National Textile University Faisalabad

Department: Computer Science
5th Semester

Project Title :

Smart Fire Safety & Automatic Water Response System

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Project title :

Smart Fire Safety & Automatic Water Response System

What is Smart Fire Safety System?

Fire accidents pose a serious threat to life and property, especially in homes, offices, and industrial environments. Traditional fire detection systems often rely on standalone alarms that provide limited information and no remote monitoring capabilities.
The **Smart Fire Safety System** is an IoT-based solution designed to detect fire-related hazards such as **gas leakage, flame presence, and abnormal temperature conditions**. Using the ESP32 microcontroller, the system continuously monitors environmental data and provides **real-time alerts** through alarms and automated responses. This system improves safety by enabling **early detection and rapid action** to prevent major disasters.

Problem Statement

Fire accidents in homes, labs, classrooms, and industries occur due to:

- Late detection
- No automatic emergency response
- No real-time alerts
- No remote monitoring
- Manual fire extinguishing systems

Most systems give **only buzzer alerts** and **no cloud connectivity**, causing delayed response.

This project provides a **low-cost, smart embedded IoT fire safety system** with:

- Instant fire & smoke detection
- Automatic water pump activation
- Real-time cloud monitoring
- Emergency alerts on mobile
- Wi-Fi + Bluetooth dual connectivity
- Remote control from anywhere

Project Objectives:

- **Fire & Smoke Detection:** Monitor fire, smoke, and high temperature instantly.
- **Automatic Water Control:** Turn the water pump ON automatically when fire is detected.
- **IoT Cloud Dashboard:** Display live sensor data including fire status, smoke level, temperature, and pump activity.
- **Alert System:** Send instant notifications to the cloud and sound a local buzzer for emergencies.
- **Connectivity Options:** Use Wi-Fi for cloud monitoring and Bluetooth for offline control.
- **Temperature & Light Monitoring:** Keep track of heat and sudden changes in light around the fire area.
- **Manual Control:** Allow the user to remotely turn the pump ON/OFF, reset the system, or switch between automatic and manual modes.

Proposed Solution

The system works as follows:

- **ESP32 Microcontroller:** Acts as the main controller with fast processing and multiple GPIOs
- **Gas Sensor (MQ-2):** Detects smoke and harmful gases
- **Flame Sensor:** Detects open flame
- **DHT Sensor:** Monitors temperature and humidity
- **Relay Module:** Controls external safety devices
- **Motor / Pump:** Simulates fire suppression mechanism
- **Buzzer:** Provides audible alerts

The system continuously monitors sensor values and immediately responds when danger is detected.

Hardware Components

1. ESP32 Microcontroller

- Dual-core processor with built-in Wi-Fi
- Multiple GPIO pins
- Ideal for IoT and real-time monitoring

2. Sensors

- **MQ-2 Gas Sensor:** Detects smoke and gas
- **Flame Sensor:** Detects fire
- **DHT Sensor:** Measures temperature and humidity

3. Actuators

- **Relay Module:** Controls high-power devices
- **Motor / Pump:** Represents fire extinguishing system
- **Buzzer:** Audio alert

Software Technologies Utilized:

- **Visual Studio Code (VS Code):**
  - A powerful code editor used for writing, editing, and managing ESP32 programs effectively.
- **Wokwi Simulator:**
  - An online tool to simulate and test ESP32 circuits virtually before deploying them on actual hardware.
- **Blynk IoT Platform:**
  - Enables real-time monitoring and visualization of sensor data on mobile devices.

Pin Configuration

Component	**ESP 32 PIN**	**Purpose**
GAS SENSOR	GPIO 34	Smoke & gas detection
FLAME SENSOR	GPIO 25	Fire detection
RELAY MODULE	GPIO 27	Control safety device
DHT 11	GPIO 14	Temperature & humidity
BUZZER	GPIO 26	Alarm

Circuit Diagram

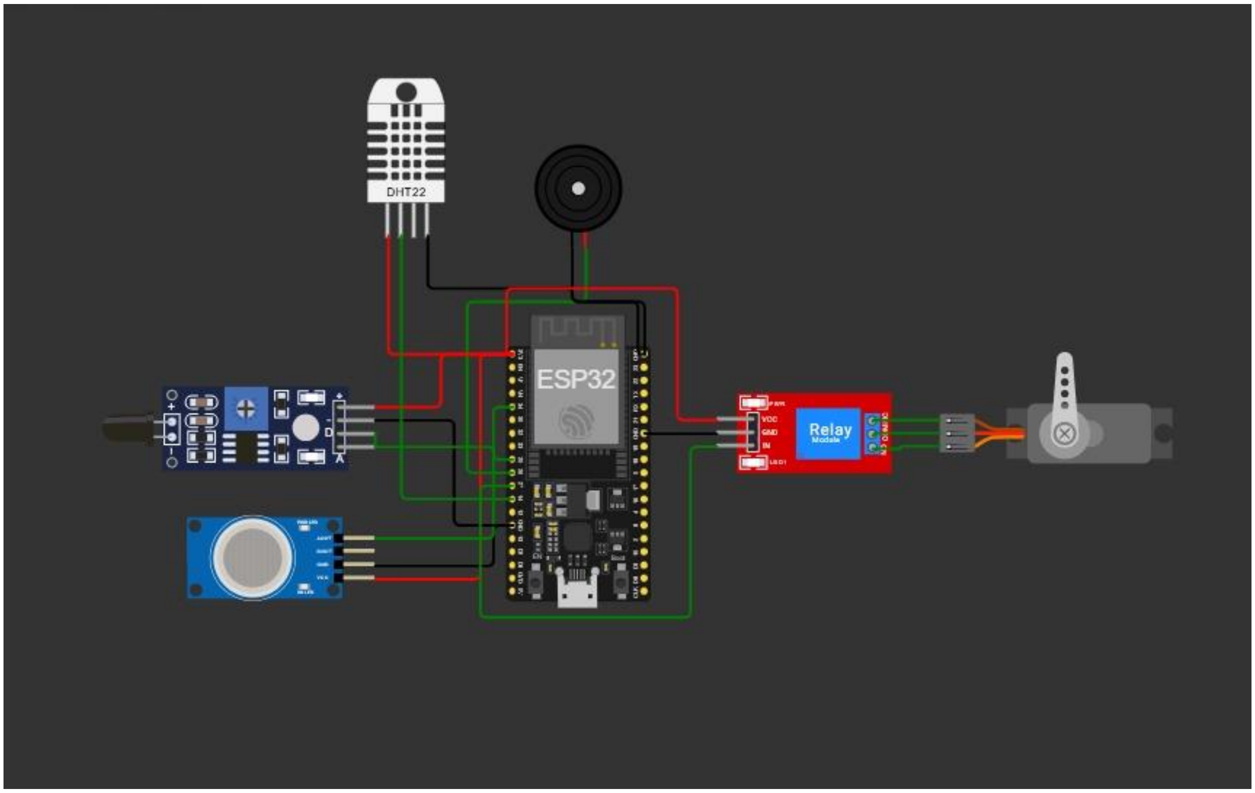


Figure 1 WOKWI CIRCUIT DIAGRAM

Basic Features

1. Gas Detection

- MQ-2 sensor detects smoke or gas leakage
- System triggers alarm when threshold is exceeded

2. Flame Detection

- Flame sensor detects presence of fire
- Immediate alert is generated

3. Temperature Monitoring

- DHT sensor monitors abnormal temperature rise

4. Automatic Alert System

- Buzzer activates during hazardous conditions
- Relay switches ON motor/pump automatically

System Workflow

1. **Initialization**
   – ESP32 initializes sensors and output devices

2. **Monitoring Loop**
   – Reads gas, flame, and temperature values
   – Compares values with predefined thresholds

3. **Alert & Control**
   – Activates buzzer on danger
   – Turns ON relay and motor for safety action

Programming Language

The system is programmed using **C++ on platform IO on VScode.**

Libraries Used:

- **Arduino.h** – Provides the core Arduino functions required for ESP32 programming.

- **Wire.h** – Enables I2C communication, used for sensor interfacing.

- **DHT.h** – Supports the DHT11 temperature and humidity sensor.

- **WiFi.h** – Allows ESP32 to connect to Wi-Fi networks.

- **BlynkSimpleEsp32.h** – Facilitates integration with the Blynk IoT platform for remote monitoring and control.

Major Code Functions

1. **setup()**

   - Initializes sensors, Relay, Motor, and Buzzer pins, and serial communication.
   - Connects ESP32 to Wi-Fi and the Blynk IoT platform.

2. **loop()**

   - Reads sensor data (temperature, humidity, smoke, flame) and updates Blynk virtual pins.
   - Activates Relay, Motor, and Buzzer on flame or smoke detection and sends

notifications.

3. **confirmFlame()**
    - Checks the flame sensor multiple times to reduce false alarms.
    - Returns true if flame is consistently detected, otherwise false.

Methodology

1. Initialize ESP32 and sensors
2. Continuously monitor gas, flame, and temperature
3. Compare sensor values with threshold levels
4. If fire detected:
    - Turn ON buzzer
    - Activate relay
    - Start motor (water pump)
5. Continue monitoring in real-time

Advantages

- **Rapid Fire Detection:** Detects fire at an early stage to prevent hazards.
- **Automated Safety Response:** Activates water system and alerts automatically.
- **Cost-Effective and Scalable:** Affordable solution that can be expanded for larger setups.
- **Minimizes Human Intervention:** Reduces reliance on manual monitoring.
- **Ideal for Smart Environments:** Integrates seamlessly with IoT-enabled spaces.

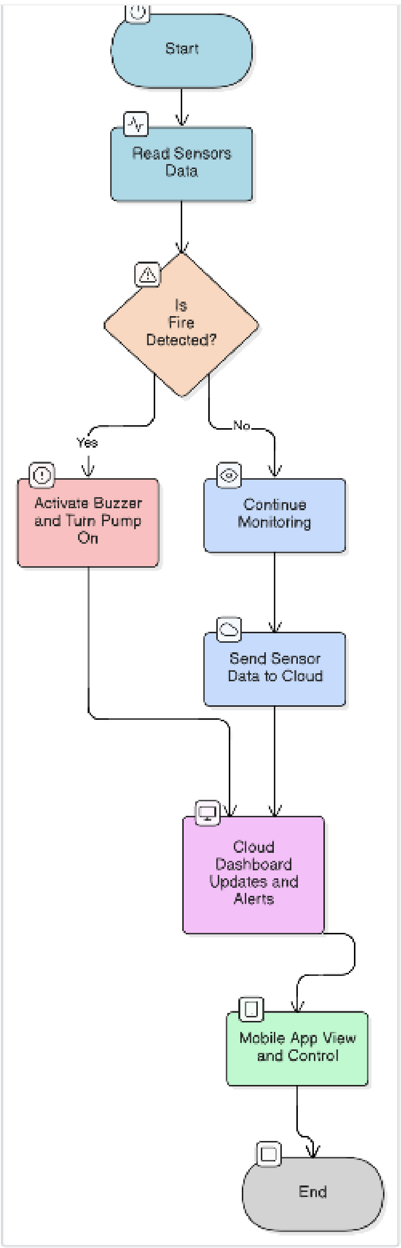
Conclusion

The Smart Fire Safety & Automatic Water Response System is an efficient and reliable IoT-based solution for early fire detection and response. It reduces dependency on human intervention and provides rapid action during emergencies. This project demonstrates practical application of embedded systems and IoT concepts in real-world safety systems.

Future Scope

- Integration with mobile apps for remote alerts
- Addition of GSM module for SMS notifications
- Cloud-based monitoring system
- Use of AI for fire pattern recognition
- Expansion to industrial-scale fire systems

Flow chart:


Start
Read Sensors Data
Is Fire Detected?
Yes
No
Activate Buzzer and Turn Pump On
Continue Monitoring
Send Sensor Data to Cloud
Cloud Dashboard Updates and Alerts
Mobile App View and Control
End

Blynk screenshots:

- **Dashboard screenshot:**

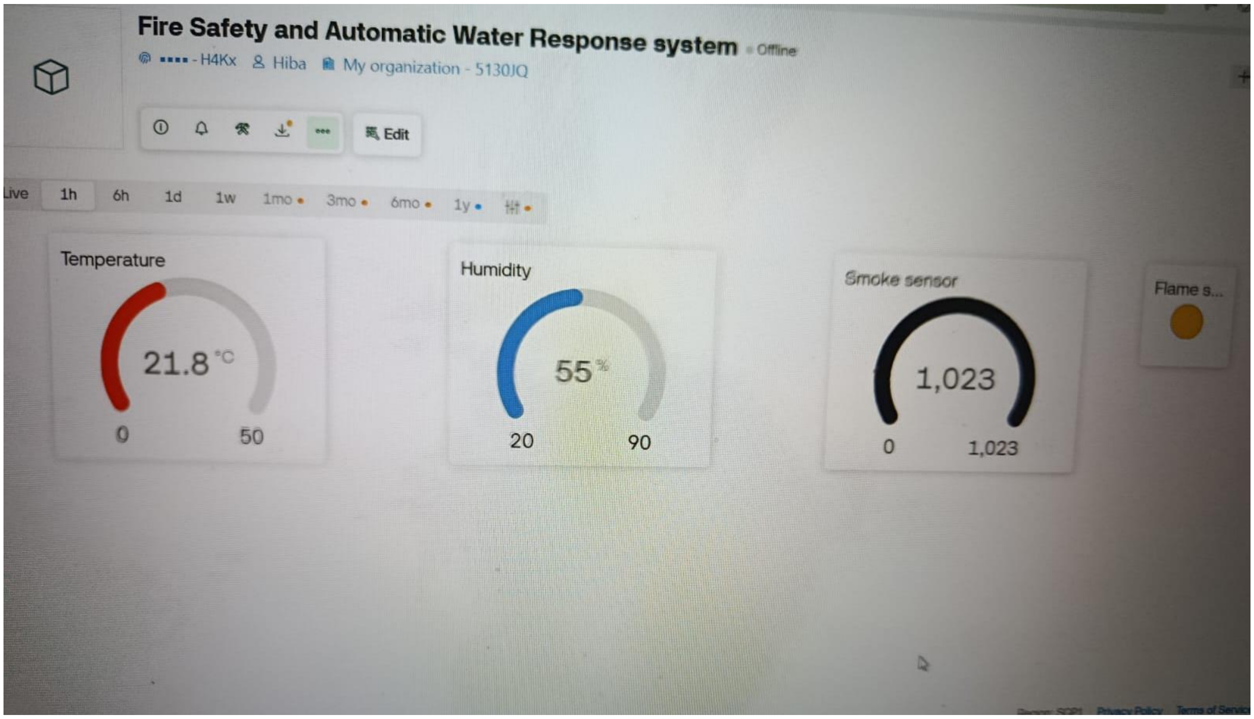
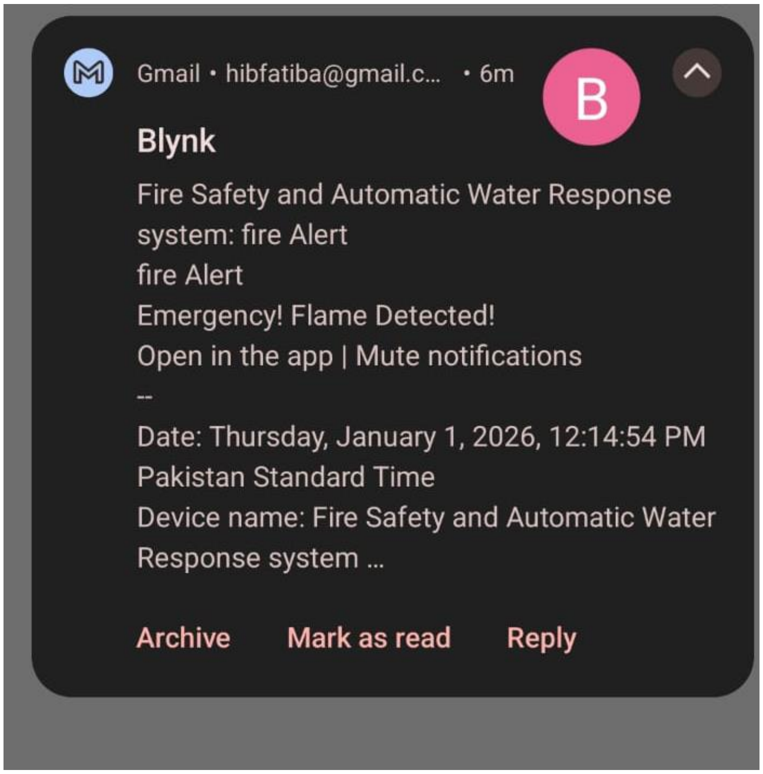


Figure 2desktop dashboard

- **Mobile notification screenshot:**



Blynk

Fire Safety and Automatic Water Response system: fire Alert

fire Alert

Emergency! Flame Detected!

Open in the app | Mute notifications

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Date: Thursday, January 1, 2026, 12:14:54 PM Pakistan Standard Time

Device name: Fire Safety and Automatic Water Response system ...

Figure 3 Alert notification

- **Mobile dashboard screenshot**

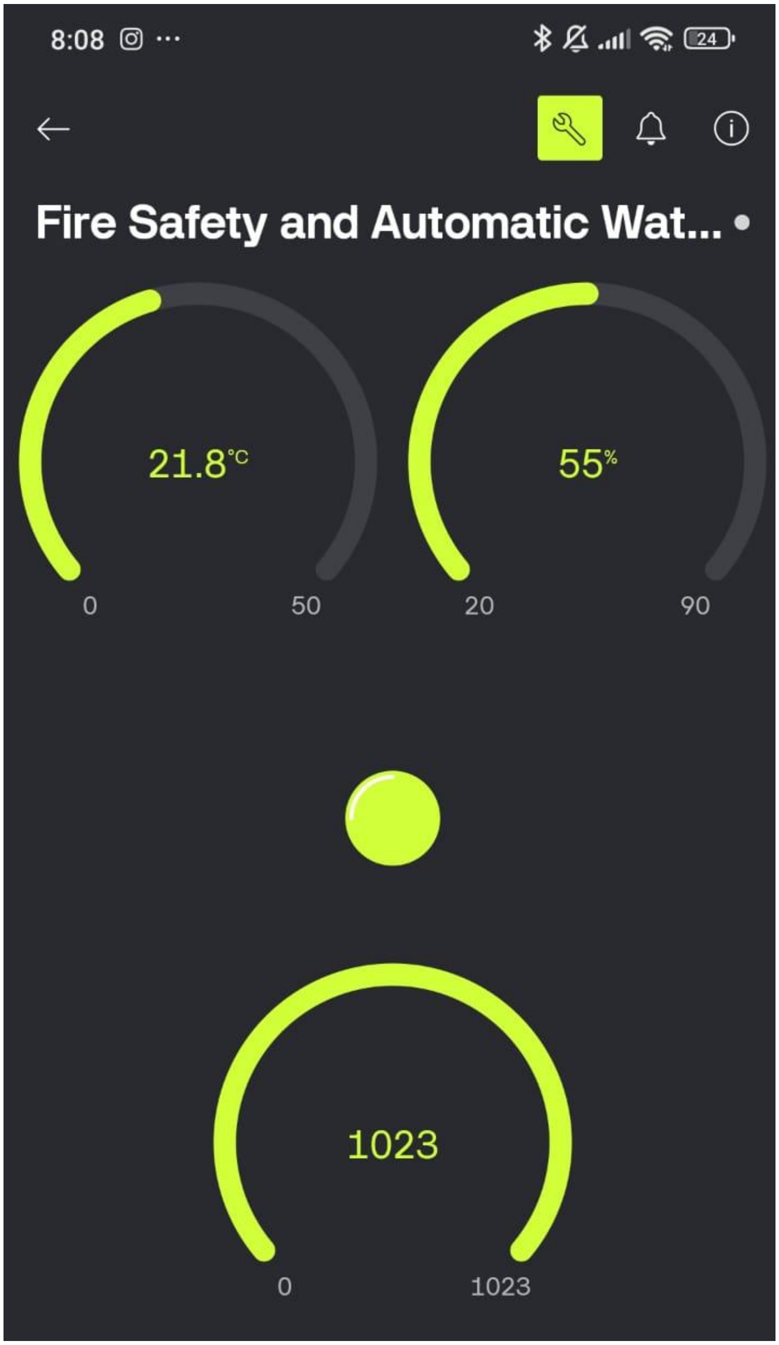

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Figure 4 mobile dashboard

- **OLED and blynk values:**

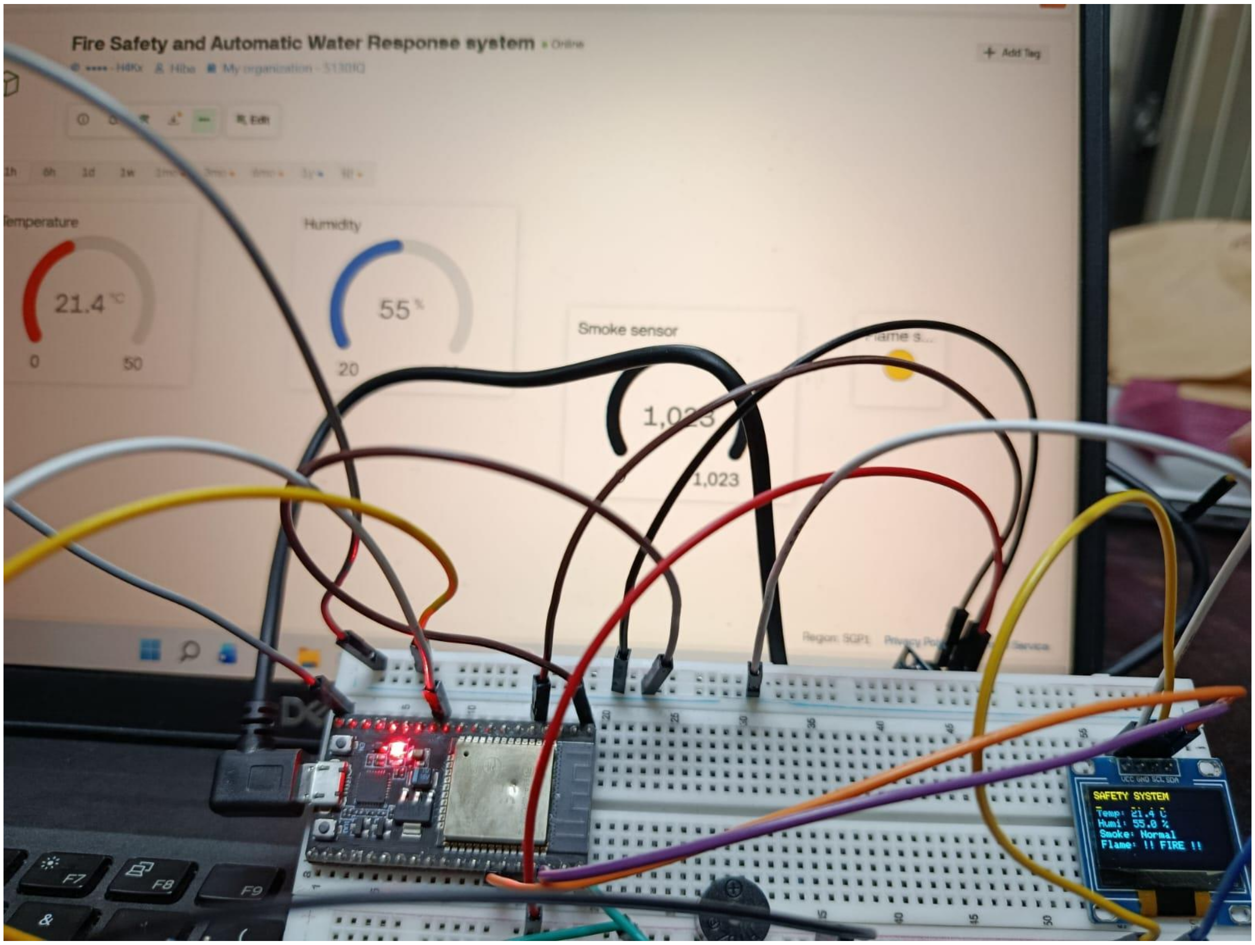

Figure 5 blynk and oled value check

Project working pictures:

- **Smoke sensor working:**

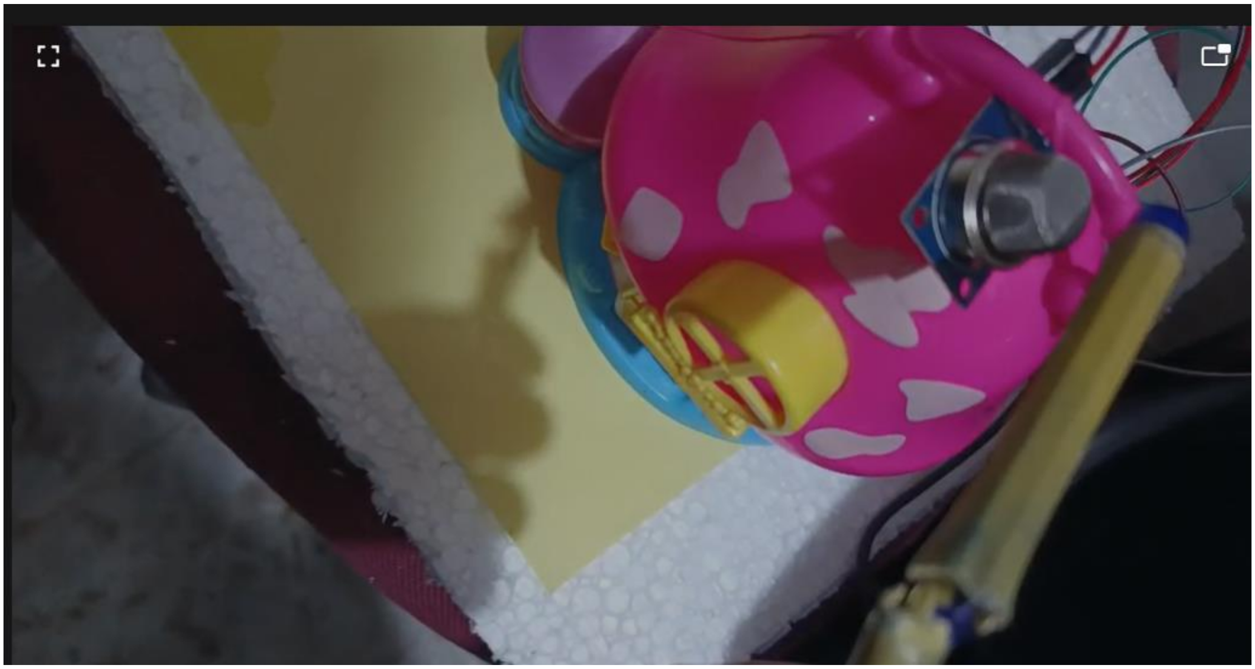

Figure 6smoke detection

- **Flame sensor working:**

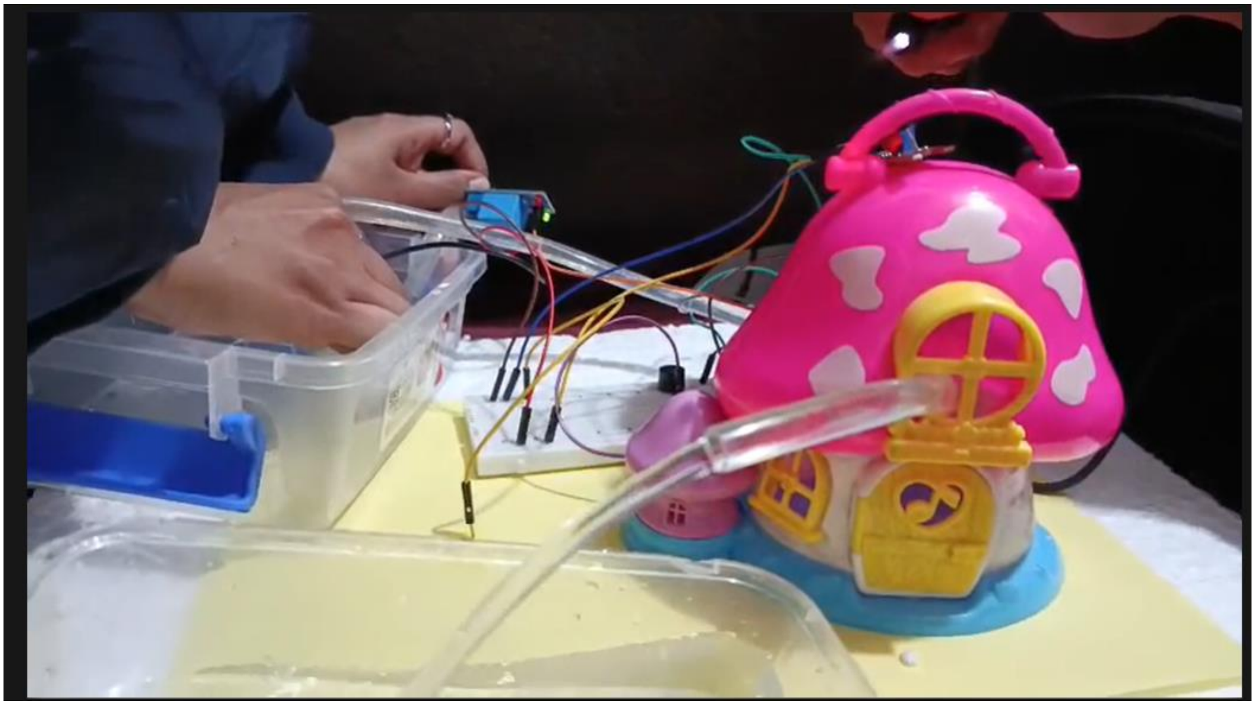

Figure 7 flame detection and water response