics and computer engineering to produce nationally, globally competitive engineers that are needed to meet the evolving demands of industry and society.

Department Mission

Imparting latest multidisciplinary technical knowledge in the field of Electronics and Computer Engineering and providing an opportunity for creating talent in students to take up challenges for the benefits of society and industry.

Program Outcomes

PO1 Engineering knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.

PO2 Problem analysis: Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.

PO3 Design/development of solutions: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.

PO4 Conduct investigations of complex problems: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.

PO5 Modern tool usage: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modelling to complex engineering activities with an understanding of the limitations.

PO6 The engineer and society: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.

PO7 Environment and sustainability: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.

PO8 Ethics: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.

PO9 Individual and team work: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.

PO10 Communication: Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.

PO11 Project management and finance: Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.

PO12 Life-long learning: Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

Program Educational Objectives (PEOs)

PEO1: Through effective teaching learning environment, the graduates will achieve a high level of technical competence in Electronics and Computer Engineering, so that they are able to develop solutions to the problems.

PEO2: Ability to work effectively in a multidisciplinary environment individually or in team at a global and societal level.

PEO3: Graduates will compete on a national, global platform to pursue their career in Electronics Engineering as well as in Computer Engineering and allied disciplines

Program Specific Outcomes (PSOs)

PSO1: Ability to identify, analyze, design and develop applications in Electronics as well as in Computer field by using appropriate modern software, tools and techniques.

PSO2: Demonstrate the knowledge of modern software and techniques of electronics and computer engineering for the development of innovative applications needed at a global and societal level.

Course Outcome (COs)

Course Outcomes Code	Statements	Bloom's Taxonomy Level	Descriptor
C472.1	Identify the problem that deals with society, industry or research needs based on investigated literature survey to explore recent technical trends.	3	Apply
C472.2	Analyse identified problem and suggest appropriate solution to solve the problem.	4	Analyse
C472.3	Design an appropriate solution to ensure performance, safety and quality.	5	Evaluate
C472.4	Implementation of solution using modern tools and development of prototype systems.	6	Create
C472.5	Work as an individual and contribute as a team member with effective management skills to achieve a desired objective.	3	Apply
C472.6	Present their work in written and oral form with ethical values.	3	Apply

ACKNOWLEDGEMENT

Inspiration and guidance are invaluable in all aspects of life, especially when it is academic. We fail to find the adequate words to express the deep sense of gratitude to our respected Head of Department of Electronics and Computer Engineering **MISS. S. S. LAVHATE** and Project Coordinator **DR. S. A. SHAIKH** and Guide **MISS. S. S. LAVHATE** who put their careful guidance and interest through which we have completed our project work.

The indebt necessity for encouragement, help and sympathetic attitude which we received from them during preparation of our work cannot be expressed in words.

Last but not the least we would like to remember our family members with whose continuous inspiration, this work wouldn't have been successfully completed. Every work is the outcome of full proof planning, continuous hard work and organized team effort. This work is the combination of the all above together, sincerely.

Mr. Shubham Vijay Thombal
Mr. Jishan Sajid Shaik

Mr.Mahesh Babasaheb Tekale

DECLARATION

We here with submit the Project Report titled **"Fire Fighting Robot With SMS and Call Alert"**to Pravara Rural Engineering College, Loni for impartial fulfilment of mini project. We carried it under the guidance of **Miss.S.S.Lavhate** ,Department of Electronics and Computer Engineering, Loni. This project report has not been submitted to any other University/Institute for award of any degree or diploma.

Mr. Shubham Vijay Thombal

Mr. Jishan Sajid Shaik

Mr.Mahesh Babasaheb Tekale

Date: / / 2024

Place: Loni

ABSTRACT

The Arduino firefighting robot is an autonomous robot designed to detect and extinguish fires in indoor environments. The robot is equipped with various sensors, including temperature sensors, flame sensors, and smoke sensors, to detect the presence of a fire. Once a fire is detected, the robot uses its onboard water pump and nozzle to extinguish the fire using water or a fire-retardant liquid. The robot's movements are controlled by a microcontroller programmed with a combination of obstacle avoidance algorithms and fire detection algorithms. This project demonstrates the use of Arduino microcontrollers and sensors in creating a cost-effective and efficient solution for firefighting in enclosed spaces.

CONTENTS

CHAPTER 1

INTRODUCTION

1.1 Introduction

An Arduino fire-fighting robot is a robotic device equipped with sensors and actuators that can detect, locate, and extinguish fires. These robots are designed to operate autonomously or under remote control to minimize the risks to human firefighters. Using Arduino microcontrollers, these robots can be programmed to navigate through indoor or outdoor environments, detect heat or smoke indicating a fire, and respond by either alerting authorities or using a fire extinguishing mechanism. They are valuable tools for enhancing fire-fighting capabilities, especially in hazardous or inaccessible areas.

1.2. Aim of Project

Aim: To Develop Fire Fighting Robot With SMS and Call Alert Using Arduino.

Objective of the project

1.Develop an autonomous fire-fighting robot for indoor environments.

2. Implement a fire suppression mechanism for efficient extinguishing.

3. Integrate a GSM module for real-time SMS alerts.

4. Enhance fire safety and response efficiency through automation.

5. Utilize Arduino Uno for control and programming flexibility.

6. Allow customization and future expansion.

1.3. Problem Statement

design an Arduino based fire-fighting robot equipped with SMS and call alert capabilities to efficiently detect and extinguish fires in a controlled environment.

1.4 motivation for project

This advanced firefighting robotic system independently detects and extinguishes fire. In the age of technology, the world is slowly turning towards the automated system and self-travelling vehicles, fire fighters are constantly at a risk of losing their life. Fire spreads rapidly if it is not controlled.

Safety Enhancement: The primary motivation is to enhance the safety of firefighters by reducing their exposure to dangerous environments. These robots can access spaces that may be too hazardous for humans, such as burning buildings or industrial accidents.

Cost-Effectiveness: While the initial investment in developing and deploying such robots may be significant, the long-term cost-effectiveness can be substantial, especially when compared to the potential costs of human injury or loss of life.

CHAPTER 2

LITERATURE REVIEW

2.1 Review

The Arduino-based Fire Fighting Robot with SMS Alert System is a robotic system designed to detect and extinguish fires in indoor environments. The robot uses flame sensors to detect the presence of a fire. Once a fire is detected, the robot moves towards the source of the fire and sprays water to extinguish the flames. The robot is equipped with a GSM module that can send SMS messages to alert the user when a fire is detected. This allows for prompt action to be taken to minimize damage and save lives. The components of the robot include an Arduino board, motor drivers, sensors, and a GSM module.

The software code is written in the Arduino IDE and controls the motors, reads sensor data, and communicates with the GSM module. The robot is tested and debugged to ensure that it functions correctly and safely in different scenarios. Overall, the Arduino-based Fire Fighting Robot with SMS Alert provides a reliable and efficient solution for fire detection and suppression with the added benefit of remote communication and control.

CHAPTER 3

SYSTEM DESIGN

3.1.Block Diagram

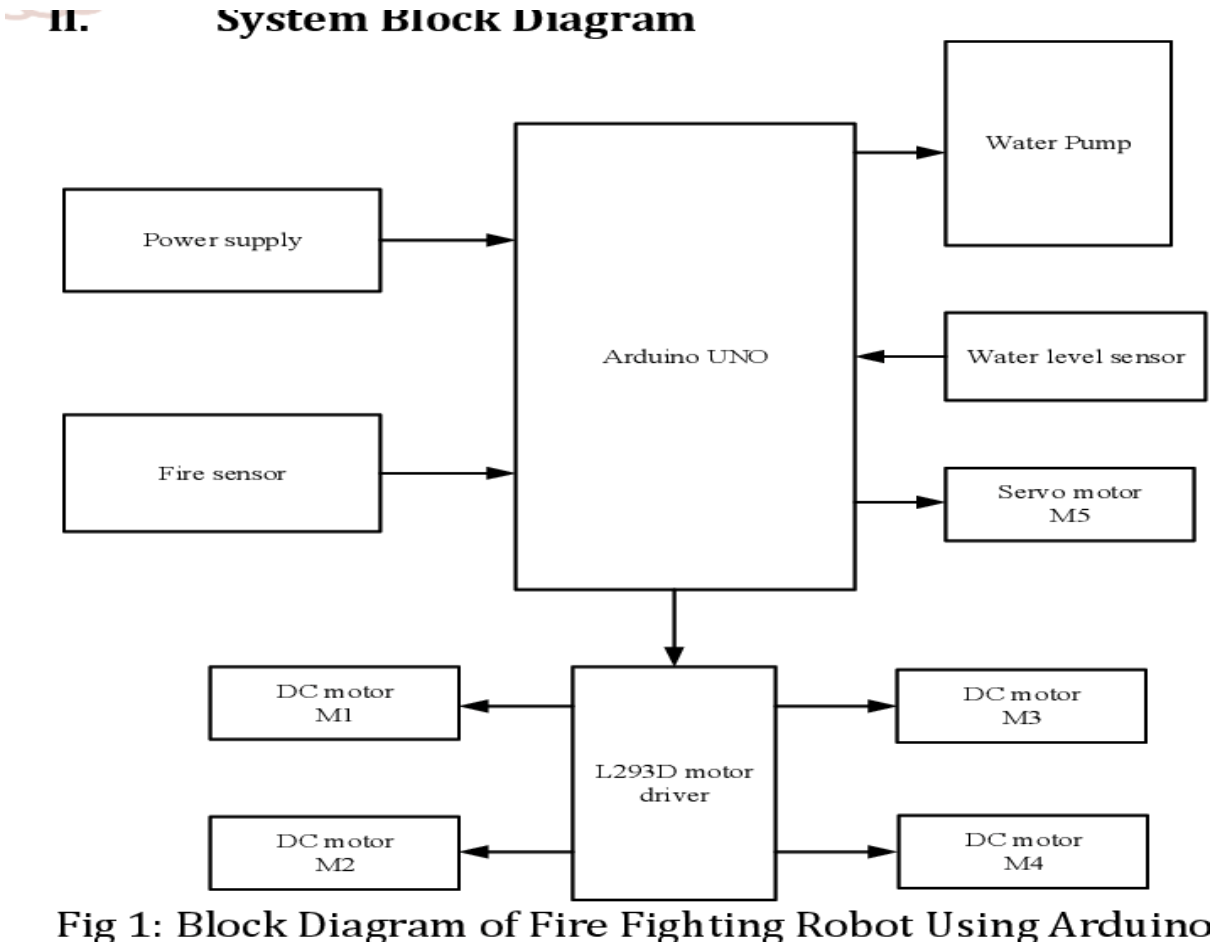


Fig.3.1

Description of Block Diagram

1 Arduino Uno Microcontroller: -

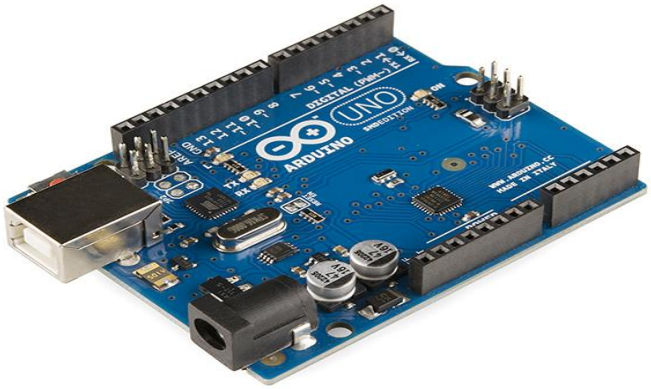


Fig.3.2

An Arduino is an open-source microcontroller development board. The most common version of Arduino is the Arduino Uno. It is relatively cheap, plugs straight into a computer's USB port, and it is simpleton setup and use when compared toother development boards.

Some of the key features of the Arduino Uno include:

- Open-source design. Large community at arduino.cc/forum/ of people using and troubleshooting it.
- Easy USB interface. The chip on the board plugs straight into your USB port and registers on your computer as a virtual serial port. This allows us to serially communicate which is an extremely easy protocol.
- Convenient power management and built-in voltage regulation. 12v can easily beregulated to both 5v and 3.3v.
- Easy-to-find and cheap, microcontroller
- Countless number of hardware features like timers, PWM pins, external and internal interrupts, and multiple sleep modes.

Specifications:

- A 16 MHz clock.
- 32 KB of flash memory.
- 13 digital pins and 6 analogue pins.
- ICSP connector to re-boot load your chip and for bypassing the USB port and interfacing the Arduino directly as a serial device.
- LED attached to digital pin 13 for and easy debugging of code.
- Reset button to reset the program on the chip.

The DS3231 is a low-cost, extremely accurate I2C real-time clock (RTC) with an integrated temperature- compensated crystal oscillator (TCXO) and crystal. The device incorporates a battery input, and maintains accurate timekeeping when main power to the device is interrupted.

2 Servo motor:

Fig 3.3

A servo motor is defined as an electric motor that allows for precise control of angular or linear position, speed, and torque. It consists of a suitable motor coupled to a Sensor for position feedback and a controller that regulates the motor's movement according to a desired set point.

Servo motors are widely used in industrial applications such as robotics, CNC machinery, and automated manufacturing, where high accuracy, fast response, and smooth motion are required.

A servo motor consists of three main components:

- A motor: This can be either a DC Motor or an AC motor depending on the power source and the application requirements. The motor provides the mechanical power to rotate or move the output shaft.
- A sensor: This can be either a Potentiometer, an encoder, a resolver, or another device that measures the position, speed, or torque of the output shaft and sends feedback signals to the controller.
- A controller: This can be either an analog or a digital circuit that compares the feedback signals from the sensor with the desired setpoint signals from an external source (such as a computer or a joystick) and generates control signals to adjust the motor's Voltage or Current accordingly.

The controller uses a closed-loop feedback system to regulate the motor's movement and ensure that it matches the desired setpoint within a certain tolerance.

The controller can also implement various control algorithms, such as proportional-integral-derivative (PID) control, fuzzy logic control, adaptive control, etc., to optimize the performance of the servo motor

3.Flame-sensor:

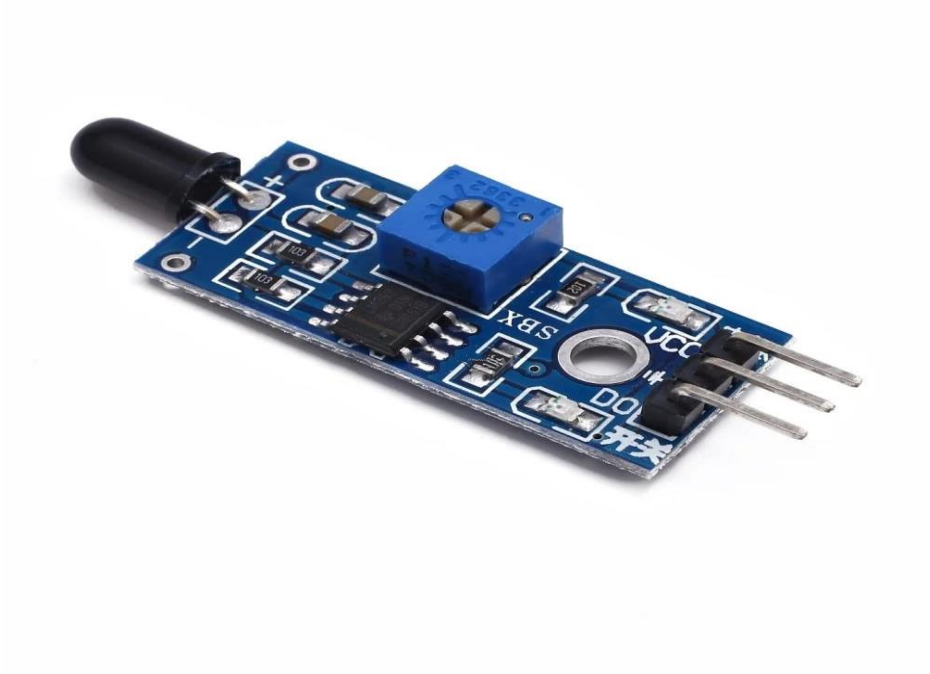


Fig 3.4

A flame-sensor is one kind of detector which is mainly designed for detecting as well as responding to the occurrence of a fire or flame. The flame detection response can depend on its fitting. It includes an alarm system, a natural gas line, propane & a fire suppression system. This sensor is used in industrial boilers. The main function of this is to give authentication whether the boiler is properly working or not. The response of these sensors is faster as well as more accurate compare with a heat/smoke detector because of its mechanism while detecting the flame.

Different Types: -

Flame-sensors are classified into four types

- IR single frequency
- IR multi-spectrum
- UV flame detectors
- UV/ IR flame detectors

Features & Specifications

The features of this sensor include the following.

- Photosensitivity is high.
- Response time is fast
- Simple to use
- Sensitivity is adjustable
- Detection angle is 600,
- It is responsive to the flame range.
- Accuracy can be adjustable
- Operating voltage of this sensor is 3.3V to 5V
- Analog voltage o/ps and digital switch o/ps
- The PCB size is 3cm X 1.6cm
- Power indicator & digital switch o/p indicator
- If the flame intensity is lighter within 0.8m then the flame test can be activated, if the flame intensity is high, then the detection of distance will be improved.

Applications:

These sensors are used in several dangerous situations which include the following.

- Hydrogen stations.
- Industrial heating.
- Fire detection.
- Fire alarm.
- Fire fighting robot.
- Drying systems.
- Industrial gas turbines.
- Domestic heating systems.
- Gas-powered cooking devices.

4.Smoke Sensor:

Fig. 3.5

The smoke sensor module was selected to serve the purpose of sensing smoke. It has the capability of sensing smoke and other combustible gases. The following are the reasons as to why it was selected:

- Wide detecting scope
- Fast response & high sensitivity
- Stable and long life
- Simple drive circuit

The MQ-2 smoke sensor is sensitive to smoke and to the following flammable gases: LPG Butane Propane Methane Alcohol Hydrogen The resistance of the sensor is different depending on the type of the gas.

The smoke sensor has a built-in potentiometer that allows you to adjust the sensor sensitivity according to how accurate you want to detect gas.

The sensor can detect smoke in the range of 300-10,000 rpm, giving an analog output voltage of between 0v to 5v depending on the quantity of smoke detected. The sensitive material used is SnO2, whose conductivity is lower in clean air. Its conductivity increases as the concentration of combustible gases increases, hence generating a corresponding analog voltage at the output.

5 .Water pump: -

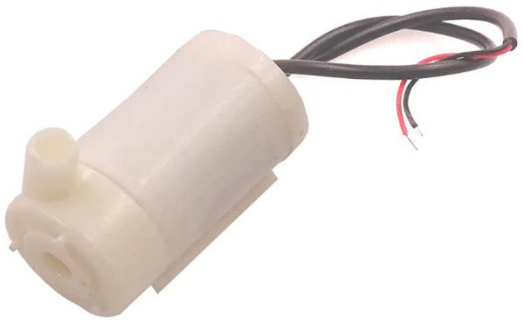


Fig.3.6

The water pump can be defined as a pump which uses the principles like mechanical as well as hydraulic throughout a piping system and to make sufficient force for its future use. They have been approximately in one structure otherwise another because of early civilization. At present these pumps are utilized within a wide range of housing, farming, municipal, and manufacturing applications.

The working principle of a water pump mainly depends upon the positive displacement principle as well as kinetic energy to push the water. These pumps use AC power otherwise DC power for energizing the motor of the water pump whereas others can be energized other kinds of drivers like gasoline engines otherwise diesel.

The collection of water pumps is very large, therefore, while selecting a strong and consistent one, one should think about the requirement

6.L298N Driver:

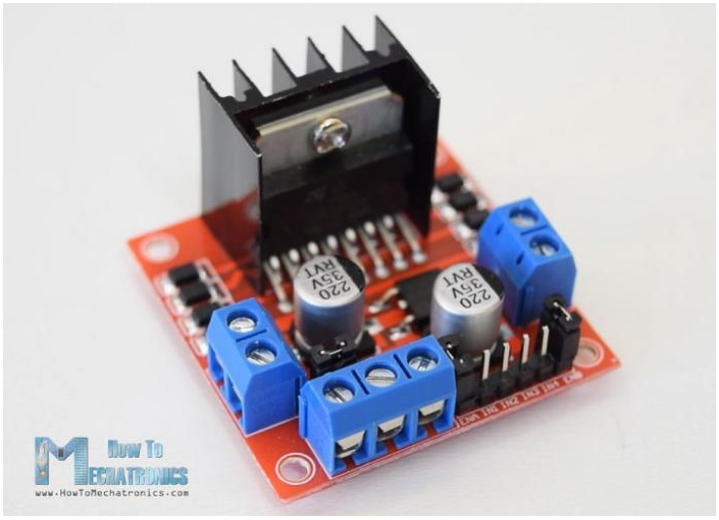


Fig.3.7

The L298N is a dual H-Bridge motor driver which allows speed and direction control of two DC motors at the same time. The module can drive DC motors that have voltages between 5 and 35V, with a peak current up to 2A.

Let's take a closer look at the pin out of L298N module and explain how it works. The module has two screw terminal blocks for the motor A and B, and another screw terminal block for the Ground pin, the VCC for motor and a 5V pin which can either be an input or output.

This depends on the voltage used at the motors VCC. The module has an on-board 5V regulator which is either enabled or disabled using a jumper. If the motor supply voltage is up to 12V we can enable the 5V regulator and the 5V pin can be used as output, for example for powering our Arduino board. But if the motor voltage is greater than 12V we must disconnect the jumper because those voltages will cause damage to the on-board 5V regulator. In this case the 5V pin will be used as input as we need connect it to a 5V power supply in order the IC to work properly.

We can note here that this IC makes a voltage drop of about 2V. So, for example, if we use a 12V power supply, the voltage at motors terminals will be about 10V, which means that we won't be able to get the maximum speed out of our 12V DC motor.

Next are the logic control inputs. The Enable A and Enable B pins are used for enabling and controlling the speed of the motor. If a jumper is present on this pin, the motor will be enabled and work at maximum speed, and if we remove the jumper, we can connect a PWM input to this pin and in that way control the speed of the motor. If we connect this pin to a Ground the motor will be disabled.

7.Relay Module:

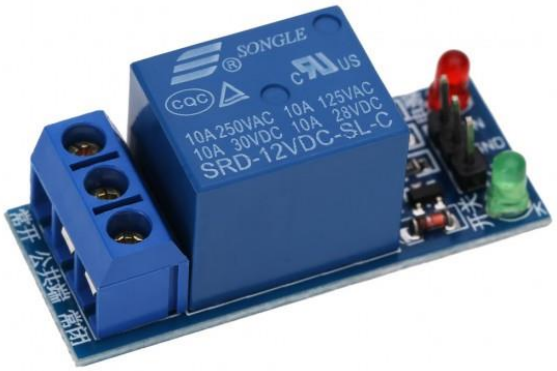
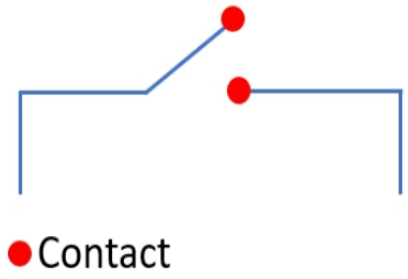


Fig.3.8

The relay module is an electrically operated switch that can be turned on or off deciding to let current flow through or not. They are designed to be controlled with low voltages like 3.3V like the ESP32, ESP8266, etc, or 5V like your Arduino.

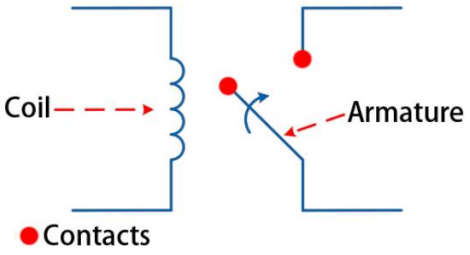
Working module

The relay is an electrically operated switch where the relay opens when the two contacts are disconnected, while the relay is closed when the two contacts touch. When set to high, the relay will close allowing current to flow.



Relay Contact

Even though there are many types of relays, electromechanical relays are the most commonly used which we



are going to talk about them and how they work.

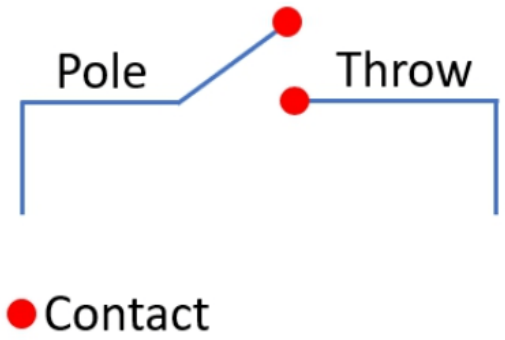
When the coil is energized, the induced magnetic field moves the armature, which opens or closes the contact.

Each contact connects to an input or output terminal. The input terminal is called Pole**,** and the output terminal is called Throw. According to the number of terminals, the relay is divided into several types. Where the commonly used are the SPST and SPDT**.** Let's look at how the SPST and the SPDT works:

SPST (Single Pole Single Throw)

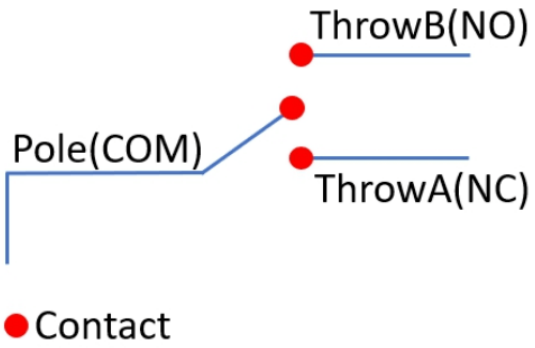
The SPST is the simplest relay, you can consider it as a button. They have 2 terminals that can be connected or disconnected. Including 2 for the coil, an SPST relay has 4 terminals in total.

This switch is normally open and when the trigger signal comes, the pole contact will connect to the throw contact which causes the switch to be closed. It is great for applications that need only an on or off state. If this the relay you are looking for, the Grove-Relay is perfect for you.



SPDT (Single Pole Double Throw):

The SPDT relay is also known as the A/B switch, as you can see below, there are two throws, this kind of relay is great for selecting between two options.



As you can see, they have three high voltage terminals that connect to the device you want to control which are the:

COM – Common terminal

NC – Normally closed 120 – 240V terminal

NO – Normally open 120 – 240V terminal

And also, normally additional 3 or 4 voltage pins which connect to the Arduino which are:

1 – Ground: Connects to the Ground on the Arduino

2 – 5V VCC: Connects to the 5V on the Arduino

3 & 4 – Signal Pins: Carries the trigger signal from the Arduino that activates the relay.

8.Mini breadboard:

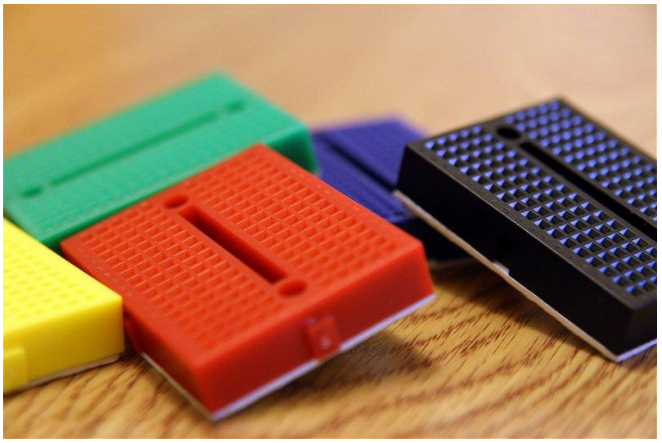


Fig.3.9

The modern breadboard is a plug-and-play way to make connections between electronic components. It gets its name from the long-dead practice of using a wooden board (an actual bread-board if it was handy) to prototype circuits. Hobbyists would hammer small nails or thumbtacks into the board and wind wires around them to prototype a circuit.

Thanks to Ronald J. Portugal; since 1971 we've had convenient plastic boards which tidily pack hundreds of tie points (also known as contacts) into a small form-factor suitable for wires, components with long leads, and socket able components with 0.1" Dual or Single in-line pins. These tie points take the form of holes within the breadboard, into which wires and components can be pushed.

They're useful for basic prototyping, but breadboards don't accommodate anything with two closely spaced rows of pins, such as the header on the Raspberry Pi. The Pi header needs a special breadboard adaptor to separate the pins so that they sit either side of the central notch. The same applies to many surface mount components, which have two rows of pins (known as a dual-in-line layout) and must sit over the central notch.

Throughout this series, we'll be using the tiny, cheap and convenient 170pt breadboard to host a variety of simple circuits that you can use with your Raspberry Pi.

9.BO (Battery Operated) Motor:

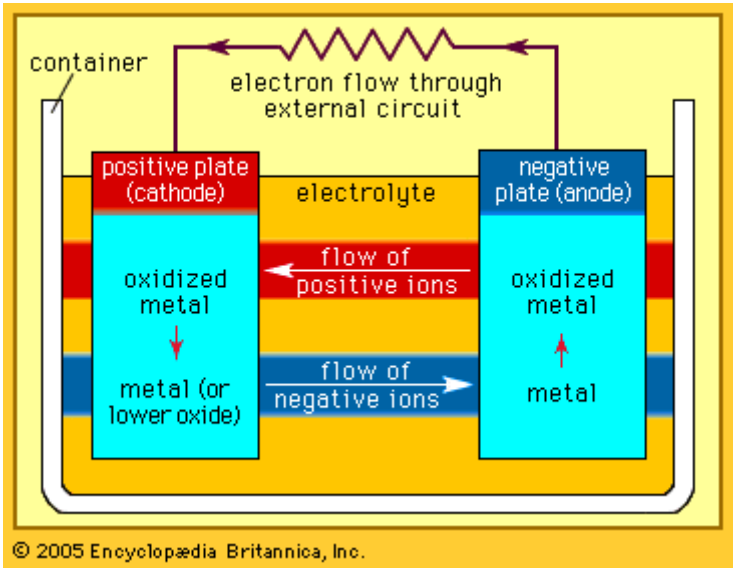
Fig.3.10

This BO (Battery Operated) Motor is lightweight DC geared motor which gives good torque and rpm at lower voltages. This motor can run at approximately 100 rpm when driven by a single Li-Ion cell. Great for battery operated lightweight robots. It can do reverse and forward directions.

10.Battery:

Fig.3.11

The electricity and electrochemistry, any of a class of devices that convert chemical energy directly into electrical energy. Although the term battery, in strict usage, designates an assembly of two or more galvanic cells capable of such energy conversion, it is commonly applied to a single cell of this kind.



Electrochemical cell: basic components

Basic components of an electrochemical cell.

Every battery (or cell) has a cathode, or positive plate, and an anode, or negative plate. These electrodes must be separated by and are often immersed in an electrolyte that permits the passage of ions between the electrodes. The electrode materials and the electrolyte are chosen and arranged so that sufficient electromotive force(measured in volts) and electric current (measured in amperes) can be developed between the terminals of

a battery to operate lights, machines, or other devices. Since an electrode contains only a limited number of units of chemical energy convertible to electrical energy, it follows that a battery of a given size has only a certain capacity to operate devices and will eventually become exhausted. The active parts of a battery are usually encased in a box with a cover system (or jacket) that keeps air outside and the electrolyte solvent inside and that provides a structure for the assembly.

Commercially available batteries are designed and built with market factors in mind. The quality of materials and the complexity of electrode and container design are reflected in the market price sought for any specific product. As new materials are discovered or the properties of traditional ones improved, however, the typical performance of even older battery systems sometimes increases by large percentages.

Batteries are divided into two general groups: (1) primary batteries and (2) secondary, or storage, batteries. Primary batteries are designed to be used until the voltage is too low to operate a given device and are then discarded. Secondary batteries have many special design features, as well as particular materials for the electrodes, that permit them to be reconstituted (recharged). After partial or complete discharge, they can be recharged by the application of direct current (DC) voltage. While the original state is usually not restored completely, the loss per recharging cycle in commercial batteries is only a small fraction of 1 percent even under varied conditions

11.GSM

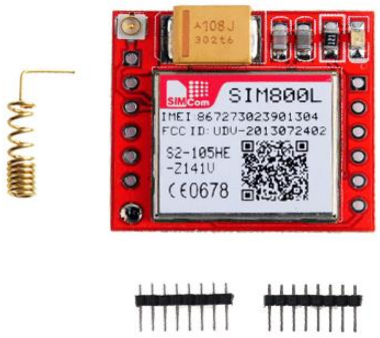


Fig.3.12

GSM (Global System for Mobile Communications, originally Groupe Spécial Mobile), is a standard developed by the European Telecommunications Standards Institute (ETSI).

Functions of Modem

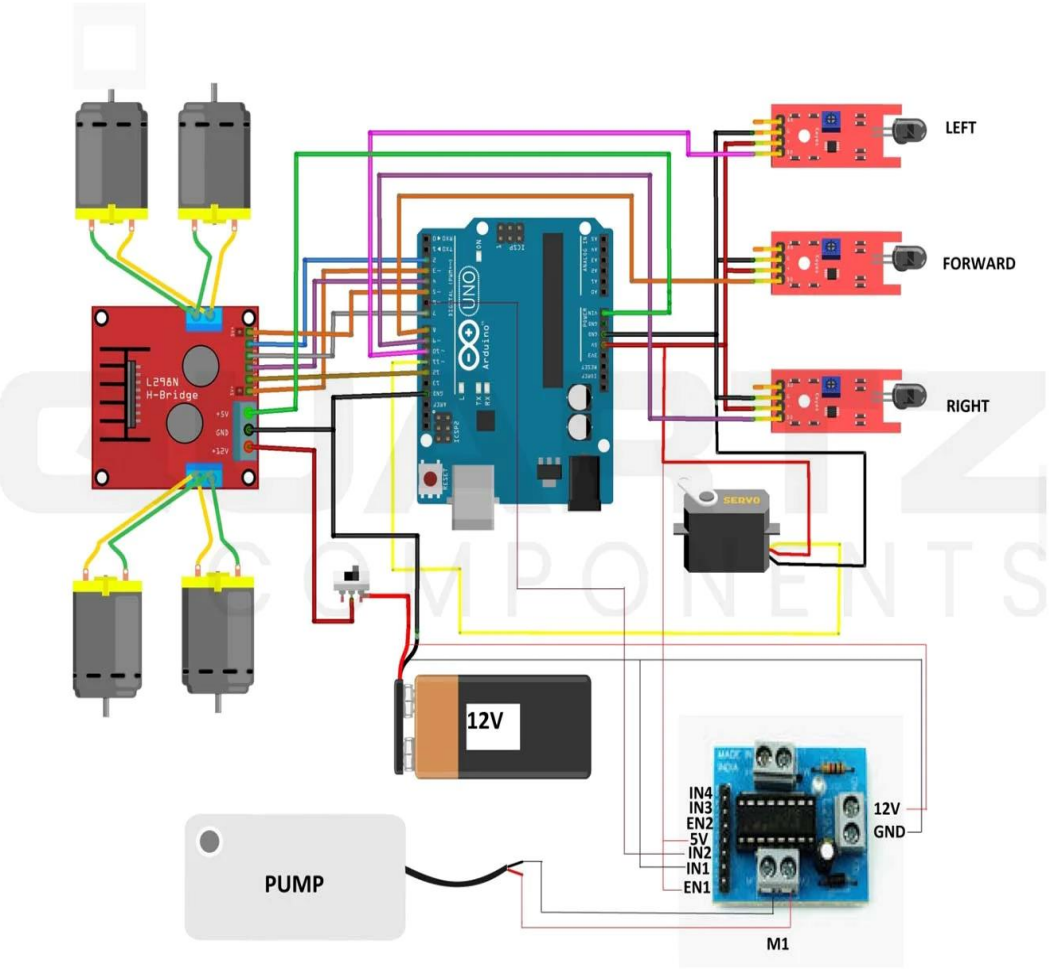
- Read, write and delete SMS messages.
- Send SMS messages.
- Monitor the signal strength.
- Monitor the charging status and charge level of the battery.
- Read, write and search phone book entries.

What is AT Command?

They are known as AT commands because every command line starts with “AT” or “at”. AT commands are instructions used to control a modem. AT is the abbreviation of ATtention.

Command	Description
AT+CMGR	Read message
AT+CMGS	Send message
AT+CMSS	Send message from storage
AT+CMGW	Write message to memory

3.3 Circuit Diagram:

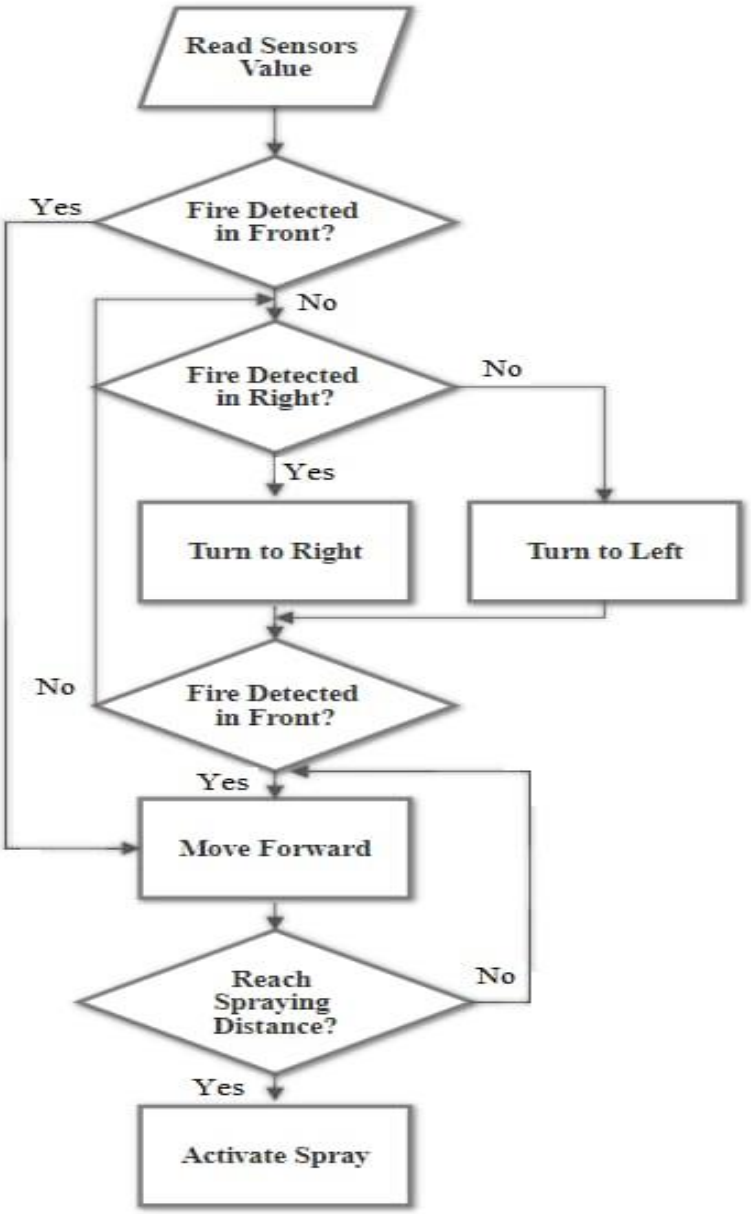


3.4 Working:

There are several possibilities of fire in any remote area or in an industry. For instance, in garments god owns, cotton mills, and fuel storage tanks, electric leakages may result in immense fire & harm. In the worst of cases & scenarios, fire causes heavy losses both financially and by taking lives. Robotics is the best possible way to guard human lives, wealth and surroundings. A Firefighting robot is designed and built with an embedded system. It is capable of navigating alone on a modelled floor while actively scanning the flames of fire. The robot could be used as a path guide in a fireplace device or, in normal case, as an emergency device. This robot is designed in such a way that it searches a fire, & douses it before the fire could spread out of range & control.

This type of firefighting robot will sooner or later work with fire-fighters, thus greatly reducing the danger of injury to victims. Apart from this, this Firefighting robotic project will also help generate interest along with the innovations in the field of robotics while operating towards a sensible and obtainable solution to save lives and mitigate the danger to property.

3.5 Flow Chart:

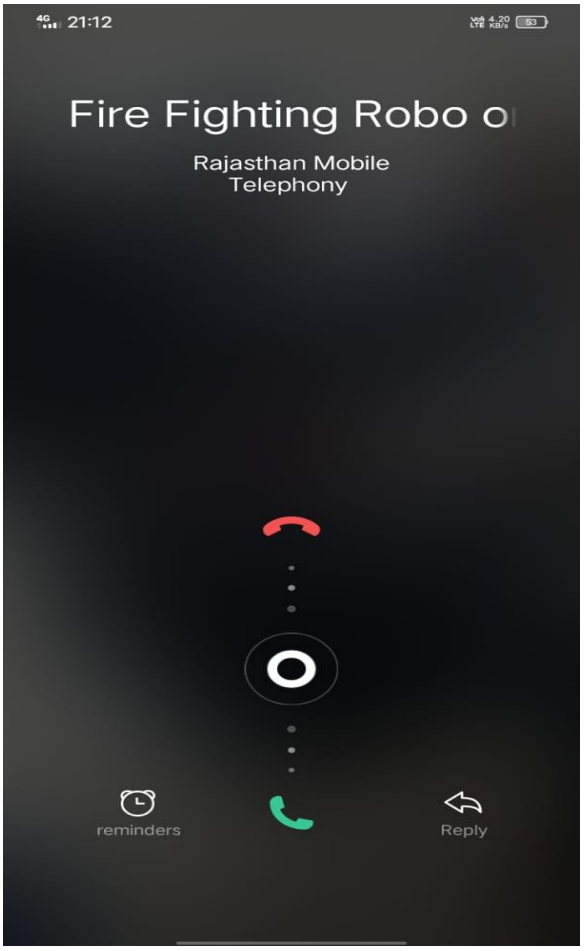


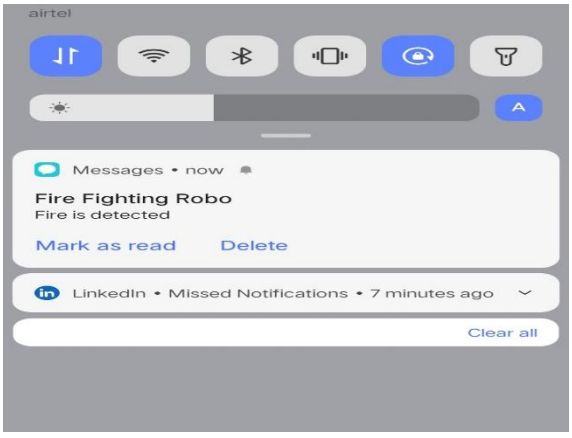
CHAPTER 4

RESULTS AND DISCUSSIONS

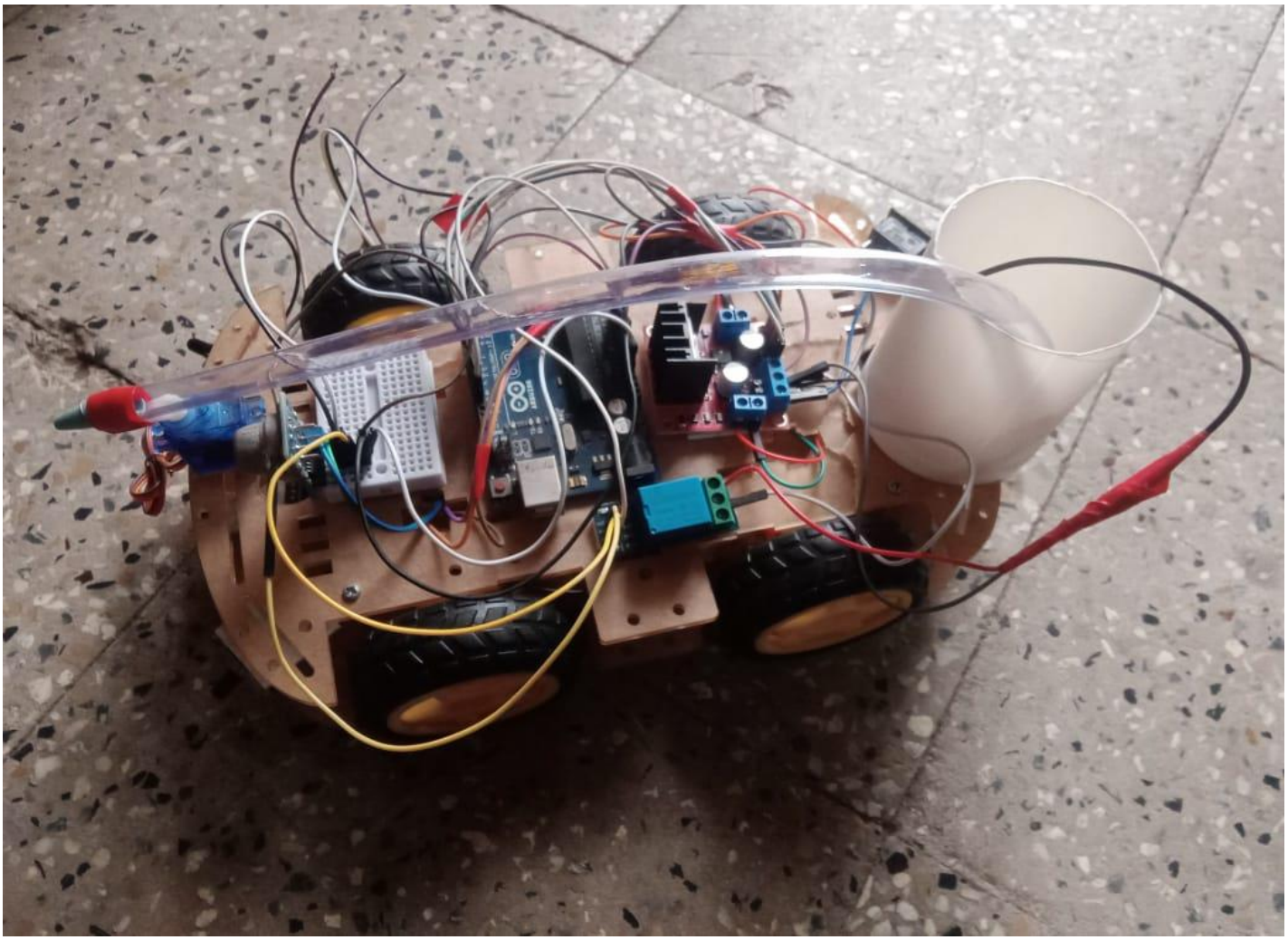
Result: -

Overall, the result of a fire-fighting robot project is a technological solution that enhances fire-fighting capabilities, improves safety, and demonstrates the potential of robotics in emergency response scenarios.





4.1. Hardware Demonstration

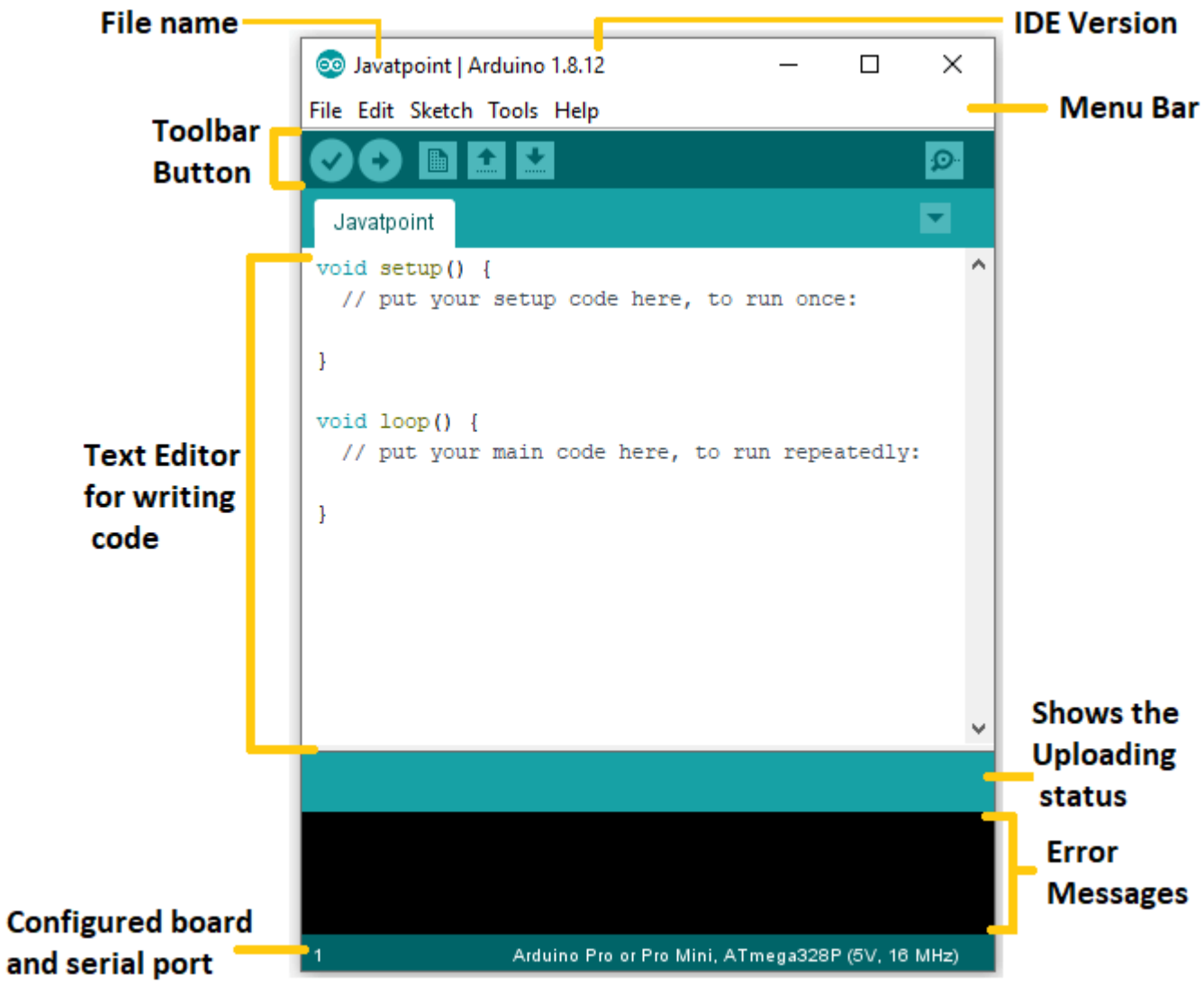


4.2. Software Description

Arduino IDE

The Arduino IDE is an open-source software, which is used to write and upload code to the Arduino boards. The IDE application is suitable for different operating systems such as Windows, Mac OS X, and Linux. It supports the programming languages C and C++. Here, IDE stands for Integrated Development Environment**.**

The program or code written in the Arduino IDE is often called as sketching. We need to connect the Genuino and Arduino board with the IDE to upload the sketch written in the Arduino IDE software. The sketch is saved with the extension '.ino.'



CHAPTER 5

CONCLUSION

5.1. Conclusion

Here we successfully developed the Fire Fighting Robot using GSM. Robot detects temperature and flame at site where the robot exists. The movement of this robot vehicle is controlled by MCU as per the program. This robot is help full in those areas where natural calamity and bomb explosions where occurred. If fire is detected with the help of sensors, MCU operates the water pump mechanism through relay circuit. Through this we can conclude that a robot can be used in place of humans reducing the risk of life of the fire fighters. We can use them in our homes, labs, offices etc. They provide us greater efficiency to detect the flame and it can be extinguished before it become uncontrollable and threat to life. Hence, this robot can play a crucial role.

5.2. Future Scopes

There's no denying that firefighters work in a dangerous business. They put their lives on the line every time they go to work — often running toward danger when everyone else is running away. And the numbers back it up. According to the National Fire Protection Association (NFPA), 60,825 firefighter injuries occurred in the line of duty in 2019. Also that year, 39% of all reported firefighter injuries occurred at the fire ground.

Despite the hazards of the job, firefighters selflessly serve a vital role in their communities, and their safety is of the utmost importance. The future of firefighting is always evolving, and new firefighting technology has helped keep firefighters safe and increased their ability to more effectively put out blazes in many different settings.

Arguably, the most impactful and significant of these recent technological advances are firefighting robots. Since they were first introduced by Howe & Howe Technologies, firefighting robots have been a game-changer in helping battle blazes of all kinds.

For anybody looking to rise through the firefighting ranks, becoming familiar with all the new technology to fight fires is crucial.

CHAPTER 6

APPENDIX

6.1.Source Code

```
#include <SoftwareSerial.h>
const String PHONE = "+918308011783"; //use your number with country code

#define rxPin 2
#define txPin 3
SoftwareSerial sim800L(rxPin,txPin);
#define enA 10//Enable1 L298 Pin enA
#define in1 9 //Motor1  L298 Pin in1
#define in2 8 //Motor1  L298 Pin in2
#define in3 7 //Motor2  L298 Pin in3
#define in4 6 //Motor2  L298 Pin in4
#define enB 5 //Enable2 L298 Pin enB
#define ir_R A0
#define ir_F A1
#define ir_L A2
#define servo A4
#define pump A5
void send_sms();

int Speed = 160; // Write The Duty Cycle 0 to 255 Enable for Motor Speed
int s1, s2, s3;
void setup(){
// put your setup code here, to run once
   Serial.begin(9600); // start serial communication at 9600bps
   sim800L.begin(9600);
   sim800L.println("AT");
   delay(1000);
   sim800L.println("AT+CMGF=1");
```

```
 delay(1000);

 pinMode(ir_R, INPUT);// declare fire sensor pin as input
 pinMode(ir_F, INPUT);// declare fire sensor pin as input
 pinMode(ir_L, INPUT);// declare fire sensor pin as input
 pinMode(enA, OUTPUT); // declare as output for L298 Pin enA
 pinMode(in1, OUTPUT); // declare as output for L298 Pin in1
 pinMode(in2, OUTPUT); // declare as output for L298 Pin in2
 pinMode(in3, OUTPUT); // declare as output for L298 Pin in3
 pinMode(in4, OUTPUT); // declare as output for L298 Pin in4
 pinMode(enB, OUTPUT); // declare as output for L298 Pin enB
 pinMode(servo, OUTPUT);
 pinMode(pump, OUTPUT);


 for (int angle = 90; angle <= 140; angle += 5)  {
 servoPulse(servo, angle);  }

 for (int angle = 140; angle >= 40; angle -= 5)  {
 servoPulse(servo, angle);  }

 for (int angle = 40; angle <= 95; angle += 5)  {
 servoPulse(servo, angle);  }

analogWrite(enA, Speed); // Write The Duty Cycle 0 to 255 Enable Pin A for Motor1 Speed
analogWrite(enB, Speed); // Write The Duty Cycle 0 to 255 Enable Pin B for Motor2 Speed
  while(sim800L.available()){
    Serial.println(sim800L.readString());
  }

delay(500);
}
```

```
 void loop(){
   s1 = analogRead(ir_R);
   s2 = analogRead(ir_F);
   s3 = analogRead(ir_L);

//============================================================
//                    Auto Control
//============================================================
Serial.print(s1);
Serial.print("\t");
Serial.print(s2);
Serial.print("\t");
Serial.println(s3);
delay(50);
if(s1<250){
Stop();
digitalWrite(pump, 1);
for(int angle = 90; angle >= 40; angle -= 3){
servoPulse(servo, angle);
}
for(int angle = 40; angle <= 90; angle += 3){
servoPulse(servo, angle);
}
send_sms();
}
else if(s2<350){
Stop();
digitalWrite(pump, 1);
for(int angle = 90; angle <= 140; angle += 3){
servoPulse(servo, angle);
}
for(int angle = 140; angle >= 40; angle -= 3){
```

```
servoPulse(servo, angle);
}
for(int angle = 40; angle <= 90; angle += 3){
servoPulse(servo, angle);
 }
send_sms();
}
else if(s3<250){
Stop();
digitalWrite(pump, 1);
for(int angle = 90; angle <= 140; angle += 3){
servoPulse(servo, angle);
send_sms();
}
for(int angle = 140; angle >= 90; angle -= 3){
servoPulse(servo, angle);
}
}
else if(s1>=251 && s1<=700){
digitalWrite(pump, 0);
backword();
delay(100);
turnRight();
delay(200);
}
else if(s2>=251 && s2<=800){
digitalWrite(pump, 0);
forword();
}
else if(s3>=251 && s3<=700){
digitalWrite(pump, 0);
backword();
```

```
delay(100);
turnLeft();
delay(200);
}else{
digitalWrite(pump, 0);
Stop();
}
delay(10);
}
void servoPulse (int pin, int angle){
int pwm = (angle*11) + 500;      // Convert angle to microseconds
 digitalWrite(pin, HIGH);
 delayMicroseconds(pwm);
 digitalWrite(pin, LOW);
 delay(50);                  // Refresh cycle of servo
}
void forword(){  //forword
digitalWrite(in1, HIGH); //Right Motor forword Pin
digitalWrite(in2, LOW);  //Right Motor backword Pin
digitalWrite(in3, LOW);  //Left Motor backword Pin
digitalWrite(in4, HIGH); //Left Motor forword Pin
}
void backword(){ //backword
digitalWrite(in1, LOW);  //Right Motor forword Pin
digitalWrite(in2, HIGH); //Right Motor backword Pin
digitalWrite(in3, HIGH); //Left Motor backword Pin
digitalWrite(in4, LOW);  //Left Motor forword Pin
}
void turnRight(){ //turnRight
digitalWrite(in1, LOW);  //Right Motor forword Pin
digitalWrite(in2, HIGH); //Right Motor backword Pin
digitalWrite(in3, LOW);  //Left Motor backword Pin
```

```
digitalWrite(in4, HIGH); //Left Motor forword Pin
}
void turnLeft(){ //turnLeft
digitalWrite(in1, HIGH); //Right Motor forword Pin
digitalWrite(in2, LOW);  //Right Motor backword Pin
digitalWrite(in3, HIGH); //Left Motor backword Pin
digitalWrite(in4, LOW);  //Left Motor forword Pin
}
void Stop(){ //stop
digitalWrite(in1, LOW); //Right Motor forword Pin
digitalWrite(in2, LOW); //Right Motor backword Pin
digitalWrite(in3, LOW); //Left Motor backword Pin
digitalWrite(in4, LOW); //Left Motor forword Pin
}
void send_sms()
{
   Serial.println("sending sms....");
   delay(50);
   sim800L.print("AT+CMGF=1\r");
   delay(1000);
   sim800L.print("AT+CMGS=\""+PHONE+"\"\r");
   delay(1000);
   sim800L.print("Gas Detected\n");
   delay(100);
   sim800L.write(0x1A);
   delay(5000);
}
```

REFERENCES

H. Amano, “Present status and problems of firefighting robots,” IEEE Proceedings of the 41st SICE Annual Conference, Vol. 2, Aug. 2002, pp. 880-885.

T. L. Chien, H. Guo, K.L. Su and S.V. Shiau, “Develop a Multiple Interface Based Fire Fighting Robot,” IEEE International Conference on Mechatronics, May 2007, pp. 1-6.

K. L. Su, “Automatic Fire Detection System Using Adaptive Fusion Algorithm for Fire Fighting Robot,” IEEE International Conference on Systems, Man and Cybernetics, Vol. 2, Oct. 2006, pp. 966-971.

T. Feng, X. Lufeng and T. Daoling, “An ultrasonic obstacle avoidance system for firefighting robot,” ; IEEE Proceedings of the 4th World Congress on Intelligent Control and Automation, Vol. 2, June 2002, pp. 1219-1222.

D. J. Pack, R. Avanzato, D. J. Ahlgren and I. M. Verner, “Fire-fighting mobile robotics and interdisciplinary design-comparative perspectives,” IEEE Transactions on Education, Vol. 47, No. 3, Aug. 2004, pp. 369-376.

S. Dearie, K. Fisher, B. Rajala and S. Wasson, “Design and construction of a fully autonomous firefighting robot,” Electrical Insulation Conference and Electrical Manufacturing & Coil Winding Conference Proceedings, Oct. 2001, pp. 303-310.

D. J. Ahlgren, “Fire-fighting robots and first-year engineering design: trinity college experience,” IEEE 31st Annual Frontiers in Education Conference, Vol. 3, Oct. 2001 pp. S2E-1-6.

D. B. Lopez, F. H. Mendoza and J. M. Ramirez, “Noise in color digital images,” IEEE Circuits and Systems, 1998. Proceedings. 1998 Midwest Symposium on, Aug. 1998, pp. 403-406

Anthony M., Ivan O. and Randy S. (2001), EE 382–Junior Design Firefighting Robot Project, pp. 1-48.

Chien T. L., Guo H., Su K. L. and Shiau S. V. (2007), Develop a multiple interface based firefighting robot, IEEE International Conference on Mechatronics, pp. 1-6.

Kumbhare M., Kumbhalkar S. S. and Malik R. (2012), Firefighting robot: an approach, Indian Streams Research Journal, pp. 1-4.

Kumar P. S., Ratheesh B. R., Gobinath B., Kumaran K. M., Venkataraman S., Gesture Controlled Fire Extinguisher Robot with Audio and Video Capture, Journal of Electronics and Communication Engineering, pp. 1-5.

Tan C. F., Liew S. M., Alkahari M. R., Ranjit S. S. S., Said M. R., Chen W., Rauterberg G. W. M., Sivakumar D. and Sivarao (2013), Fire Fighting Mobile Robot: State of the Art and Recent Development, Australian Journal of Basic and Applied Sciences, 7, 220-230.

Sahulhameed K., Raj W. N. D., Samsudeen S., Noorulhak K. and Nagamani G. S. (2013), Artificial Eye and Sensory based an Intelligent Robot for Fire Extinguishment Task, International Journal on Advanced Computer Theory and Engineering, 2, pp. 101-105.

Chattunyakit S., Kondo T. and Nilkhamhang I. (2013), Development of Robotic Platform for Swarm Robots in Fire Detection Application, Kasetsart Journal Natural Science, 47, pp. 967-976.

Sonsale P., Gawas R., Pise S. and Kaldate A. (2014), Intelligent Fire Extinguisher System, Journal of Computer Engineering, 16, pp. 59-6