IOT Based Wearable Safety Badge for Cracker Factory Workers

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Abstract- Firecracker factory workers are constantly exposed to hazardous environments where sudden rises in temperature or the presence of smoke can lead to life-threatening situations. This paper presents the development of a wearable safety badge that detects abnormal temperature and smoke levels using LM35 and MQ-2 sensors, processes the data via a NodeMCU (ESP8266) microcontroller, and provides real-time silent alerts to the wearer using a vibration motor. The device is compact, battery-powered, and designed to be worn comfortably, offering a practical solution for worker safety in explosive zones.

1.INTRODUCTION

India's firecracker industry has faced numerous accidents resulting in worker casualties due to poor detection and delayed response mechanisms. Traditional safety alarms are either not wearable or ineffective in noisy and chaotic environments. The proposed system bridges this gap by offering an individual, wearable early-warning system that ensures instant feedback without relying on sound or lights.

2.PROBLEM STATEMENT

- Accidents in firecracker factories often occur without early warning.
- Workers may not notice high temperature or smoke in time.
- Audible alarms are ineffective in noisy settings.
- There is a need for wearable, personal, silent, and real-time alerting systems.

3.OBJECTIVE

- To design a wearable device that monitors smoke and temperature.
- To provide silent vibration alerts when dangerous levels are detected.
- To ensure the system is battery-powered, compact, and cost-effective.

4.METHODOLOGY

4.1 Components Used

Component	Purpose
NodeMCU ESP8266	Microcontroller for data processing
MQ-2 Sensor	Smoke and gas detection
LM35 Sensor	Temperature monitoring
Vibration Motor	Silent alert to worker
TP4056 Module	Battery charging and protection
3.7V Li-ion Battery	Power source

4.2 Working Principle

- The MQ-2 detects smoke/gas and LM35 measures ambient temperature.
- When readings exceed set thresholds (e.g., 300 ppm for smoke, 45°C for temp), the NodeMCU triggers the vibration motor.
- The system resets if conditions return to safe levels.

5. CIRCUIT DIAGRAM
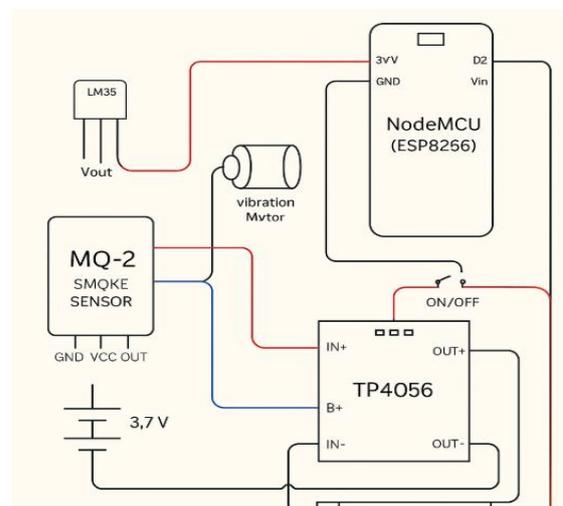
- NodeMCU connections to MQ-2 (A0), LM35 (A1), and vibration motor (D2).
- TP4056 power management circuit for battery recharging.

6. SOFTWARE IMPLEMENTATION

Programmed using the Arduino IDE:

```cpp
CopyEdit
#define smokeSensor A0
#define tempSensor A1
#define vibMotor D2

int smokeThreshold = 300;
int tempThreshold = 45;

void setup() {
  pinMode(vibMotor, OUTPUT);
  Serial.begin(9600);
}

void loop() {
  int smokeValue = analogRead(smokeSensor);
  int tempRaw = analogRead(tempSensor);
  float voltage = tempRaw * (3.3 / 1024.0);
  float temperatureC = voltage * 100.0;

  if (smokeValue > smokeThreshold || temperatureC > tempThreshold) {
    digitalWrite(vibMotor, HIGH);
  } else {
    digitalWrite(vibMotor, LOW);
  }

  delay(1000);
}
```

7. RESULTS

- Smoke Test: Triggered within 2–3 seconds of smoke exposure.
- Heat Test: Vibration triggered at 46°C.
- Battery Life: 6–8 hours on a 600mAh battery.
- Wearability: Easily fits in a badge holder or arm strap.

8. APPLICATIONS

- Cracker factories
- Chemical warehouses
- Fire-prone industrial zones
- Refineries and fuel storage facilities

9. LIMITATIONS

- No remote monitoring or logging in this version.
- No GPS for location-based alerts.
- Vibration alone may not be sufficient for workers with reduced sensation.

10. FUTURE SCOPE

- Add Wi-Fi or LoRa for remote monitoring.
- Use Blynk/ThingSpeak for alert logging.
- Add GPS for worker tracking.
- Implement SOS button for emergencies.

11. CONCLUSION

The Wearable Safety Badge offers a simple yet powerful tool to enhance safety in hazardous workspaces. With low-cost components and reliable alert mechanisms, it can reduce response times and potentially save lives in environments prone to fire and smoke hazards.

REFERENCES

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