FIRE FIGHTING ROBOT

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Agraharam, Rajanna Sircilla Dist. – 505 302, Telangana.

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FIRE FIGHTING ROBOT

MINI PROJECT REPORT

SUBMITTED IN PARTIAL FULFILLMENT

OF THE REQUIREMENTS FOR THE DEGREE OF

BACHELOR OF TECHNOLOGY

IN

ELECTRONICS AND COMMUNICATION ENGINEERING

BY

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CERTIFICATE

Date: /06/2025

This is to certify that project work entitled ***FIRE FIGHTING ROBOT*** *is a Bonafide work carried out by* ***PANNIRU PHANIDHAR, GURRAM SAHITHI, PAVURALA AHALYA ,MATTAM TANISHQ ABHILASH SHASTRI, R JAWAHARLAL*** *and* ***VANGURU VENKATESH*** *bearing Roll No's* ***23RS5A0411, 22RS1A0420, 23RS5A0413, 22RS1A0431, 22RS1A0440*** *and* ***22RS1A0452*** *in partial fulfillment of the requirements for the degree* ***of BACHELOR OF TECHNOLOGY in ELECTRONICS & COMMUNICATION ENGINEERING*** *by the Jawaharlal Nehru Technological University Hyderabad during the academic year 2024-25.*

The results embodied in this report have not been submitted to any other University or Institution for the award of any degree or diploma.

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ABSTRACT

Human intrusion has decreased as a result of the improvements in robotics, and robots are now frequently deployed for security purposes. Fire errors have become common in our daily lives and can occasionally create dangers that make it difficult for the firemen to preserve human life. In these situations, a firefighting robot is utilized to prevent fire incidents from endangering people's lives, property, and the environment.

The project's objective is to create a fire-extinguishing robot. The objective of this firefighting robot is to create Although it is small, the robot is incredibly resilient and flexible. It has a high level of risk, and there have been numerous severe losses. This project was created with the assistance of a MCU board node. Fire is automatically detected by it. With the support of the IOT, we can handle our project. The challenges that the firefighting robot faces have been overcome.

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Chapter 1
Introduction

1.1 Introduction

There are numerous individuals who have tried to find a replacement for human work and efforts with new advancements in embedded design technology as technology for robots has improved and become an essential part of our lives, particularly when people risk their lives in fire hazards. This enables robots to function to the best of their abilities and comprehend complicated and challenging conditions in the wake of a disaster, but it would be labour-intensive for the robots to prevent fire threats rather than react to their occurrence. Cities and large towns are required to have manufacturing systems, and this robot has been designed to work in the challenging topographical conditions found there. Recent modifications include fire extinguishing spread and flame sensors.

Robotics has reduced human intrusion, and they are now frequently utilised for safety purposes. Fire errors have become common in everyday situations and can occasionally create hazards that make it difficult for the firemen to preserve human life. To prevent fire accidents, the firefighting robot is used to protect people's lives, property, and environment. Here, we use two robotic operation modes.

It is a robot that battles fire that can be used to either protect our homes, businesses, and other buildings from fire. The research's unique and fresh idea is that, while no one is home or at work, our robot is going to move towards a suffocating fire in our houses or in buildings housing other companies. When it has done so, it will use water pump to extinguish the fire it has found before sending a signal to an IOT server. These devices can be employed in a variety of locations where it is humanly possible.

1.2 Aim of the Project

The aim of this project is to implement Automatic Fire Detection and Extinguishing system.

The objectives of the project are as follows:

1. To understand the features and architecture of ESP32-CAM Module.
2. To protect human firefighters by handling dangerous situations, such as fires in hazardous environments or structural collapses.
3. It can provide real-time data and surveillance, aiding in decision-making and resource

allocation for firefighting efforts.

4. The firefighting robots are equipped with tools to extinguish fires directly, such as water cannons or chemical suppressants.
5. To develop the necessary code using Embedded C language in Arduino IDE software.

1.3 Methodology

This system is based on the ability to automatically sense environmental fire and extinguish it without human interference. The methodology is divided into two parts. The first part is on the design structure, followed by the hardware description, and the final part is on the programming design. All these parts were assembled together; experiments were then performed to build a system that could extinguish the fire. The system is tested for satisfactory results.

1.4 Significance of the work

In this project we attempt to develop a firefighting robot which can be designed to detect and extinguish fires automatically. The robot is equipped with a flame sensor that detects the presence of fire and triggers the extinguishing mechanism.

It has the following advantages:

- Safety: Reduces the risk to human firefighters by entering dangerous environments.
- Efficiency: Robots can work continuously without fatigue.
- Precision: Advanced sensors and cameras allow robots to detect fires early and respond more effectively.
- Access to unreachable areas: Robots can go into confined spaces or areas where human entry is impossible or dangerous

1.5 Organization of the thesis

This thesis is divided into six chapters including introduction and conclusions. The block diagram, features, pin diagram and other functional units of ESP32 CAM MODULE are explained in Chapter 2. The description of various hardware components and the software used in the project is explained in chapter 3 and chapter 4. The schematic diagram, flowchart, experimental setup and results are discussed in chapter 5. The conclusions in chapter 6.

Chapter 2
Overview of ESP32-CAM Module

2.1 Introduction

ESP32 is a family of low-cost, energy-efficient microcontrollers that integrate both Wi-Fi and Bluetooth capabilities. These chips feature a variety of processing options, including the Tensilica Xtensa LX6 microprocessor available in both dual-core and single-core variants, the Xtensa LX7 dual-core processor, or a single-core RISC-V microprocessor. In addition, the ESP32 incorporates components essential for wireless data communication such as built-in antenna switches, an RF balun, power amplifiers, low-noise receivers, filters, and power-management modules.

Typically, the ESP32 is embedded on device-specific printed circuit boards or offered as part of development kits that include a variety of GPIO pins and connectors, with configurations varying by model and manufacturer. The ESP32 was designed by Espressif Systems and is manufactured by TSMC using their 40 nm process. It is a successor to the ESP8266 microcontroller.

2.2 Types of ESP32-CAM

There are different kinds of ESP32 Cam boards which are discussed below.

2.2.1 ESP32-CAM AI-Thinker

The ESP32-CAM AI-Thinker is a very popular ESP32 CAM development board with an ESP32-S chip & regular 2MP OV2640 camera. This type of ESP32 cam board includes PSRAM – 4MB, is used for image buffering into video streaming from the camera or different tasks & permits you to utilize high quality within your pictures without colliding the ESP32.

This board supports simply a microSD card with 10 available GPIOs & power pins, not all GPIO pins are used but some are being used either by the microSD card or camera. This board is available with an on-board antenna, although it also with an IPEX connector allowing you to utilize alternatively an exterior antenna to develop the range of Wi-Fi communication.

This board has an on-board reset button which helps in restarting your module & also an in-built LED that functions as a flash lamp to light up the region before video streaming or capturing a picture.

2.2.2 ESP-EYE

The ESP32-based ESP-EYE board is dedicated to AI (artificial intelligence) through voice wake-up & face recognition. This board is set with an onboard microphone, 2 MP OV2640 camera, boot, function buttons, two LEDs & reset. This board has some features like; Flash - 4MB, PSRAM – 8MB, type-C a Micro USB connector, an on-board antenna & IPEX connector.

The main benefit of this board is; a USB type-C connector which helps in very fast & easy uploading code to this board. The microphone of this board simply allows you to include a voice feature for your application and PSRAM – 8MB will ensure that your module doesn't collide while using quality settings of the high image.

2.2.3 Freenove ESP32-Wrover CAM Board

This kind of ESP32 CAM development board is available with the ESP32-Wrover-E chip. This module includes the OV2640 camera which is very simple to use as well as set up. This module includes a USB-to-UART converter thus it is simple to upload code into the board.

This board is not available with a microSD card slot but it comes with different available GPIOs, so you can connect an exterior microSD card module easily if required. This board includes some exposed GPIOs which help in connecting other peripherals. In addition, if you are not using the module's camera, then you can utilize it as a normal ESP32 with several accessible GPIOs. This module is also available with RESET & BOOT buttons to make it very easy to reset this module or place it within flashing mode if required.

2.2.4 TTGO T-Camera Plus

The TTGO T-Camera Plus module supports a microSD card, a microphone, an onboard reset button, a 3.7V lithium battery, a battery management circuit, a micro-USB interface, and a 1.3 TFT display. This module comes with some GPIO pins which are used for connecting an on-board BME280 sensor. But this sensor will get hot on the module, thus the manufacturer decided to eliminate the sensor although you will get access still to the GPIOs, thus you can attach other I2C peripherals. So, these GPIOs are accessible simply through a grove connector.

2.2.5 M5-Camera Model A/B

The M5-Camera A/B is similar to other types of modules with the OV2640 camera. This module has PSRAM -4MB so that capturing pictures & streaming through higher quality is

possible. This module includes a LEGO-style enclosure with a grove connector which is perfect for connecting additional M5-Stack expansions such as; the MPU6050 gyroscope or accelerometer, a microphone, and a BME280 temperature, pressure & humidity sensor.

2.2.6 TTGO T-Journal

This type of ESP32 cam module includes an OV2640 camera, a 0.91-inch I2C SSD1306 OLED display, an exterior antenna, a function button, some exposed GPIOs, a micro-USB & a battery connector. This OLED display helps in displaying the IP address of the board, otherwise, any errors when debugging. This board has four accessible GPIOs where two are used for I2C communication & remaining ones are suitable for connecting servo motors. This development board has a connector, which helps in connecting a 3.7V Li battery.

2.3 ESP32-CAM Module

The ESP32-CAM is a small-size, low-power camera module based on **ESP32**. It comes with an **OV2640 camera** and provides an onboard TF card slot. This board has **4MB PSRAM** which is used for buffering images from the camera into video streaming or other tasks and allows you to use higher quality in your pictures without crashing the ESP32. It also comes with an onboard LED for flash and several GPIOs to connect peripherals.

2.3.1 Features of ESP32-CAM Module

- This module supports WIFI and Bluetooth.
- It has an OV2640 camera by flash.
- It has an Onboard TF card slot that supports up to 4G TF cards used for data storage
- It supports Wi-Fi video monitoring & image upload.
- It supports different sleep modes with 6mA low a deep sleep current.
- The control interface can be accessible easily through a pin header.
- It is very easy to integrate & embedded into consumer products
- ESP-32S WIFI module.
- ESP32-D0WD Processor.
- Built-in 32Mbit Flash.
- Internal 512KB RAM.

- External 4M PSRAM.
- Onboard PCB Antenna.
- IEEE 802.11 b/g/n/e/i WIFI protocol.
- Bluetooth is Bluetooth 4.2 BR/EDR & BLE.
- Station or SoftAP or SoftAP+Station WIFI mode.
- WPA or WPA2 or WPA2-Enterprise or WPS Security.
- Its o/p image format is JPEG, GRAYSCALE & BMP.
- It supports up to 4G TF cards.
- UART/ I2C/ SPI/PWM Peripheral interface.
- I/O ports -9
- Baud rate of UART is 115200bps by default.
- The power supply is 5V.
- Flash off at 5V is 180mA
- Flash on & maximum brightness at 5V is 310mA.
- Deep-Sleep is 6mA at 5V.
- The operating temperature ranges from -20 ℃ to 85 ℃.
- Its dimensions are 40.5mm x 27mm x 4.5mm.

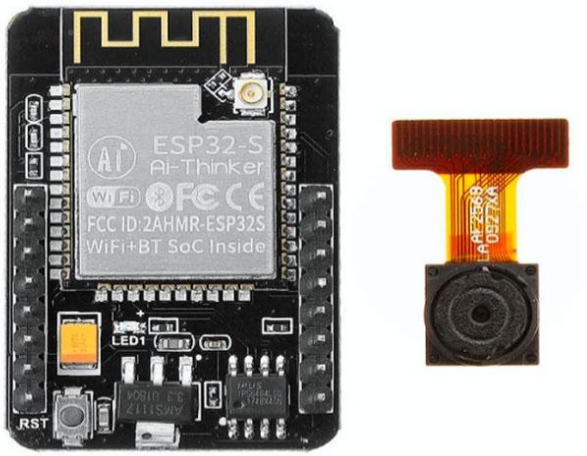

Figure 2.1: ESP32-CAM Module

2.3.2 Description of ESP32-CAM Module

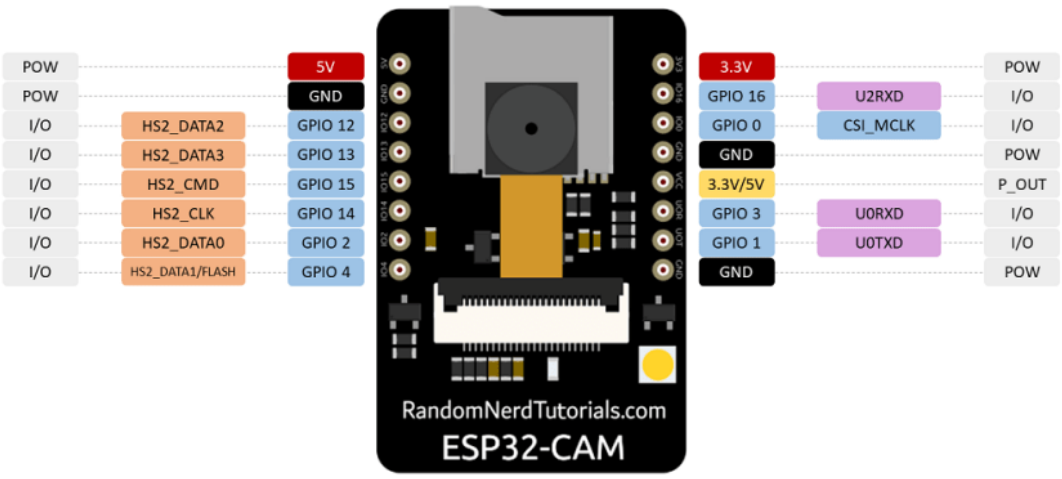

Figure 2.2: ESP32-CAM Module Top View

2.3.2 Pin Description of ESP32-CAM Module

The ESP32-CAM module has several GPIO pins that serve different functions, including power, communication, and peripheral interfacing.

Key Pin Functions

- Power Pins:
    - 5V – Main power supply.
    - 3.3V – Alternative power supply.
    - GND – Ground connection.
- GPIO Pins:
    - GPIO 0 – Boot mode selection.
    - GPIO 1 (TX) & GPIO 3 (RX) – UART communication.
    - GPIO 2, 4, 12, 13, 14, 15 – Used for MicroSD card interface.
    - GPIO 16 – Connected to internal PSRAM.
    - GPIO 33 – Built-in red LED indicator**.**
- Camera Interface:
    - GPIO 5, 18, 19, 21, 36, 39, 34, 35 – Data transfer.
    - GPIO 0 – Clock signal.

- GPIO 22, 25, 23 – Synchronization signals.
- GPIO 26, 27 – I2C communication.

These pins allow the ESP32-CAM to interact with various peripherals, including sensors, storage devices, and communication modules.

2.4 ESP32-CAM MB

The ESP32-CAM-MB is a base module designed to work with the ESP32-CAM, a low-cost development board with a camera module. This module facilitates easier connections and programming of the ESP32-CAM by providing a USB-UART interface and other enhancements.

2.4.1 Features of ESP32-CAM MB

- USB-UART Interface: The ESP32-CAM-MB includes a CH340C USB-UART chip, which simplifies the process of uploading code to the ESP32-CAM.
- External Reset Pin: The ESP32-CAM V1.6 lacked an exposed reset pin, making it less user-friendly. The ESP32-CAM-MB addresses this by providing an external reset pin, making it easier to reset the device.
- Enhanced Stability: The ESP32-CAM V1.6 had issues with stability due to the lack of a buffer capacitor on the LDO input.
- Auto Download: The ESP32-CAM-MB supports auto-download functionality, making it easier to upload code without manual intervention.

2.4.2 Description of ESP32-CAM MB

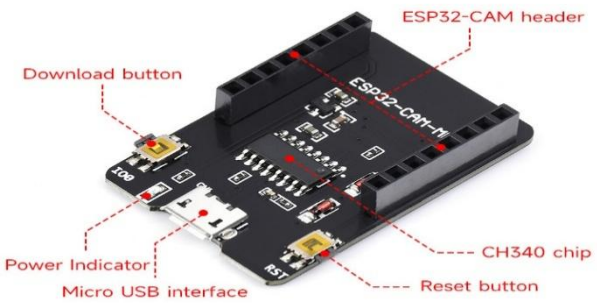

Figure 2.3: ESP32-CAM MB Module Top View

2.4.3 Pin Description of ESP32-CAM MB

The ESP32-CAM MB is a development board designed to simplify programming and interfacing with the ESP32-CAM module. It provides a USB-to-serial converter for easy flashing and debugging.

Key Pin Functions

- **Power Pins**:
    - **5V** – Main power supply.
    - **3.3V** – Alternative power supply.
    - **GND** – Ground connection.
- **GPIO Pins**:
    - **GPIO 0** – Boot mode selection.
    - **GPIO 1 (TX) & GPIO 3 (RX)** – UART communication.
    - **GPIO 2, 4, 12, 13, 14, 15** – Used for MicroSD card interface.
    - **GPIO 16** – Connected to internal PSRAM.
    - **GPIO 33** – Built-in red LED indicator.
- **Camera Interface**:
    - **GPIO 5, 18, 19, 21, 36, 39, 34, 35** – Data transfer.
    - **GPIO 0** – Clock signal.
    - **GPIO 22, 25, 23** – Synchronization signals.
    - **GPIO 26, 27** – I2C communication.

2.5 Conclusions

In this chapter the history of ESP32-CAM Module and salient features of different types of ESP32-CAM are explained. The architecture ESP32-CAM Module is discussed along with its pin configuration.

Chapter 3
Hardware Description

3.1 Introduction

One of the most important components in the creation of a firefighting robot is the hardware component. It has a motor driver, an ESP32 Cam Module, flame sensors, a submersible water pump, motors, and rubber wheels. Flame sensors provide the input for the firefighting robot in block diagram. A development board called ESP32 Cam Module is employed to link other parts.

3.2 Block Diagram

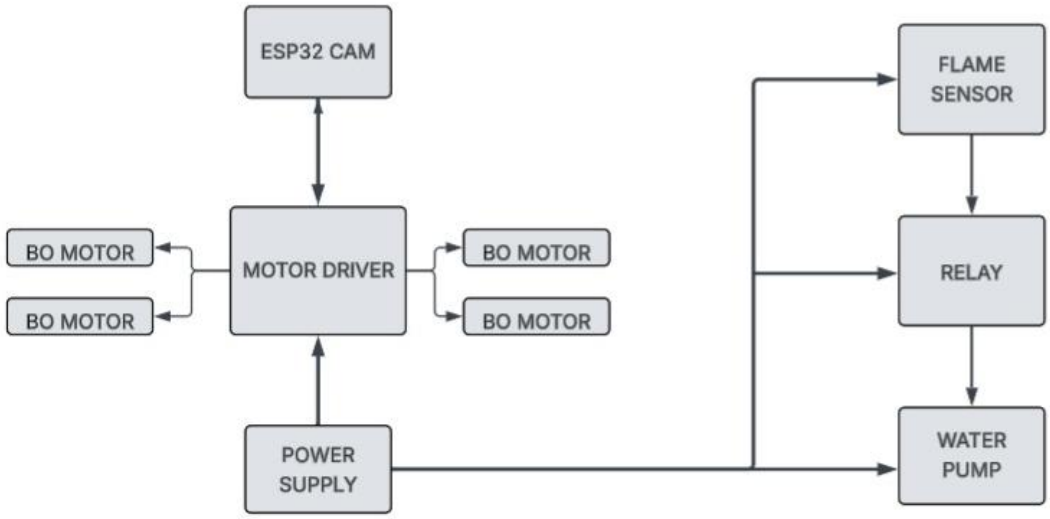

Figure 3.1: Block Diagram

3.2.1 Block Diagram Description

The firefighting robot is designed to detect and extinguish fires automatically. The robot is equipped with a flame sensor that detects the presence of fire and triggers the extinguishing mechanism. The robot also has an ESP32 Cam Module that helps it navigate through the environment and avoid obstacles.

The flame sensor is connected to one of the pins of the relay. When the sensor detects a flame, it sends a signal to the Relay, which triggers the extinguishing mechanism. The extinguishing mechanism consists of a motor that drives a water pump, which sprays water on the fire. The motors are controlled by an L293D motor driver, which is connected to the ESP32 Cam Module.

3.3 L298N Motor Driver

This L298N Motor Driver Module is a high-power motor driver module for driving DC and Stepper Motors. This module consists of an L298 motor driver IC and a 78M05 5V regulator. L298N Module can control up to 4 DC motors, or 2 DC motors with directional and speed control.

Figure 3.2 L298N Motor Driver Module

3.3.1 Features of L298N Motor Driver

- **Driver Model:** L298N (Dual H-Bridge Motor Driver)
- **Motor Supply Voltage:** Up to 46V
- **Motor Supply Current:** Maximum of 2A per channel
- **Logic Voltage:** 5V (TTL compatible)
- **Driver Voltage:** 5V–35V
- **Maximum Power:** 25W
- **Current Sense:** Available for each motor
- **Speed Control:** Supports PWM (Pulse Width Modulation)
- **Direction Control:** Uses H-Bridge technique
- **Built-in Voltage Regulator:** 78M05 (5V regulator)
- **Heat Sink:** Included for better performance
- **Power-On LED Indicator:** Helps in monitoring power status
- **Control Capability:** Can drive up to 4 DC motors or 2 DC motors with speed and directional control

3.3.2 Description of L298N Motor Driver

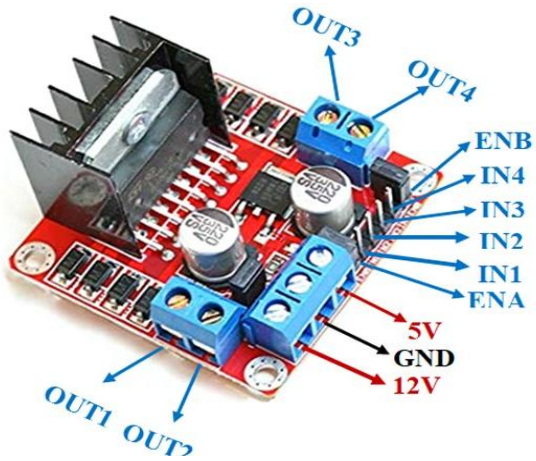

Figure 3.3 Pin Description L298N Motor Driver Module

3.3.3 Pin Description of L298N Motor Driver

The L298N Motor Driver is a dual H-Bridge motor driver that allows control of DC motors and stepper motors. It operates at voltages up to 46V and can handle a maximum current of 2A per channel. The module includes a 78M05 voltage regulator, which provides 5V logic compatibility. It supports PWM (Pulse Width Modulation) for speed control and H-Bridge techniques for direction control. Additionally, it features heat sinks for better performance and power-on LED indicators

- **VCC**: Supplies power to the motor (5V–35V).
- **GND**: Ground connection.
- **+5V**: Supplies power for the logic circuitry
- **ENA & ENB**: Enable pins for Motor A and Motor B (used for speed control via PWM).
- **IN1 & IN2**: Control pins for Motor A (set HIGH/LOW to control direction).
- **IN3 & IN4**: Control pins for Motor B (set HIGH/LOW to control direction).
- **OUT1 & OUT2**: Output terminals for Motor A.
- **OUT3 & OUT4**: Output terminals for Motor B.

3.3.4 Interfacing of Motor Driver with ESP32-CAM

1.Power Supply:

- A 7–12V DC adapter or battery pack is used to power the system

- The positive terminal (+) is connected to the 12V pin on the L298N motor driver.
- The negative terminal (–) is connected to GND on the L298N.

2. L298N to Motors:

- OUT1 and OUT2 → Connected to Right Motor 1.
- OUT3 and OUT4 → Connected to Right Motor 2.
- OUT1 and OUT2 → Also connected to Left Motor 1.
- OUT3 and OUT4 → Also connected to Left Motor 2.

3. ESP32-CAM Power:

- 5V pin of ESP32-CAM → Connected to regulated L298N
- GND of ESP32-CAM → Connected to GND of L298N to ensure common ground

4. ESP32-CAM to L298N Control Pins:

- GPIO13 → Connected to IN1 of L298N (controls Motor A direction).
- GPIO15 → Connected to IN2.
- GPIO14 → Connected to IN3 (controls Motor B direction).
- GPIO2 → Connected to IN4.

5. Enable Pins (Optional PWM for Speed Control):

- ENA → Connect to a PWM-enabled GPIO12.
- ENB → Connect to another PWM-enabled GPIO12.

3.4 BO Motors

BO Motors are battery-operated DC motors commonly used in robotics and DIY projects. They come in different RPM variations, such as 100 RPM, 150 RPM, and 300 RPM, and are available in single-shaft and dual-shaft designs. These motors are lightweight, cost-effective, and provide good torque at lower operating voltages, making them ideal for small robotic applications.

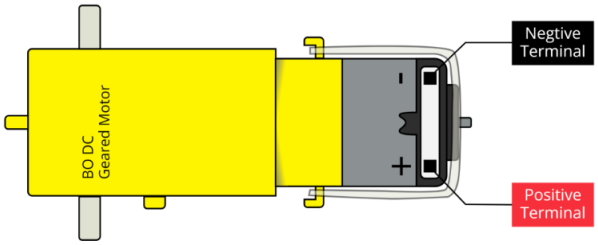

Figure 3.4 BO Motors

3.5 Flame Sensor

A flame sensor definition is a type of detector that is used to detect as well as react to the occurrence of a fire or flame. A flame sensor frequently responds faster & more precisely as compared to a heat because of the mechanisms it utilizes to notice the flame.

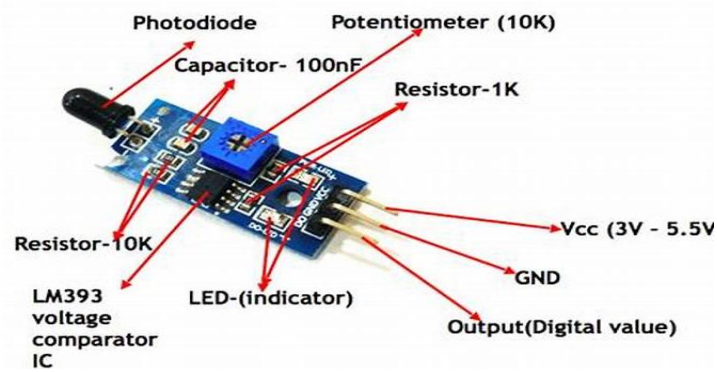

Figure 3.5 Flame Sensor

3.5.1 Features of Flame Sensor

- **Sensing Range:** Few centimetres up to several meters.
- **Detection Angle:** Narrow angles such as 60 degrees or 90 degrees.
- **Response Time:** Few milliseconds to several seconds.
- **Operating Voltage:** The Voltage ranges from 3.3V, 5V, or 12V, depending on the sensor.
- **Output Type:** Digital or Analog.

3.5.2 Working Principle of Flame Sensor

The working flame sensor, at the top, is a photodiode available and is detected the fire. if the fire is detected the photodiode anode pin is high and is given to the signal of LM393 IC.

If the fire is detected The Digital value is LOW(0v) and if not detected any fire the output value is HIGH(5v)

3.5.3 Pin Description of Flame Sensor

- **VCC** – Power supply pin (typically 3.3V to 5V).
- **GND** – Ground connection.
- **AOUT** (Analog Output) – Provides an analog signal proportional to flame intensity.

- **DOUT** (Digital Output) – Outputs HIGH (1) when no flame is detected and LOW (0) when a flame is detected**.**

3.5.4 Interfacing of Flame Sensor with Relay

Flame Sensor

- VCC → Connect to 5V Battery
- GND → Connect to GND.
- DOUT → Connect to a digital input pin of the microcontroller.

Relay Module:

- VCC → Connect to 5V.
- GND → Connect to GND.
- IN → Connect to the microcontroller's digital output pin.

3.6 Relay

Figure 3.6 Relay

3.6.1 Features of Relay

- 12V DC SPDT Relay
- Rated up to 7A @240VAC
- Fully Sealed

3.6.2 Description of Relay

The Single Pole Double Throw SPDT relay is quite useful in certain applications because of its internal configuration. It has one common terminal and 2 contacts in 2 different configurations: one can be Normally Closed and the other one is opened or it can be Normally Open and the other one closed. So basically, you can see the SPDT relay as a way of switching between 2 circuits: when there is no voltage applied to the coil one circuit "receives" current, the other one doesn't and when the coil gets energized the opposite is happening.

3.6.3 Pin Configuration of Relay

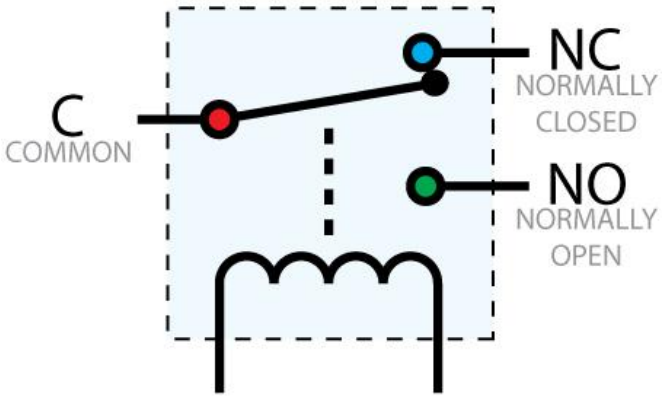

Fig 3.7: Pin Configuration of Relay

- **Coil End 1-** Used to trigger (On/Off) the Relay, normally one end is connected to 12V and the other end to ground.
- **Coil End 2** - Used to trigger (On/Off) the Relay, normally one end is connected to 12V and the other end to ground.
- **Common (COM)** - Common is connected to one End of the Load that is to be controlled.
- **Normally Close (NC)** - The other end of the load is either connected to NO or NC. If connected to NC the load remains connected before trigger.
- **Normally Open (NO)** - The other end of the load is either connected to NO or NC. If connected to NO the load remains disconnected before trigger.

3.7 Mini DC Submersible Pump

A mini-DC submersible pump is a small water pump that is designed to be used underwater. Mini DC submersible pumps are usually compact in size and have a low power consumption, making them ideal for use in small water systems. They typically have a flow rate of 50-500 litres per hour.

Fig 3.8: Mini DC Submersible Pump

3.8 Breadboard

A breadboard is a rectangular plastic board with a bunch of tiny holes in it. Most electronic components in electronic circuits can be interconnected by inserting their leads or terminals into the holes and then making connections through wires where appropriate.

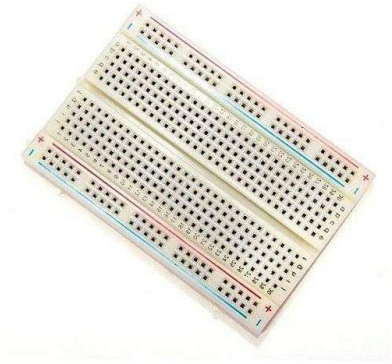

Fig 3.9: Breadboard

3.9 Jumper Wires

Jumper wires are used to connect two points in a circuit. All Electronics stocks jumper wire in a variety of lengths and assortments. Male jumpers are designed to plug securely into the holes in a breadboard. Female jumpers are useful for connecting male header posts and pin terminals on components. Jumpers are available in female- female, male-male and male-female configurations.

Fig 3.10: Jumper Wires

3.10 Conclusions

In this chapter different hardware modules involved in the project are discussed and their interfacing is explained

Chapter 4

Software Tools

4.1 Introduction

The software tools which are used in this project are Arduino IDE, Embedded C, Blynk IoT Application and Proteus Software.

4.2 Arduino IDE

Arduino IDE (Integrated Development Environment) is used to write code to interface different modules with an Arduino board. An Arduino board connects to the computer via USB cable. Arduino IDE is user friendly where code can be written and various toolbars are available for easy programming. Arduino IDE interface is shown in Fig. 4.1.

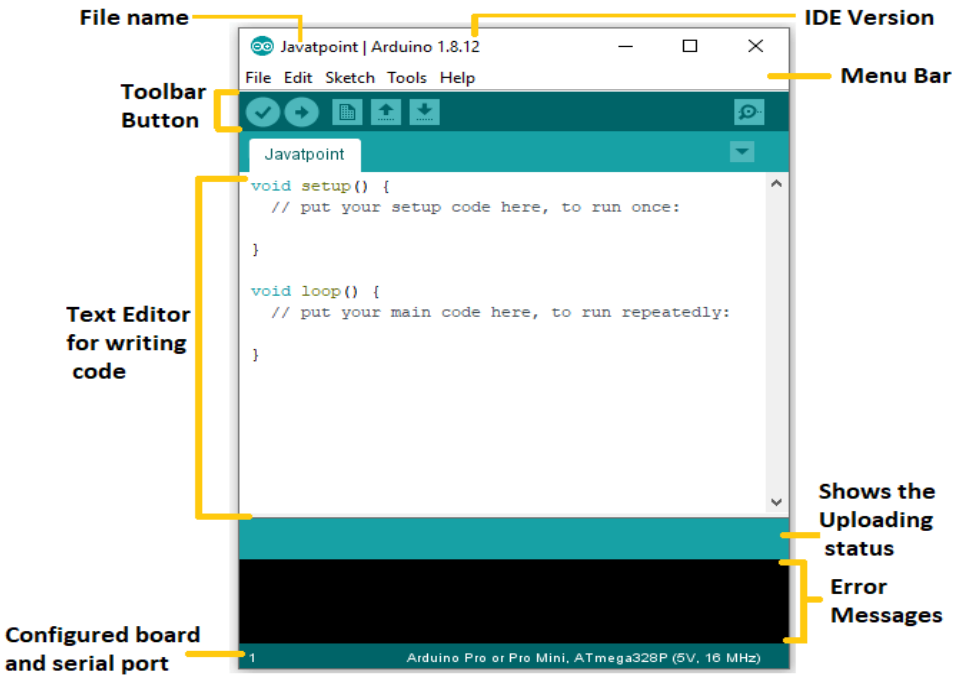

Fig 4.1: Arduino IDE

Steps to follow for Arduino programming IDE:

Step 1: Choose a suitable Arduino board and connect it to PC using USB cable.

Step 2: Arduino IDE Software should be downloaded and installed from the website.

Step 3: Provide power supply. Most Arduino boards have USB as a power source. Adaptor can also be a choice. The power LED named PWR glows on the power supply.

Step 4: Start Arduino IDE. Open the installed software by double click.

Step 5: Initiate a project. It can be done in two ways:

1. A new project can be designed.
2. An existing project can be reviewed.

Step 6: Type of Arduino board needs to be selected. Any discrepancy can be eliminated while uploading code if a compatible board is chosen. Board can be chosen from the toolbar.

Step 7: Configuration of Serial port. See the port to which Arduino is connected and select that port like COM3.

Step 8: The program can now be uploaded to the board. The code is finally dumped and the result can be verified. Done uploading is seen on screen if upload is successful.

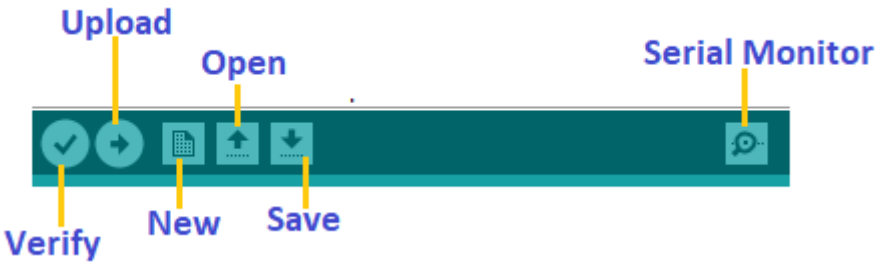

Fig 4.2: Arduino IDE tool bar

4.3 Embedded C

Embedded C is a set of language extensions for the C programming language by the C Standards Committee to address commonality issues that exist between C extensions for different embedded systems. In 2008, the C Standards Committee extended the C language to address these issues by providing a common standard for all implementations to adhere to. It includes a number of features not available in normal C, such as, fixed point arithmetic, named address spaces, and basic I/O hardware addressing.

4.7 Conclusions

In this chapter, software tools like Arduino IDE, Embedded C, are studied.

Chapter 5

Results and Discussion

5.1 Introduction

In this chapter we discuss the project outputs and the sequential process of the project, i.e., flowchart of the project, and schematic diagram of setup, explanation of experimental setup, and results of the project.

5.2 Schematic diagram

Figure 5.1 shows the schematic diagram of the project.

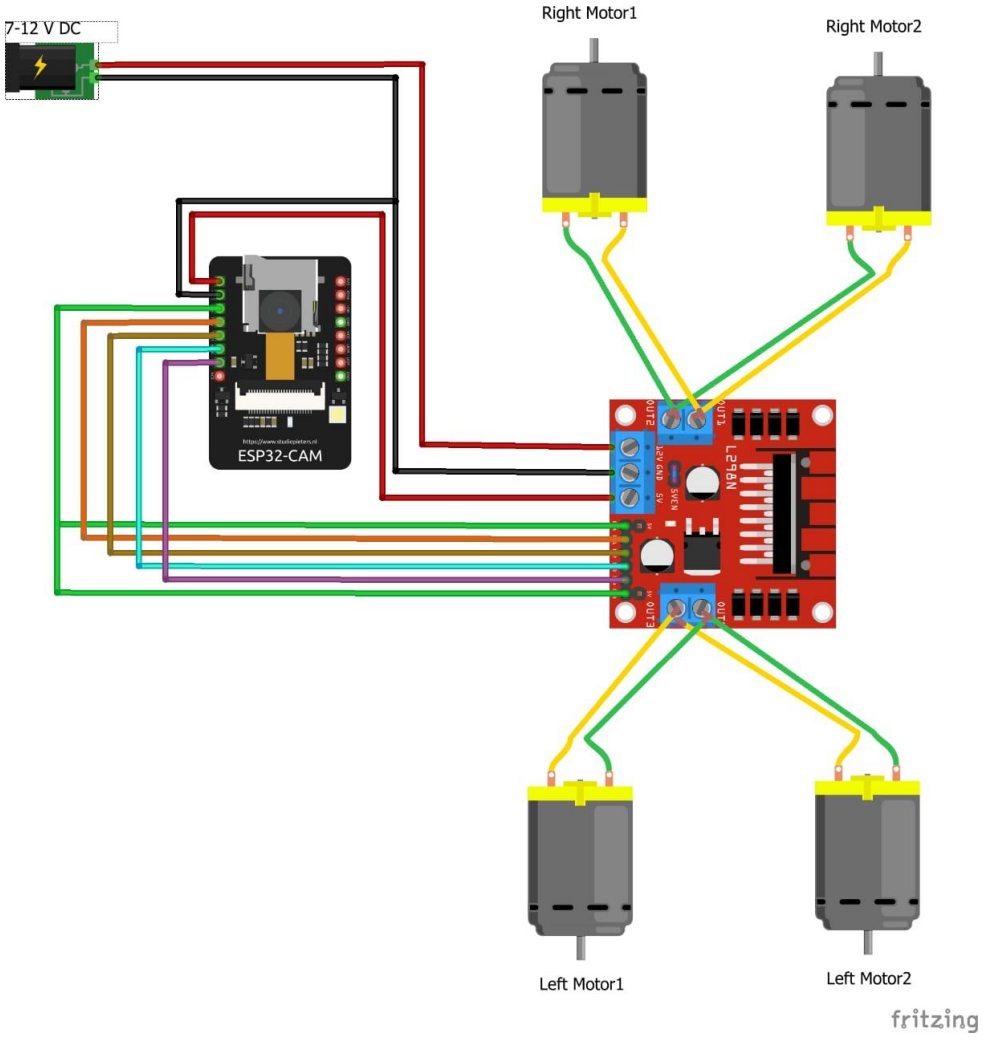

Fig 5.1: Schematic diagram of the project 1

The L298N Motor Driver is interfaced with ESP32-CAM Module. All the other components are connected with their respective pin connections. The circuit is connected as per the schematic diagram shown above.

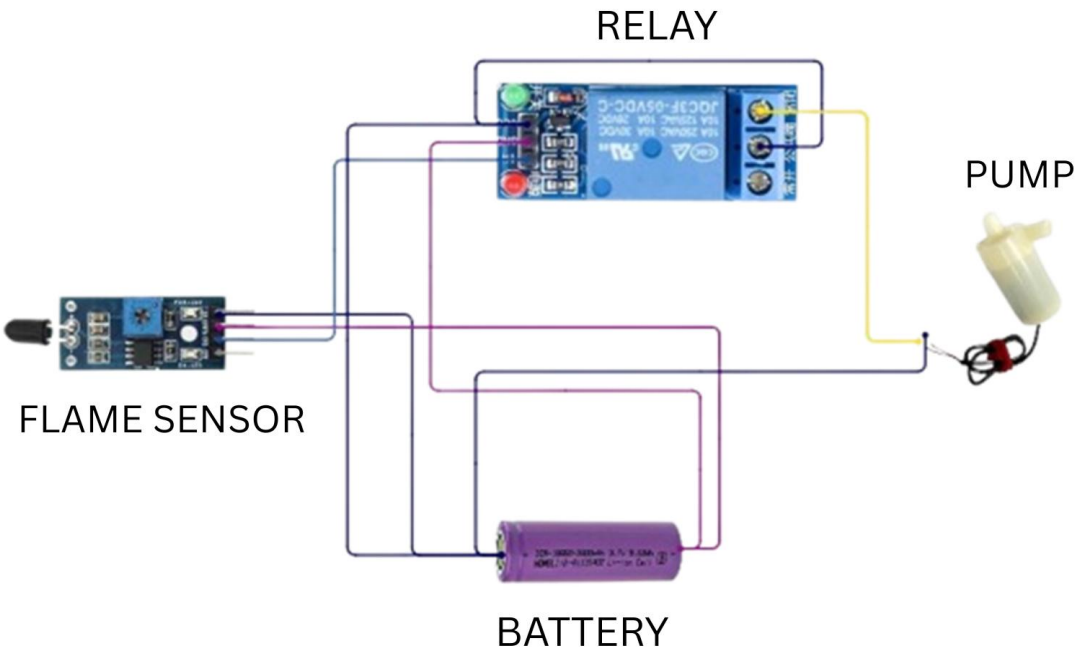

Fig 5.2: Schematic diagram of the project 2

The Flame Sensor is interfaced with Relay and Mini DC Submersible Pump. All the other components are connected with their respective pin connections. The circuit is connected as per the schematic diagram shown above.

5.3 Flowchart

Figure 5.2 shows the flowchart of Project.

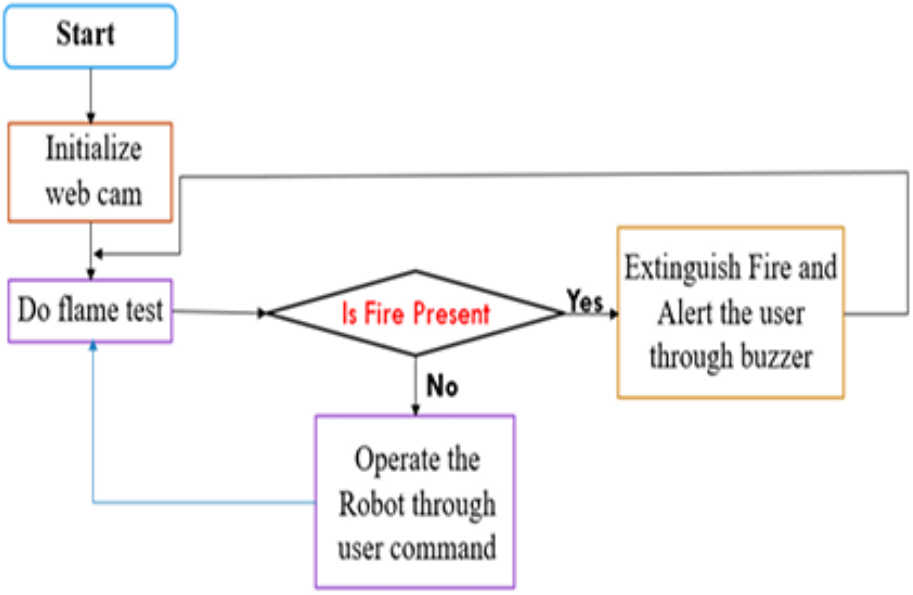

Fig 5.3: Flowchart

5.4 Experimental Setup

Figure 5.4 shows the experimental setup of the project.

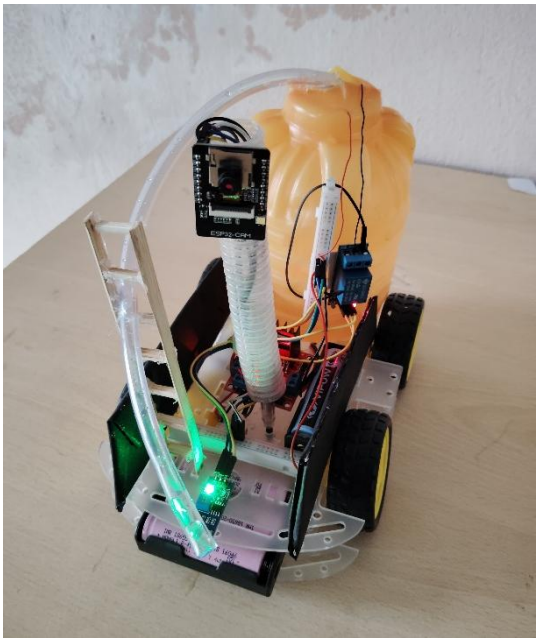

Fig 5.4: Experimental Setup

5.5 Results

The following figures show the results obtained during this project.

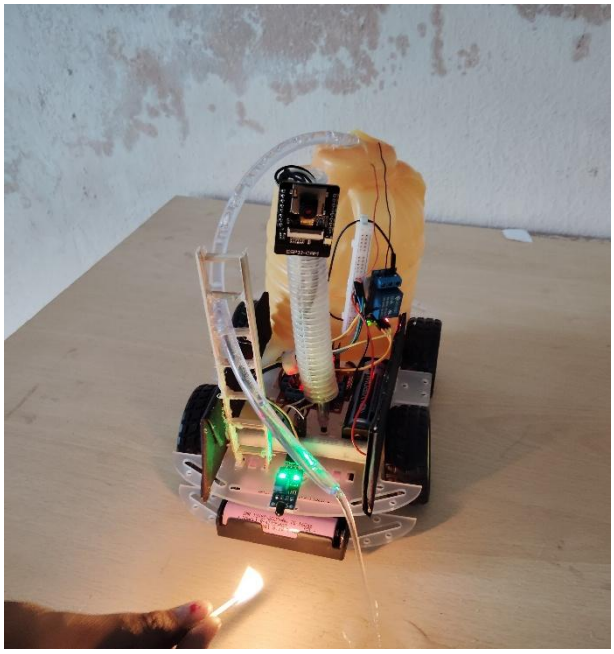

Fig 5.5: Fire detected

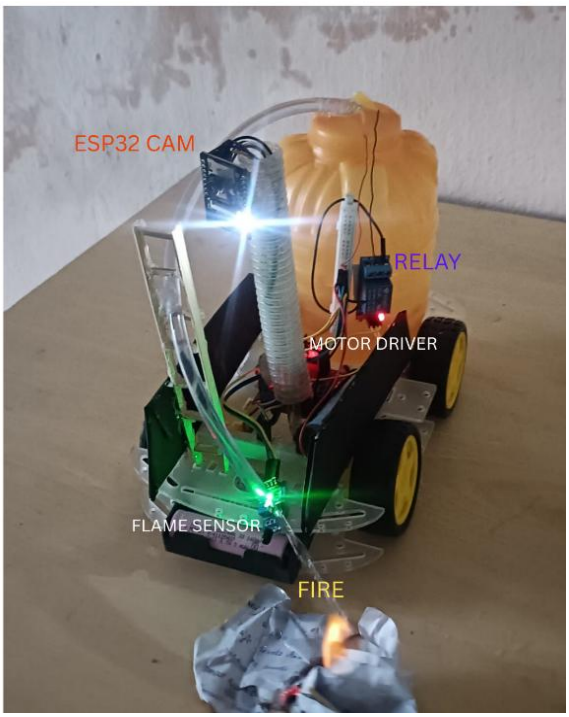

Fig 5.6: Fire Extinguished

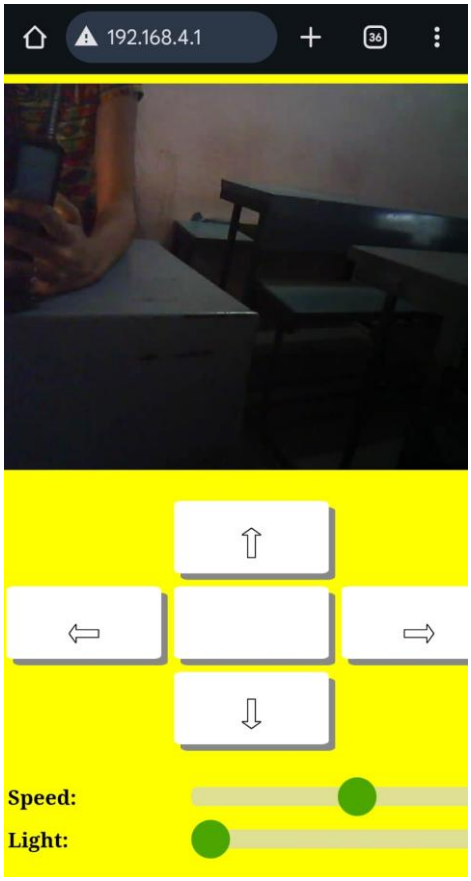

Fig 5.7 Control Unit

5.6 Conclusions

In this chapter we have seen the schematic diagram, flowchart, experimental setup of the project and their results during various operations.

Chapter 6

Conclusions

The Automated Fire Fighting Robot using ESP32-CAM Module is an innovative project that demonstrates the potential of using technology to fight fires more effectively and efficiently. The project provides a safer environment for firefighters and helps reduce the risks associated with firefighting. The project can be further improved by incorporating advanced sensors and actuators to enhance the robot's capabilities.

Through this project, we have shown that it is possible to create an automated firefighting robot that can detect and respond to fire in a timely and efficient manner. The use of ESP32-CAM Module, an open-source microcontroller, has made the project cost-effective and accessible to a wide range of users

References

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