

Smart Disaster Management System using STM32F401

Course: Embedded Systems Design - 23CSE304

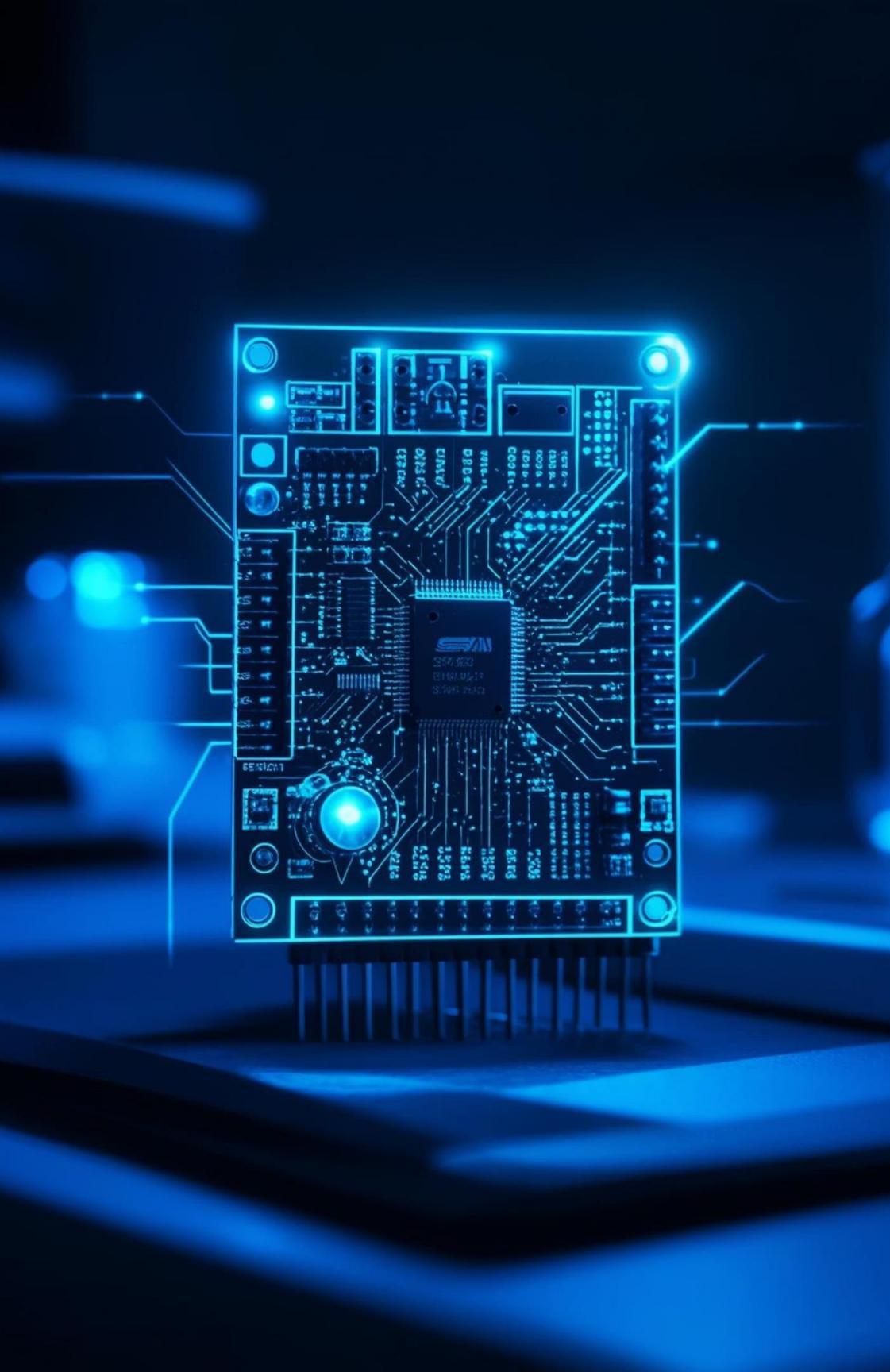
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Problem Statement

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.

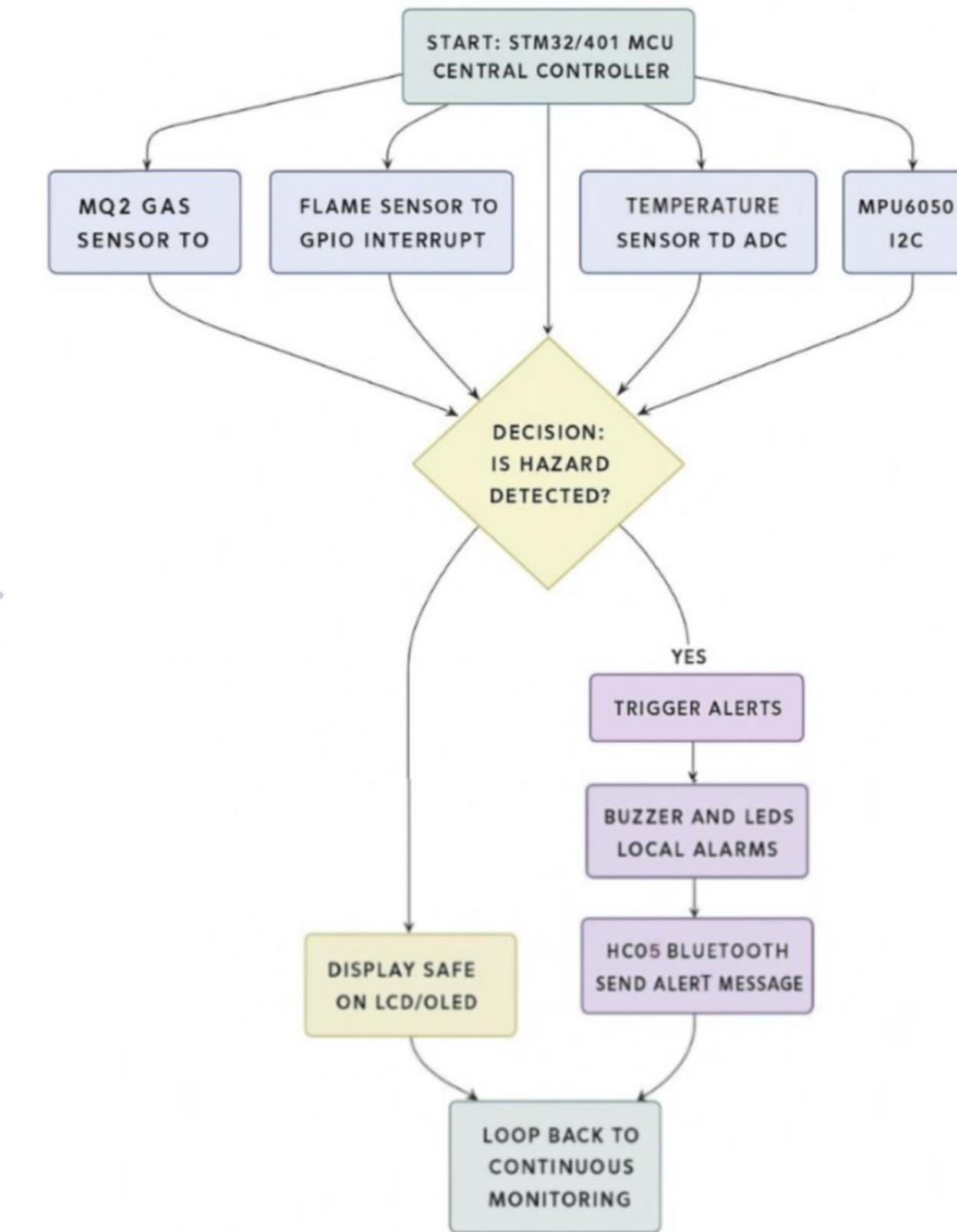
Why did we choose this?

- 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

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sensor Data Acquisition

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

Normal Operation

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

Hazard Detection

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

Alert Activation

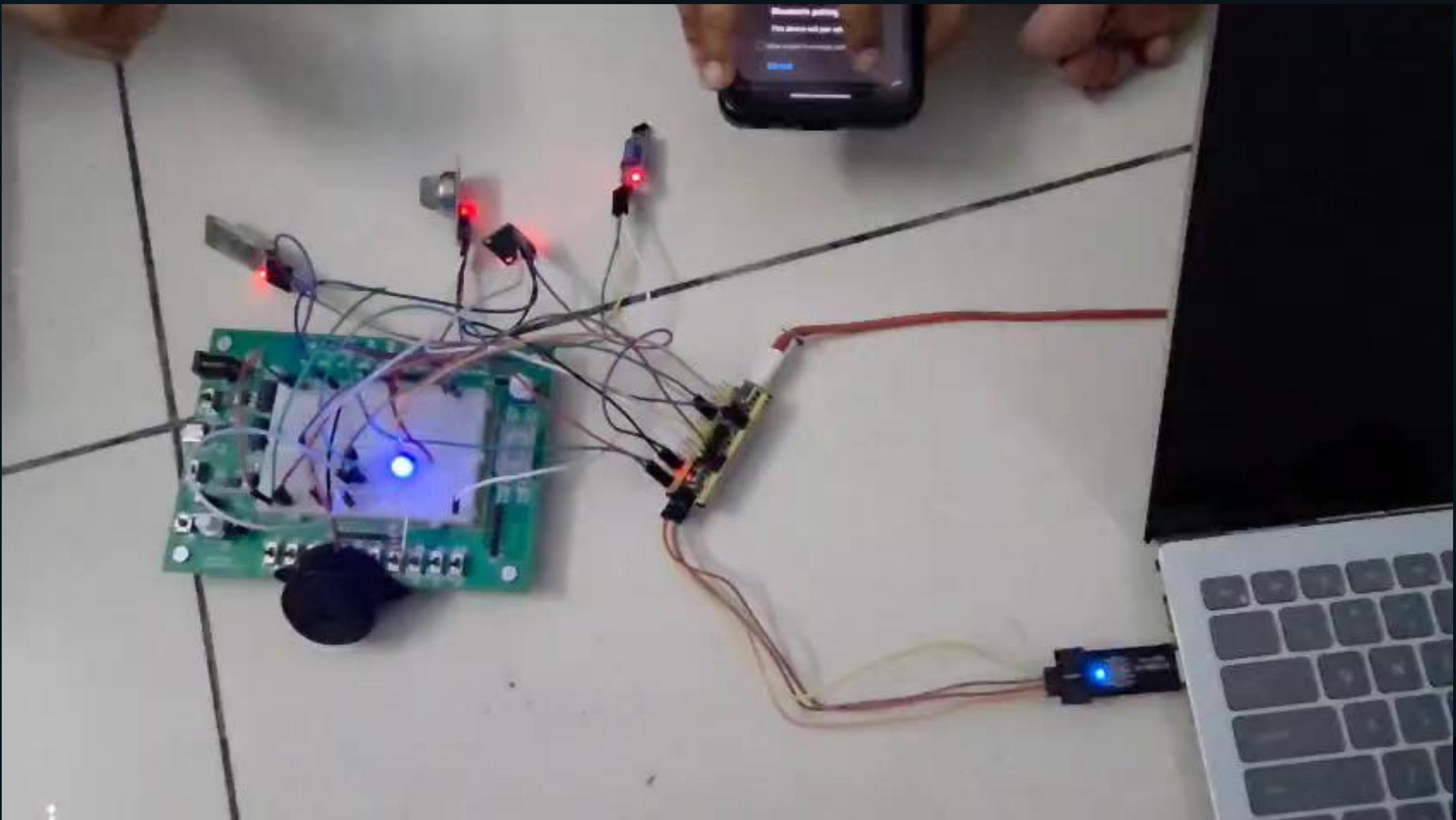
IBuzzer and LEDs provide immediate local alert, and warnings appear on the phone using Bluetooth module.

Remote Notification

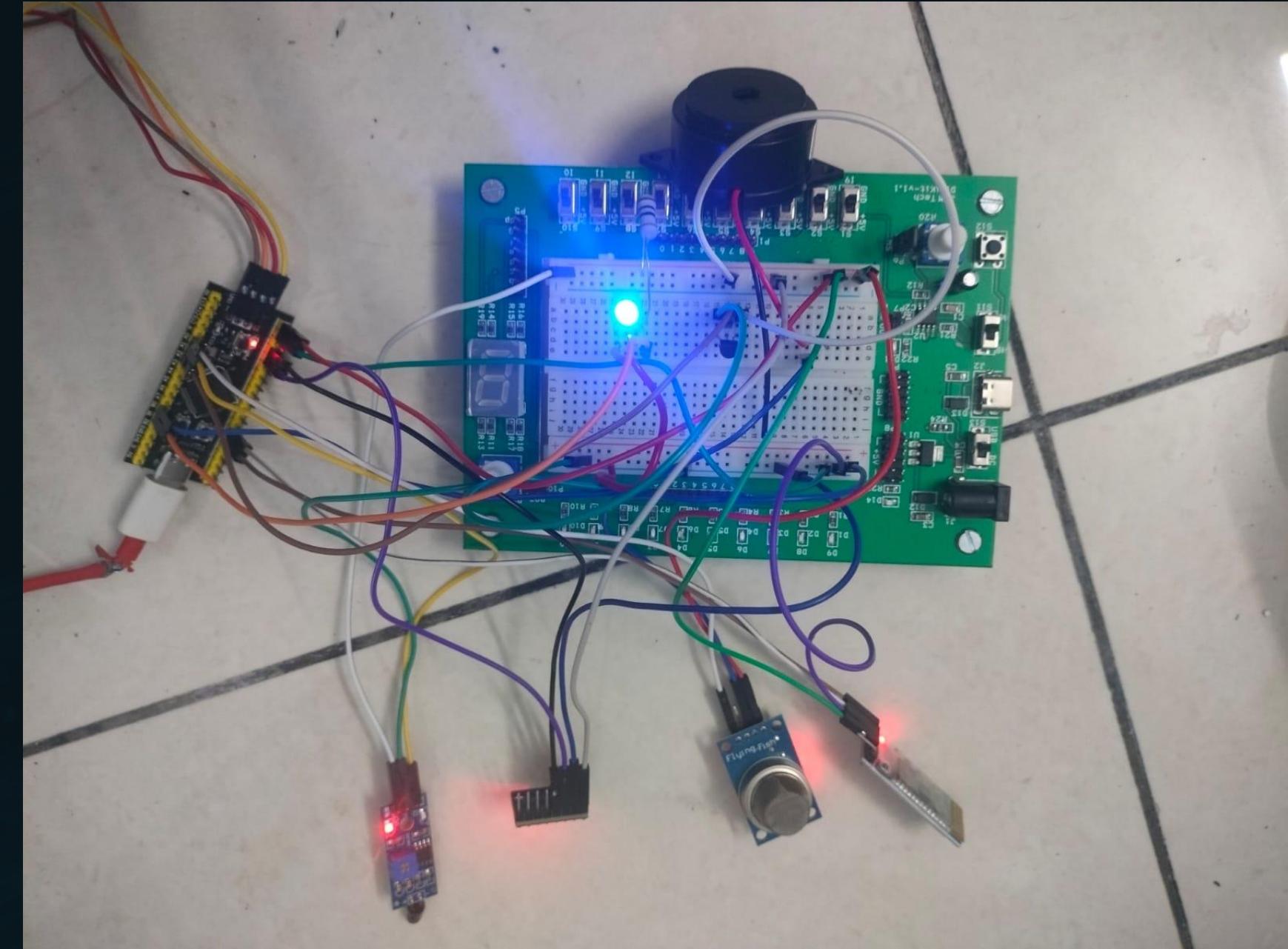
Alert messages are sent to mobile/PC via Bluetooth (UART) for remote monitoring.



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

```
21:10:01.500 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
21:10:29.060 Status: SAFE
```