



Khulna University of Engineering and Technology

Course Name: Peripherals and Interfacing Laboratory Course No : CSE3104

Project Topic: Automatic Fire Extinguisher

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Table of Content

1. Objectives -----	2
2. Introduction -----	2
3. Apparatus Require -----	3
4. Component Details -----	4
4.1. Arduino Uno	
4.2. LED (Light Emitter Diode)	
4.3. Flame Sensor Module	
4.4. Buzzer	
4.5. Relay Module	
4.6. Water Pump	
4.7. Paper Board	
5. Working Principle -----	10
6. Pseudo code -----	11
7. Flow Chart -----	12
8. Project Picture -----	13
9. Application-----	18
10. Limitation-----	18
11. Future Plans-----	19
12. Discussion-----	20
13. Conclusion-----	20

Objectives:

1. To detect the presence of fire using a flame sensor module.
2. To activate an alarm (buzzer) and visual indication (LED) when fire is detected.
3. To trigger a relay switch to close all electric circuits, ensuring safety measures.
4. To incorporate a water splash mechanism for immediate fire suppression.
5. To implement the system using Arduino and other necessary components.

Introduction:

The fire detecting alarming system with water splash and circuit closure using Arduino is a vital solution designed to detect fire, activate alarms, and ensure safety measures are initiated promptly. By incorporating a flame sensor module, the system can detect the presence of fire based on infrared radiation emitted by flames. Upon detection, an alarm (buzzer) and visual indication (LED) are activated to alert nearby individuals. The system also includes a relay switch to close all electric circuits, preventing further damage and potential hazards. Additionally, a water splash mechanism is integrated to suppress the fire. With its versatile Arduino microcontroller, the system provides customizable and adaptable fire safety measures for residential, commercial, and industrial applications.

Apparatus Required:

- Arduino Uno
- LED (Light Emitting diode)
- Flame Sensor Modul
- Buzzer
- 12v & 7.4v Battery
- 5v Relay Module
- Mini Water Pump
- Pipe
- Paperboard
- Bread Board
- Jumper Wires

Component Details:

Arduino Uno:

The Arduino Uno is a popular microcontroller board that acts as the brain of the robotic arm system. It provides the necessary computational power and I/O capabilities to control and coordinate the movement of the arm. The Arduino Uno is user-friendly, flexible, and supports a wide range of programming languages, making it an ideal choice for peripheral applications.



Fig : Arduino Uno

LED(Light Emitting Diode):

A light-emitting diode (LED) is a semiconductor device that emits light when an electric current flows through it. When current passes through an LED, the electrons recombine with holes emitting light in the process. LEDs allow the current to flow in the forward direction and blocks the current in the reverse direction.



Fig : LEDs

Flame Sensor Module:

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 or smoke sensor because of the mechanisms it utilizes to notice the flame. Flame sensors are usually used to verify whether the furnaces are functioning correctly. These sensors are also used in an ignition system to get precise actions otherwise to inform the operator.



Fig : Flame sensor module

Buzzer:

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



Fig : Buzzer

Battery:

A 3.7V battery typically refers to a lithium-ion or lithium-polymer battery with a nominal voltage of 3.7 volts. These batteries are widely used in portable electronic devices, such as smartphones, tablets, digital cameras, and other small electronics.



Fig : 3.7V Battery

Relay Module:

Relay is an electromechanical device that uses an electric current to open or close the contacts of a switch. The single-channel relay module is much more than just a plain relay, it comprises of components that make switching and connection easier and act as indicators to show if the module is powered and if the relay is active or not.

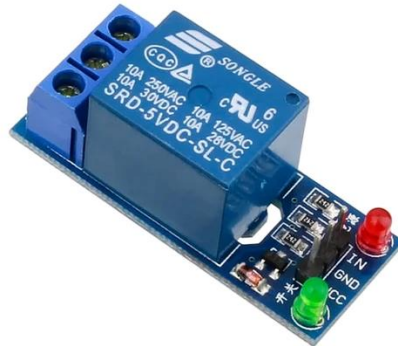


Fig : Relay Module

Water Pump:

A mini submersible water pump is a centrifugal water pump, which means that it uses a motor to power an impeller that is designed to rotate and push water outwards. The motor is located in a waterproof seal and closely connected to the body of the water pump which it powers.



Fig : Water Pump

Pipe:



Fig : Pipe

Paper Board:



Fig : Paper Board

Bread Board:

A breadboard is a fundamental tool used in electronics prototyping and circuit design. It provides a convenient platform for quickly building and testing circuits without the need for soldering.

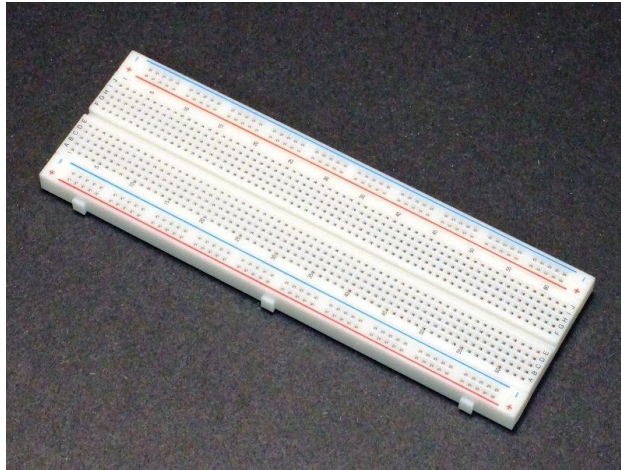


Fig : Bread Board

Jumper wires:

Jumper wires are simply wires that have connector pins at each end, allowing them to be used to connect two points to each other without soldering. Jumper wires are typically used with breadboards and other prototyping tools in order to make it easy to change a circuit as needed. Fairly simple. In fact, it doesn't get much more basic than jumper wires.

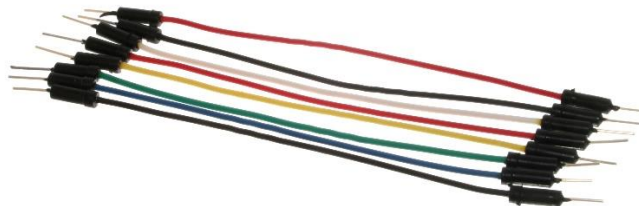


Fig : Jumper Wires

Working Principle:

The fire detecting alarming system with water splash and circuit closure operates based on the following working principle:

Fire Detection: The system employs a flame sensor module that detects the presence of fire by capturing the infrared radiation emitted by flames. The module converts the detected radiation into an electrical signal, which is then analyzed by the system to determine the presence or absence of a fire.

Alarm Activation: Upon detecting a fire, the system triggers an audible alarm in the form of a buzzer. This alarm serves as an immediate alert to individuals in the vicinity, prompting them to take necessary actions and evacuate the area.

Visual Indication: Simultaneously, a visual indication is activated using an LED. This visual signal provides a clear and visible indication of the fire's presence, enhancing awareness and ensuring prompt responses.

Circuit Closure: To enhance safety and minimize electrical hazards, the system incorporates a relay switch. When a fire is detected, the relay switch is triggered, resulting in the closure of all electric circuits in the vicinity of the fire. This action isolates the affected area from the power supply, preventing fire from spreading through electrical connections and reducing the risk of electrical accidents.

Water Splash Mechanism: As an additional safety measure, the system incorporates a water splash mechanism. Once a fire is detected, a motor-driven mechanism is activated to release a controlled amount of water. This immediate response helps to suppress the fire, containing and extinguishing it at its early stages.

Arduino Control: The entire system is controlled and coordinated by an Arduino microcontroller. The Arduino reads the electrical signal from the flame sensor module, triggers the alarm, activates the visual indication, controls the relay switch, and coordinates the water splash mechanism. Its programmable capabilities allow for customization, flexibility, and future enhancements.

Pseudo Code:

a. Define constants for pin

Define Flame Pin

Define Buzzer Pin

Define Relay Pin

Define LED Pin

Define Flame Value as Global Variable

b. Set pin modes

Set Pin Mode Flame Pin as INPUT

Set Pin Mode Buzzer Pin as OUTPUT

Set Pin Mode Relay Pin as OUTPUT

Set Pin Mode Led Pin as OUTPUT

Set Pin Mode Flame Pin as OUTPUT

c. Main Program loop

Read Flame Value from Flame Pin

IF Flame Value is HIGH then

Turn on the Buzzer

Turn on the Relay

Turn of the LED

ELSE

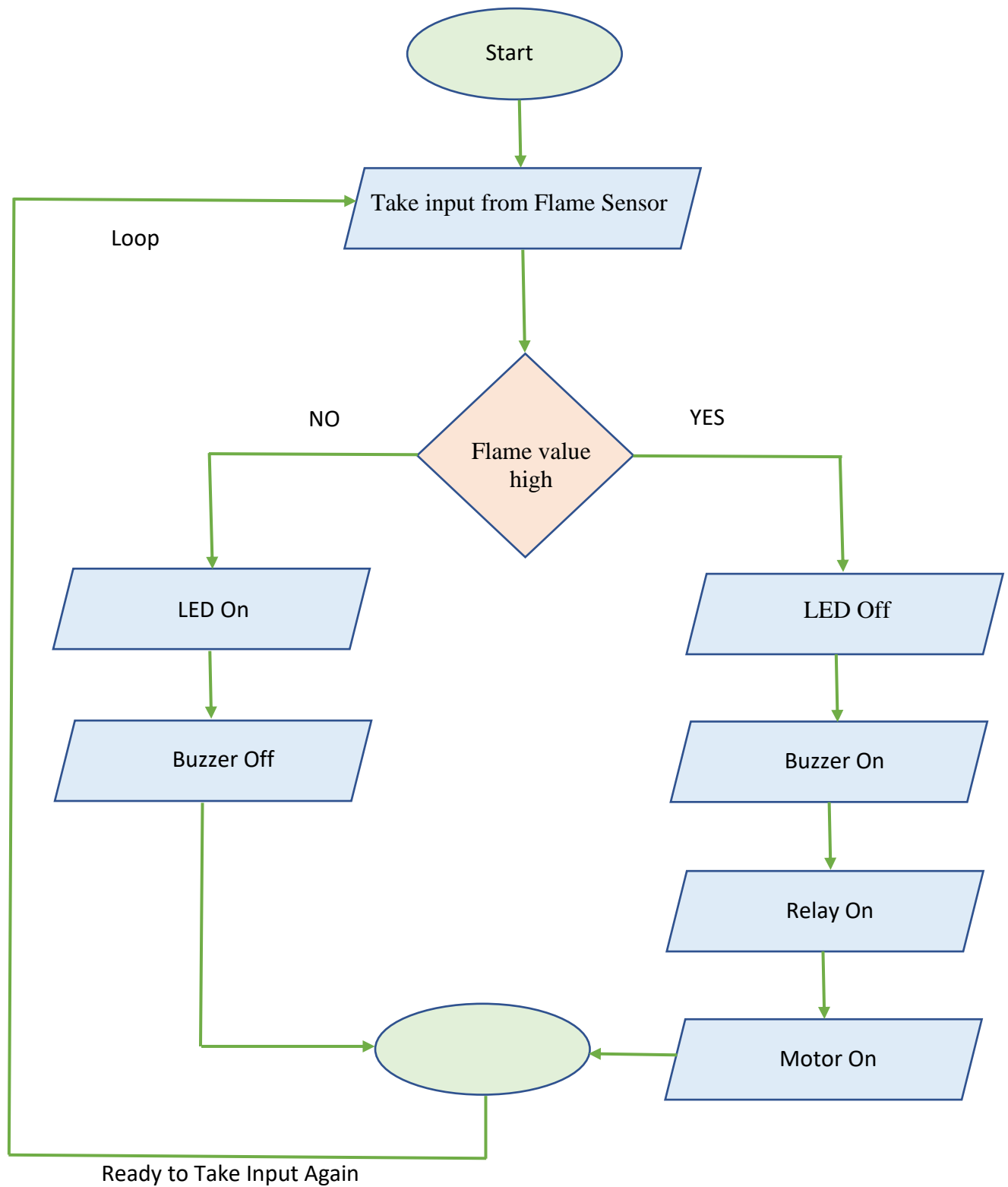
Turn Off Buzzer

Turn Off Relay

Turn On LED

Set Delay

Flow Chart:



Application Picture:

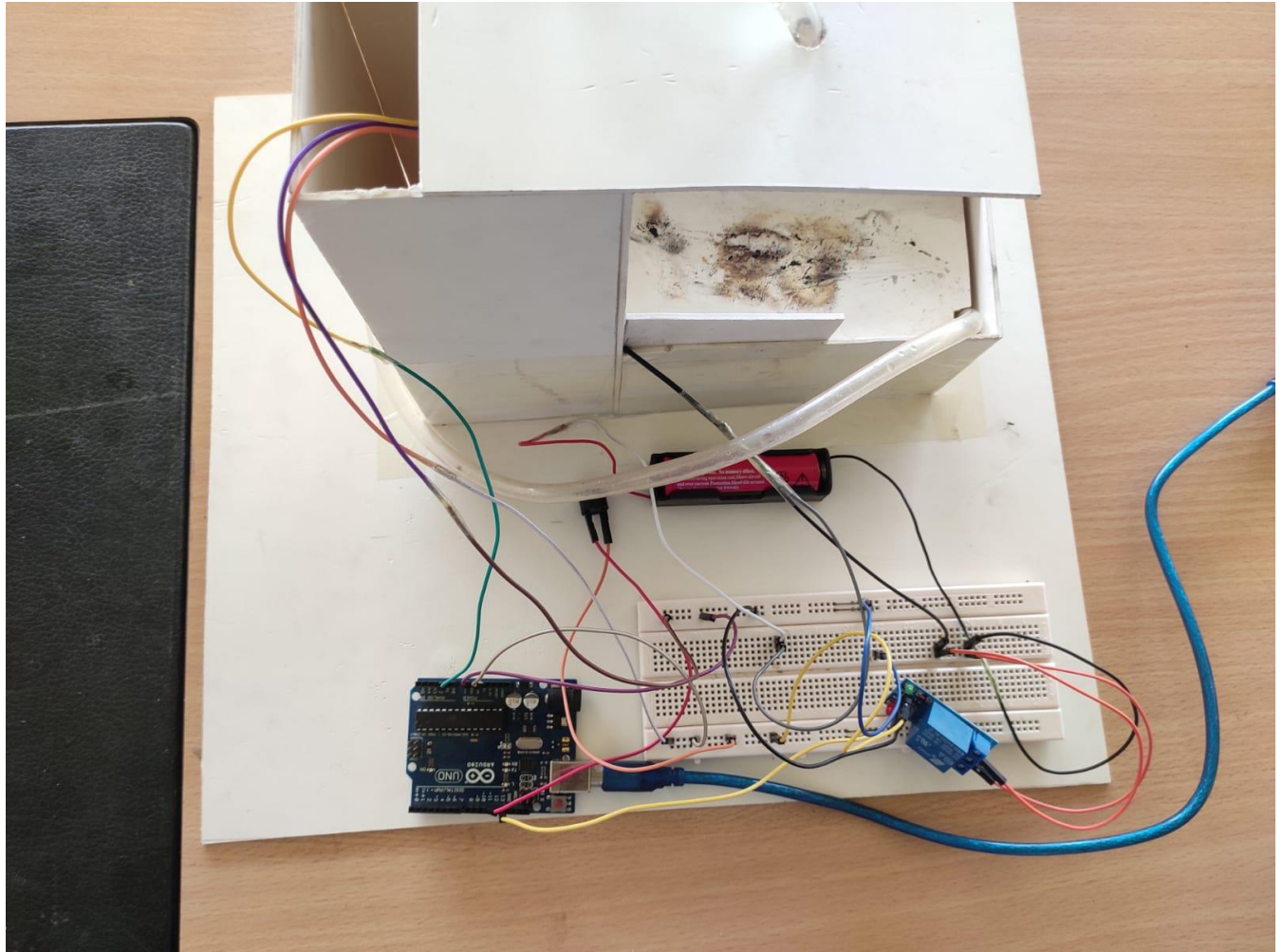


Fig: Top View of Project

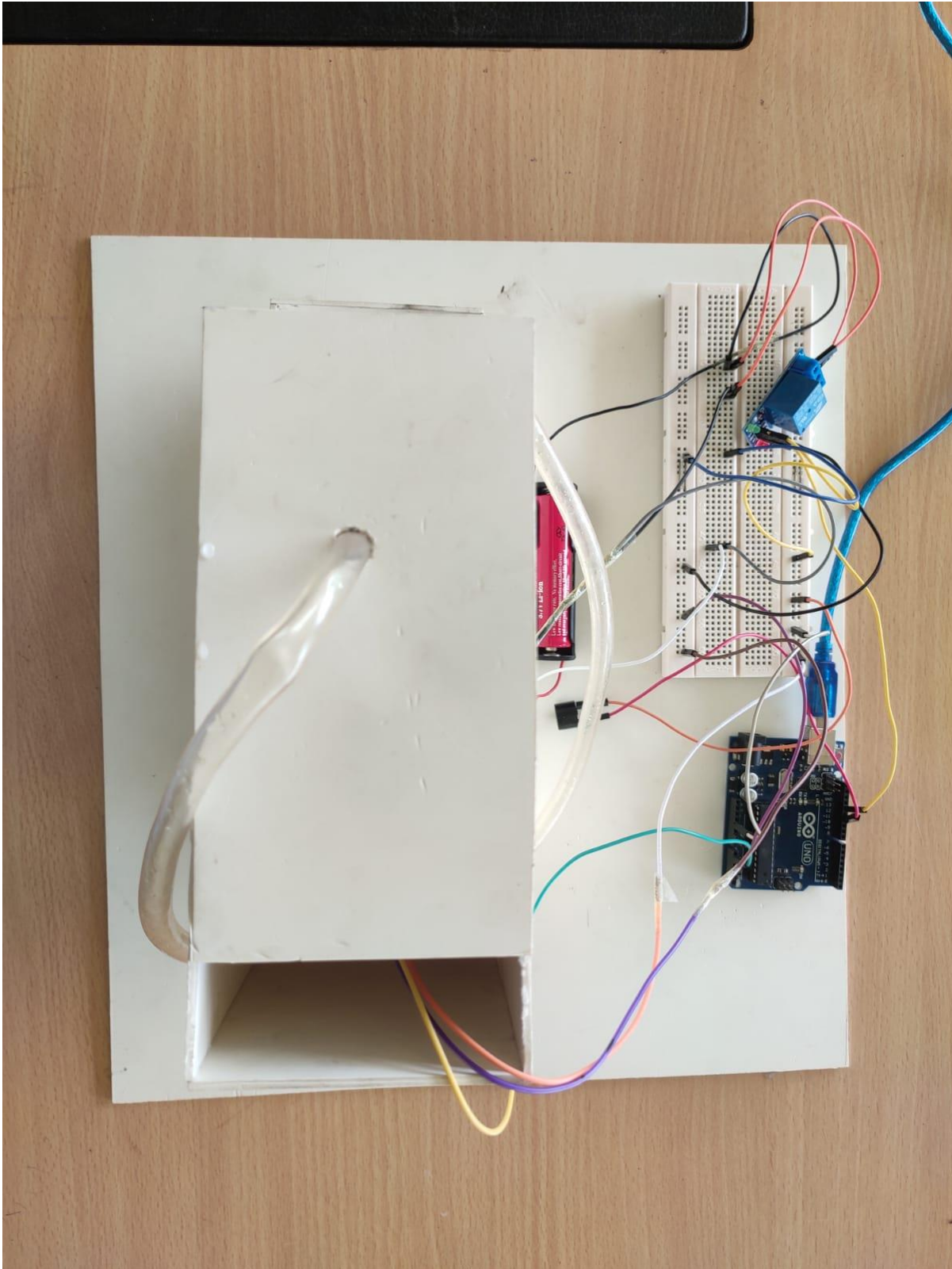


Fig: Top View of Project

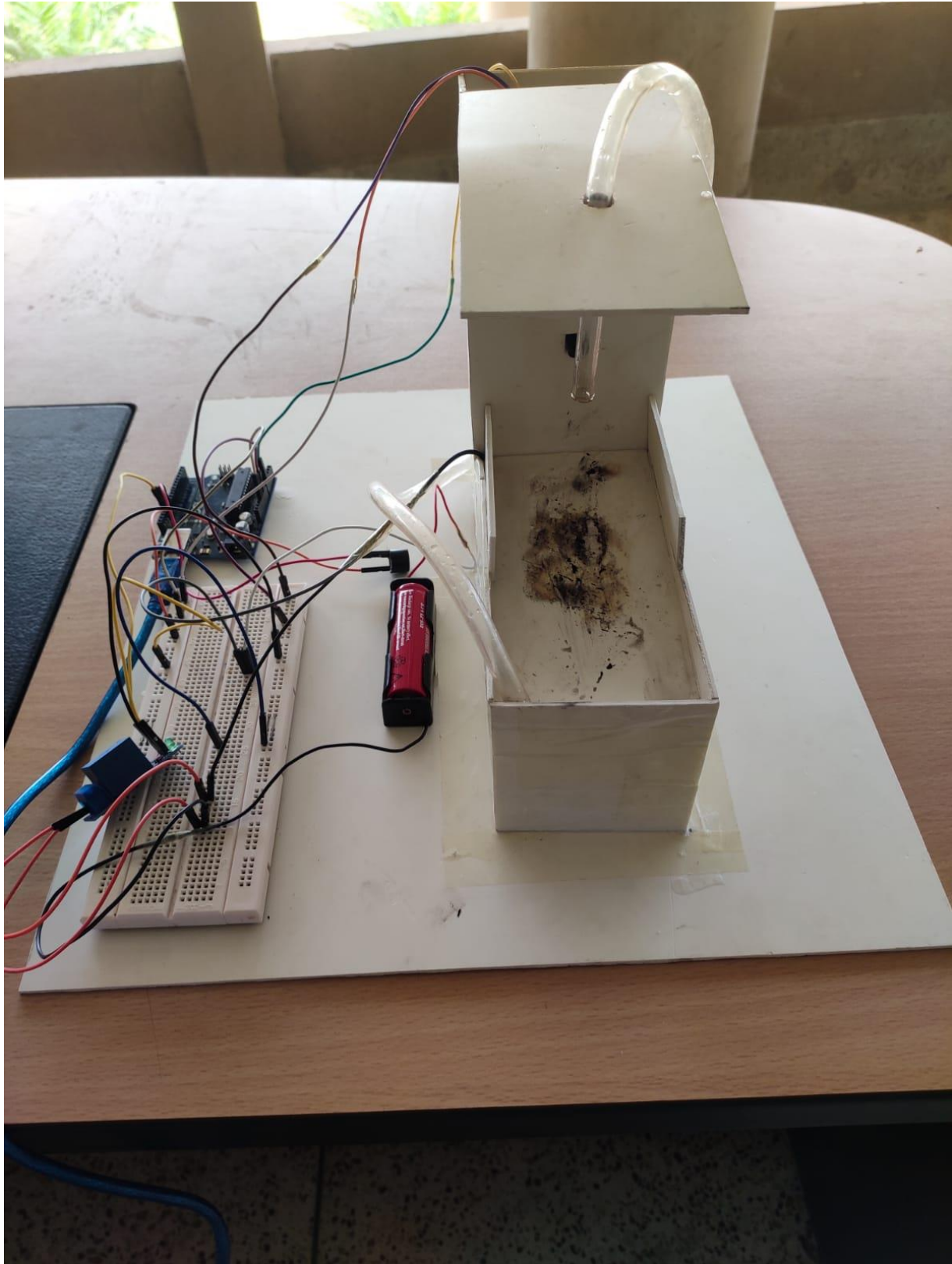


Fig: Front View of Project

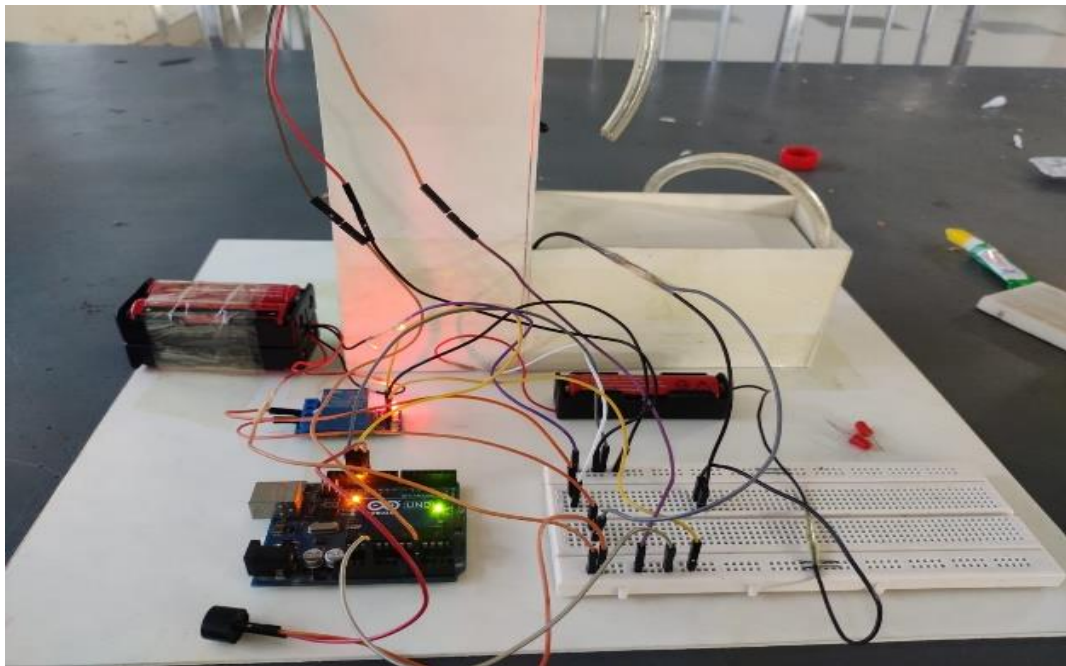
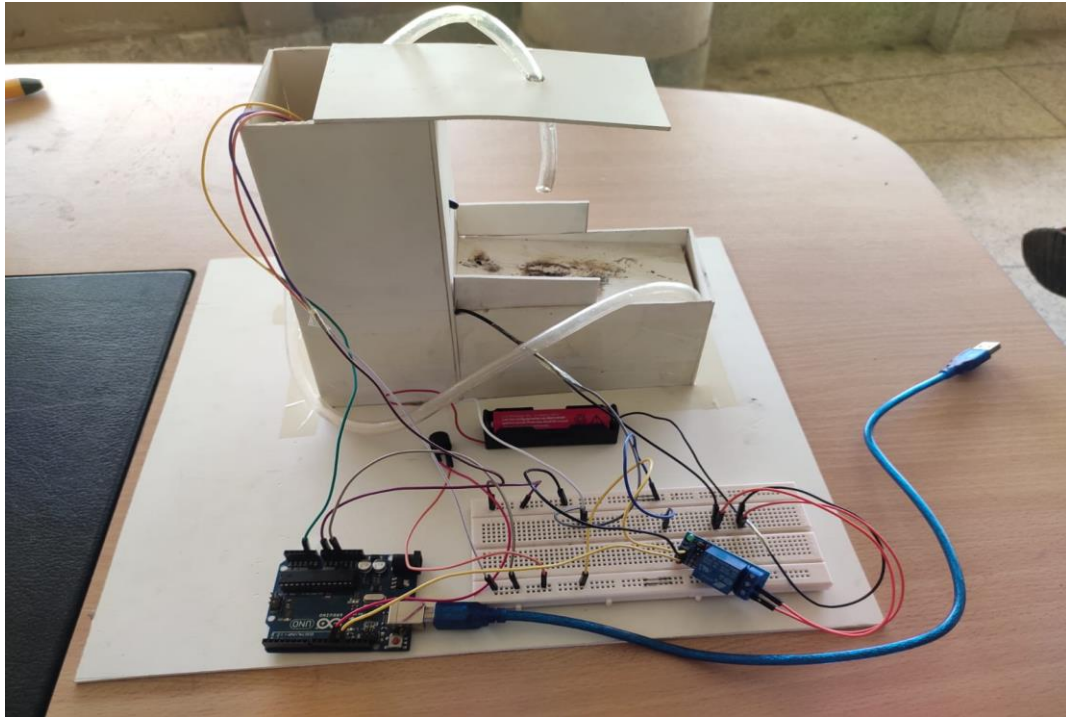


Fig: Side View of Project

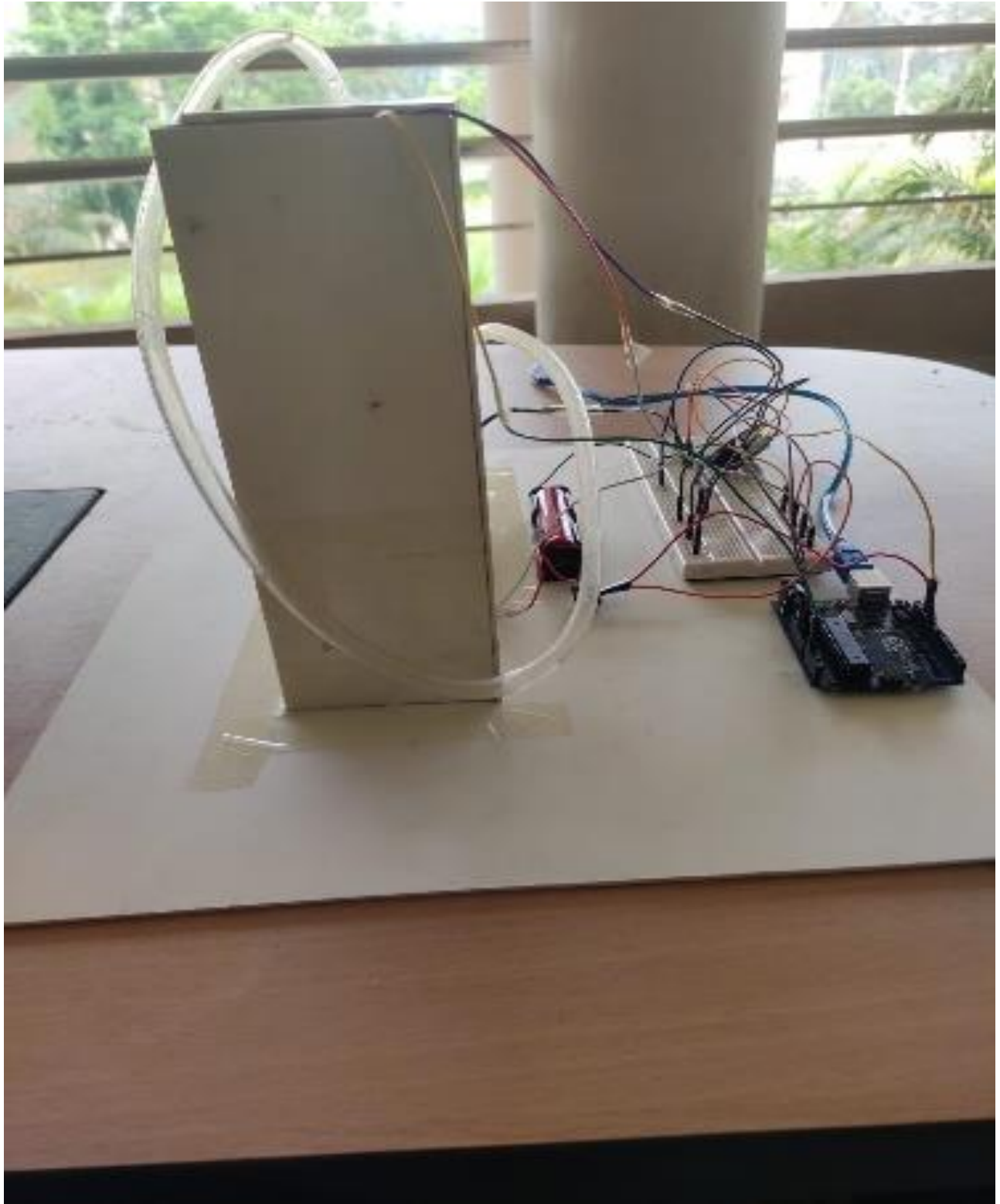


Fig: Back View of Project

Application:

1. Home fire detection and suppression systems
2. Industrial fire safety systems
3. Office buildings and commercial spaces
4. Laboratories and research facilities
5. Server rooms and data center.

Limitation:

1. The flame sensor module may have limited detection range and sensitivity.
2. The water splash mechanism may require additional infrastructure and maintenance.
3. The system may not be suitable for detecting certain types of fires, such as smoldering fires with minimal flames.
4. The system relies on the availability of power supply and may not function during power outages.
5. False alarms may occur due to environmental factors, such as smoke or high-temperature conditions.

Future Plans:

1. Improve flame sensor module sensitivity and accuracy.
2. Integrate advanced fire detection technologies (smoke, heat sensors) for enhanced reliability.
3. Develop wireless communication for remote fire alerts to monitoring systems or emergency services.
4. Implement machine learning algorithms for differentiating real fire events from false alarms.
5. Enhance water splash mechanism for efficient and effective fire suppression.
6. Integrate with intelligent building systems and automation platforms.
7. Enable remote monitoring and control via mobile app or web interface.
8. Research and develop advanced suppression agents for different fire hazards.
9. Explore robotic units for autonomous fire extinguishing in complex environments.
10. Utilize data analytics for predictive maintenance and optimized scheduling.

Discussion:

The fire detecting alarming system with water splash and circuit closure using Arduino offers a comprehensive approach to fire safety. By integrating a flame sensor module, buzzer, LED, relay switch, water splash mechanism, and Arduino microcontroller, the system enables prompt fire detection, effective alarming, and safety measures. The system's ability to detect fires accurately and initiate timely responses enhances overall fire safety. The inclusion of a relay switch isolates the fire by closing electric circuits, minimizing the risk of electrical accidents. The water splash mechanism provides an additional layer of fire suppression. While there are limitations such as detection range and false alarms, continuous research and improvements can further enhance the system's effectiveness and reliability in the future. Overall, this system contributes to efficient fire prevention and response in various settings

Conclusion:

In conclusion, the fire detecting alarming system with water splash and circuit closure using Arduino provides an effective solution for fire detection and safety. By utilizing a flame sensor module, the system can promptly detect the presence of fire and trigger an alarm and visual indication to alert individuals nearby. The activation of the relay switch ensures the closure of electric circuits, minimizing further damage and potential hazards. The integration of a water splash mechanism adds an additional layer of fire suppression. Although the system has its limitations, future enhancements and advancements can overcome these challenges and provide even greater fire safety measures