

Smart Disaster Management System using STM32F401

Course: Embedded Systems Design - 23CSE304

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Problem Statement

Disasters like gas leaks, fire, and earthquakes cause severe loss of life and property. Existing alarms are single-purpose and cannot handle multiple hazards. Our project uses an **STM32F401** to build an **integrated multi-hazard monitoring system** with ADC, I²C, UART, interrupts, and display for improved safety and real-world use.

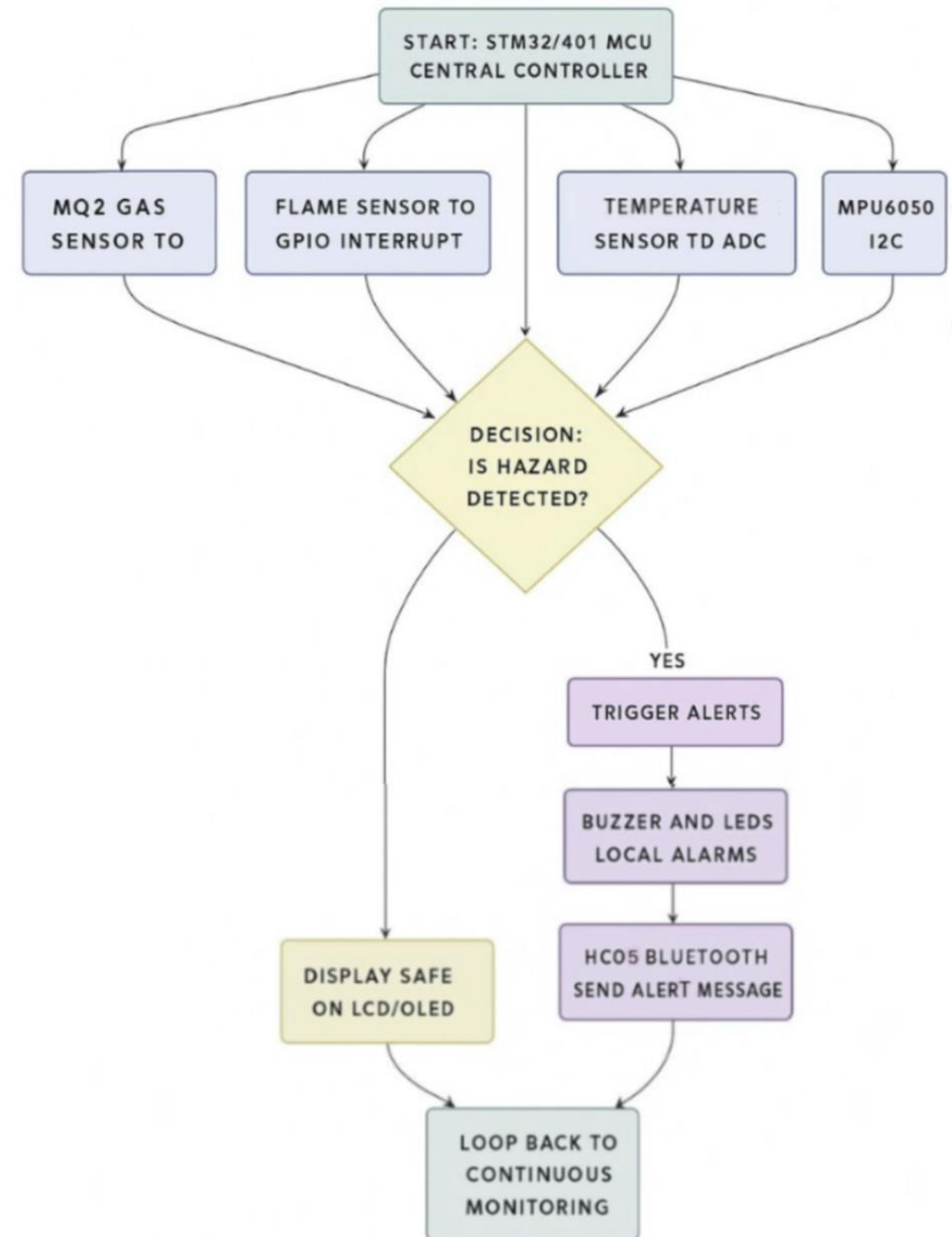
Why did we choose this?

- Disasters like **gas leaks, fire, and earthquakes** demand **early detection**.
- Existing systems are **single-purpose** and cannot handle multiple hazards.(only fire alarm, only gas detector).
- The system should detect **gas leaks, fire and vibrations** simultaneously.
- A **multi-sensor node** improves **safety, reliability, and awareness**.



Hardware Components

- STM32F401 Black Pill → Core microcontroller
- MQ-2 Gas Sensor → Detects gas leaks (ADC)
- Flame Sensor → Detects fire (digital interrupt)
- MPU6050 → Vibration/earthquake detection (I²C)
- HC-05 Bluetooth → Mobile alerts (UART)
- Buzzer + LEDs → Local alerts



Implementation

1

sensor Data Acquisition

STM32F401 continuously reads values from Gas, Flame, and Vibration sensors.

2

Normal Operation

if readings are safe, The system will give us an indication.

3

Hazard Detection

When thresholds are crossed or interrupts trigger, the system identifies abnormal conditions.

4

Alert Activation

IBuzzer and LEDs provide immediate local alert, and warnings appear on the phone using Bluetooth module.

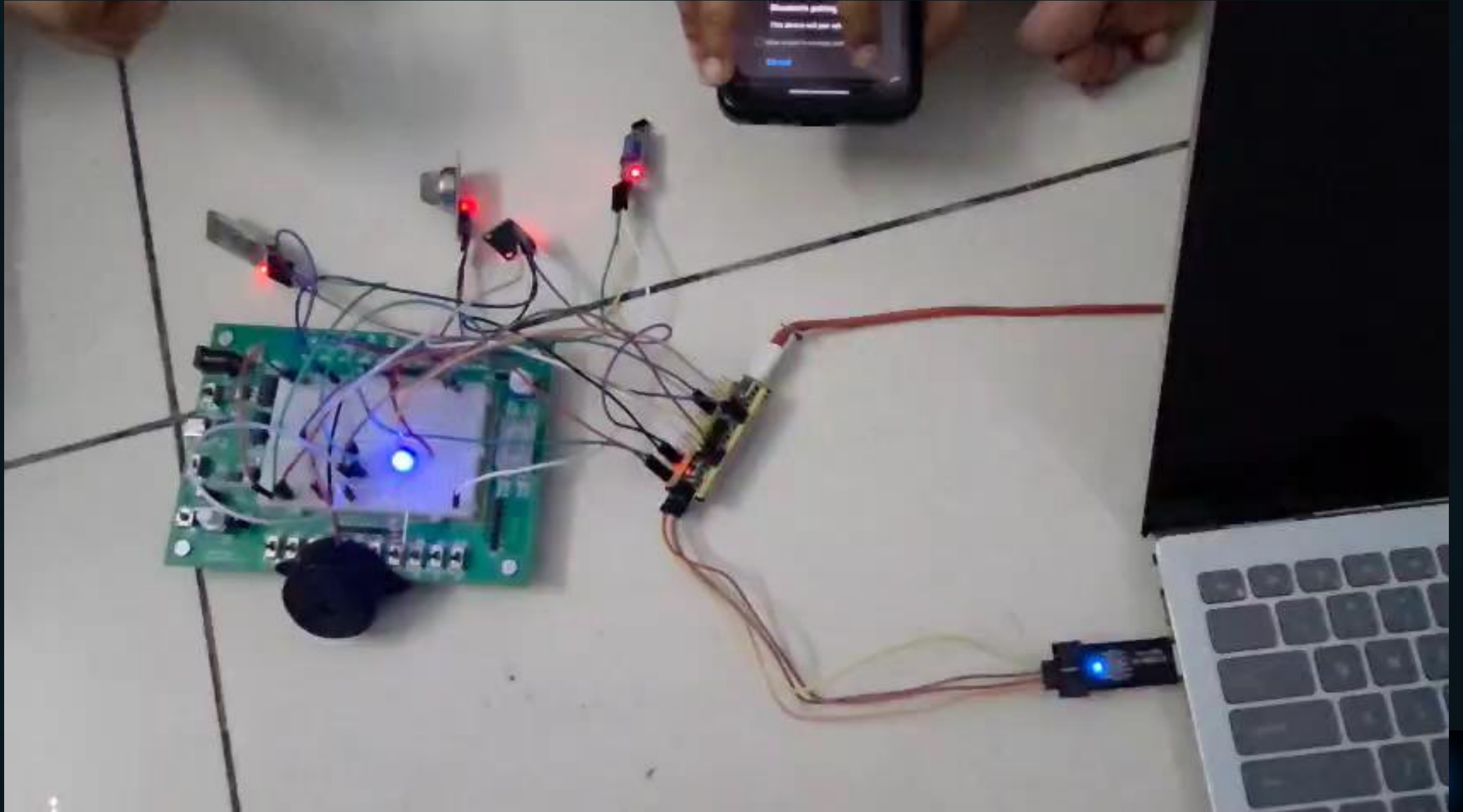
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Remote Notification

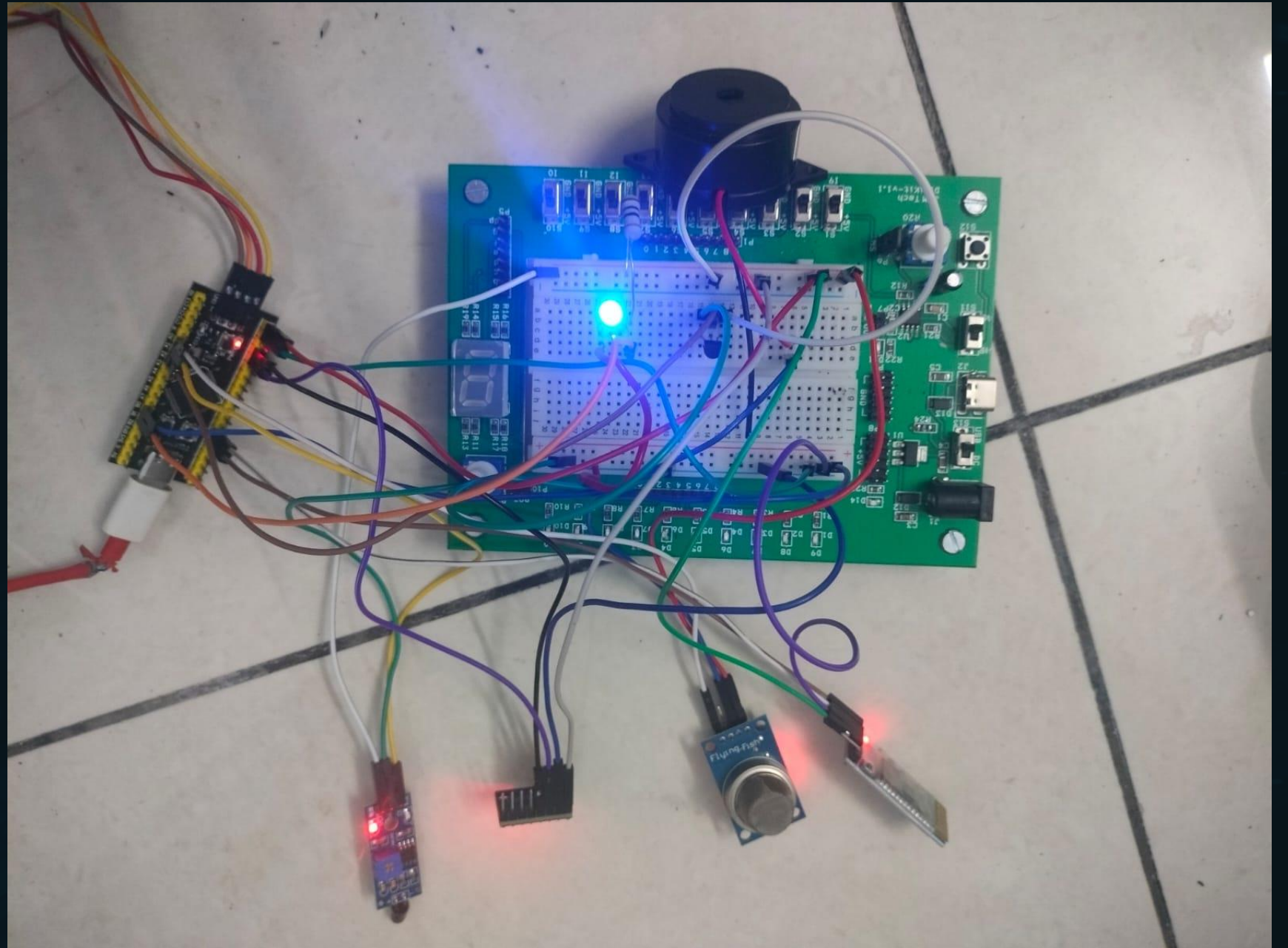
Alert messages are sent to mobile/PC via Bluetooth (UART) for remote monitoring.



Prototype



Our Prototype



Bluetooth module output

```
21:09:08.344 Connecting to HC-05 ...
21:09:09.072 Connected
21:09:13.050 Status: SAFE
21:09:13.657 Status: SAFE
21:09:14.284 ALERT! Flame Detected
21:09:14.905 Status: SAFE
21:09:15.536 Status: SAFE
21:09:16.130 ALERT! Flame Detected
21:09:16.766 ALERT! Flame Detected
21:09:17.394 ALERT! Flame Detected
21:09:17.996 ALERT! Flame Detected
21:09:18.624 ALERT! Flame Detected
21:09:19.226 ALERT! Flame Detected
21:09:19.853 ALERT! Flame Detected
21:09:20.494 ALERT! Flame Detected
21:09:21.090 ALERT! Flame Detected
21:09:21.717 ALERT! Flame Detected
21:09:22.315 ALERT! Flame Detected
21:09:22.944 ALERT! Flame Detected
21:09:23.575 ALERT! Flame Detected
21:09:24.173 Status: SAFE
21:09:24.776 Status: SAFE
21:09:25.404 Status: SAFE
21:09:26.004 Status: SAFE
21:09:26.604 Status: SAFE
21:09:27.243 Status: SAFE
21:09:27.836 Status: SAFE
21:09:28.437 Status: SAFE
21:09:29.035 Status: SAFE
21:09:29.664 Status: SAFE
21:09:30.266 Status: SAFE
21:09:30.844 Status: SAFE
21:09:31.471 Status: SAFE
21:09:32.092 Status: SAFE
21:09:32.693 Status: SAFE
21:09:33.324 Status: SAFE
```

```
≡ Terminal 🔊 🗑️ ⋮
21:10:11.001 Status: SAFE
21:10:12.290 Status: SAFE
21:10:12.889 ALERT! Gas Detected, ADC=1629
21:10:13.521 ALERT! Gas Detected, ADC=1703
21:10:14.149 ALERT! Gas Detected, ADC=1711
21:10:14.779 ALERT! Gas Detected, ADC=1677
21:10:15.409 ALERT! Gas Detected, ADC=1603
21:10:16.040 ALERT! Gas Detected, ADC=1549
21:10:16.641 Status: SAFE
21:10:17.243 Status: SAFE
21:10:17.869 Status: SAFE
21:10:18.469 Status: SAFE
21:10:19.070 Status: SAFE
21:10:19.699 Status: SAFE
21:10:20.331 ALERT! EARTHQUAKE detected, dev=316 m
g
21:10:20.959 Earthquake cleared
21:10:20.959 Status: SAFE
21:10:21.590 ALERT! EARTHQUAKE detected, dev=336 m
g
21:10:24.025 Earthquake cleared
21:10:24.025 Status: SAFE
21:10:24.625 Status: SAFE
21:10:25.219 Status: SAFE
21:10:25.879 ALERT! EARTHQUAKE detected, dev=339 m
g
21:10:26.509 Earthquake cleared
21:10:26.509 Status: SAFE
21:10:27.141 ALERT! EARTHQUAKE detected, dev=468 m
g
21:10:27.776 Earthquake cleared
21:10:27.776 Status: SAFE
21:10:28.370 Status: SAFE
21:10:28.960 Status: SAFE
```