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IOT Based Hospital Gas Leakage Alert

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Abstract*—The IoT-Based Hospital Gas Leakage Alert System is designed to detect and monitor hazardous gas leakage in hospitals and provide immediate alerts to prevent accidents. Hospitals use medical gases such as oxygen and nitrous oxide for patient treatment and medical procedures. Gas leakage can create serious safety risks, including fire hazards, explosions, and harmful exposure. The proposed system uses gas sensors to monitor gas concentration continuously. A microcontroller processes the sensor readings and compares them with a predefined safety limit. When the gas concentration exceeds this limit, the system activates a buzzer and warning indicators and sends an alert through an IoT platform. This system helps hospital staff respond quickly and improves the safety of patients and medical personnel.

***Keywords*— Hospital gas leakage detection,gas leakage aleart sytem, MQ135,DHT11,WIFI,communication**

I. INTRODUCTION

Hospitals require a safe environment because they contain medical gas pipelines, cylinders, laboratories, intensive care units, and operation theatres. Gas leakage in these areas can lead to dangerous situations if it is not detected promptly. Traditional monitoring methods may not always provide immediate warnings or remote monitoring facilities. The IoT-Based Hospital Gas Leakage Alert System addresses this problem by combining gas sensors, a microcontroller, wireless communication, and an alert mechanism. The system continuously monitors gas levels and notifies authorized hospital personnel when an unsafe condition is detected. It provides a simple and cost-effective approach to improving hospital safety and emergency response.

II. PROPOSED SYSTEM AND ARCHITECTURE

A. Proposed System

The proposed system consists of a gas sensor, microcontroller, IoT connectivity, buzzer, LED indicators, display, and power supply. The gas sensor detects the presence of hazardous gases and sends the readings to the microcontroller. The microcontroller processes the data and checks whether the gas concentration exceeds the predefined safety limit. If an unsafe condition is detected, the system activates an audible alarm and visual warning. Through Wi-Fi connectivity, the system can also send notifications to an IoT platform or mobile application. This arrangement provides continuous monitoring and helps hospital staff take appropriate action during a gas leakage emergency

.B. System Architecture

The system is built as four layers, and data moves from the sensing end to the user end. Each layer has a separate job, which keeps the design modular and easy to expand with more sensors or rooms.

The first layer is the perception layer, which is the eyes of the system. It contains the MQ-2 sensor for LPG, methane and smoke, the MQ-135 sensor for CO_2 and ammonia, and the DHT11 sensor for temperature and humidity. These sensors only measure the surroundings and pass raw analog or digital signals to the next layer.

The second layer is the processing and control layer, which is the brain of the system. The ESP32 reads the sensor signals, converts them to digital values, and compares them with a preset threshold. When a leak is detected, it drives the local alert unit (buzzer, LEDs and LCD) and switches on the exhaust fan through the relay. Because this happens on the ESP32 itself, the room still responds to a leak if the internet is down.

The third layer is the network and cloud layer, which carries the data out of the room. The ESP32 sends readings through the Wi-Fi router, using a protocol such as MQTT or HTTP, to a cloud platform such as ThingSpeak or Blynk. The cloud stores the data and triggers the alert notifications.

The fourth layer is the application layer, which is where people use the information. Staff receive push notifications on the mobile app, and the nurse station gets an SMS or dashboard alert. The stored logs and trends can be used for analysis and safety audits.
The overall block diagram of the proposed system is shown in Fig. 1.

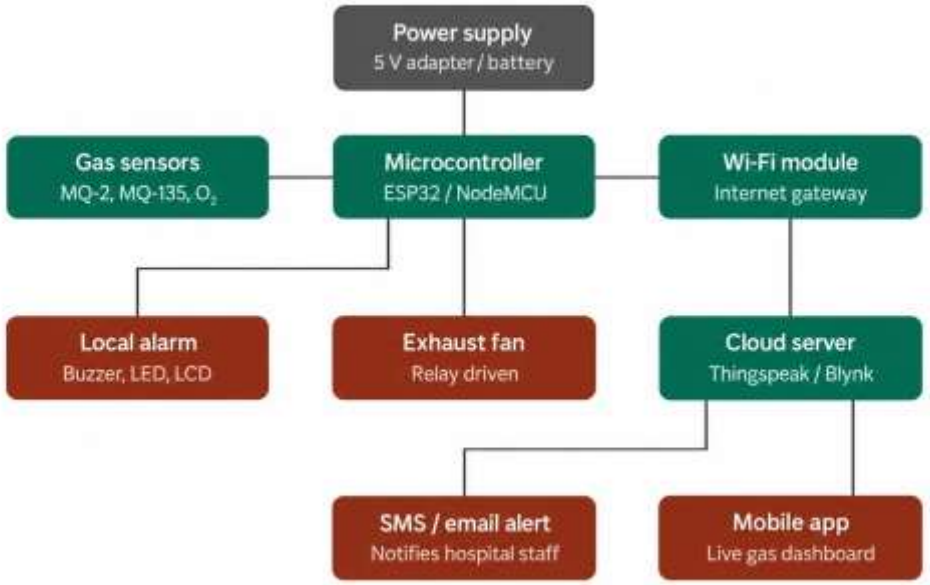


Fig. 1. Block diagram of the iot based hospital gas leakage .

The interfacing schematic of the complete embedded circuitry is shown in Fig. 2.

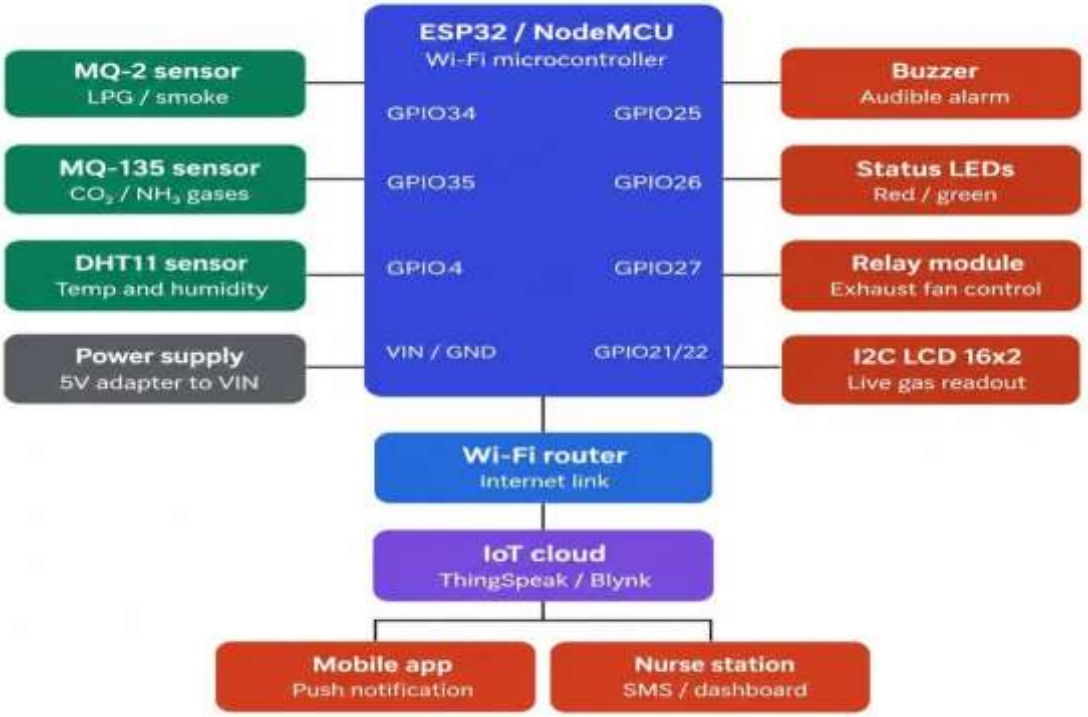


Fig. 2. Interfacing circuit schematic of the complete rescue prototype.

C. Software Architecture

The software architecture of an IoT-Based Hospital Gas Leakage Alert System is designed to continuously monitor harmful gases and provide immediate alerts. Gas sensors such as MQ-2 and MQ-135 detect LPG, smoke, CO_2, NH_3, and other gases, while the DHT11 sensor monitors temperature and humidity. The sensor data is collected and processed by an ESP32/NodeMCU microcontroller. When the gas concentration exceeds the predefined safety level, the controller activates a buzzer, warning LEDs, and exhaust fan through a relay. At the same time, the ESP32 sends the collected data through a Wi-Fi network to an IoT cloud platform such as ThingSpeak or Blynk. Hospital staff can monitor the gas levels through a mobile dashboard, and alerts can be delivered through notifications, SMS, or email. This architecture enables real-time monitoring, automatic safety actions, remote supervision, and quick response to gas leakage, helping improve safety in hospital environments.

III. HARDWARE-BASED SYSTEM

A. Bread bord



Fig. 3. Bread bord
Source: https://en.wikipedia.org/wiki/Breadboard

A breadboard is a solderless prototyping board used to connect and test electronic components easily without permanent soldering.

B. nodeMCU esp8266



Fig. 4. *nodeMCU esp8266*
Source: https://robu.in/product/nodemcu-cp2102-board/

NodeMCU ESP8266 is a Wi-Fi-enabled microcontroller board used to connect sensors and devices to the internet in IoT applications.

C. jumper wires



Fig. 5. *jumper wires*
Source: https://en.wikipedia.org/wiki/Jump_wire

Jumper wires are flexible electrical wires used to connect components on a breadboard or microcontroller without soldering.

D. MQ-135 Gas Sensor



Fig. 6. MQ-135 gas sensor.
Source: https://shop.controllerstech.com/products/mq-135-air-quality-hazardous-gas-sensor-module

The MQ-135 sensor (Fig. 6) monitors air quality and detects toxic gases such as carbon dioxide, ammonia, and smoke inside the subterranean shaft.

E. DHT11 Temperature and Humidity Sensor



Fig. 7. DHT11 temperature and humidity sensor.
Source: https://shop.controllerstech.com/products/dht11-temperature-and-humidity-sensor-module

The DHT11 sensor (Fig. 7) measures ambient temperature and relative humidity inside the borewell shaft to monitor heat stress.

F. Drone / Model frame



Fig. 8 *Drone / Model frame*
Source: https://robu.in/product-category/drone-frame/

The drone frame is the lightweight structural body that supports and holds the drone's motors, propellers, battery, and electronic components together.

G. 11.1 V 6000 mAh Li-Po Battery (CS-MCN126SL)



Fig. 9. 11.1 V 6000 mAh battery (CS-MCN126SL).
Source: https://www.amazon.ae/6000mAh-Heated-Clothes-Replacement-Battery/dp/B0HFVKHVTL/ref=sr_1_7?sr=8-7

A rechargeable 11.1V 6000 mAh Li-Po battery pack (CS-MCN126SL) (Fig. 12) powers the entire rescue system for over 45 minutes of continuous operation.

IV. WORKING OF THE SYSTEM

When the system is powered on, the 5V supply energizes the ESP32 and the sensors. The MQ-2 and MQ-135 gas sensors need a few minutes to warm up before their readings are stable. Once ready, the LCD shows "System ready" and the green LED glows to indicate normal operation.

The MQ-2 detects gases such as LPG, methane and smoke, and the MQ-135 detects CO_2 and ammonia. Both give an analog voltage that rises with gas concentration, and the DHT11 measures temperature and humidity. The ESP32 reads these values through its ADC, converts them to approximate ppm, and compares them with a preset threshold, for example 300 to 400 ppm. While the readings stay below the threshold, the LCD shows live values and the ESP32 uploads the data to the cloud every 15 to 20 seconds.

If any reading crosses the threshold, the ESP32 treats it as a leak and responds immediately. It switches the green LED off and the red LED on, sounds the buzzer, and shows "GAS LEAK!" with the gas level on the LCD. It also energizes the relay, which turns on the exhaust fan to clear the gas from the room.

At the same time, the ESP32 sends the alert over Wi-Fi through the router to the IoT cloud, such as ThingSpeak or Blynk. The cloud then pushes a notification to the mobile app and sends an SMS or dashboard alert to the nurse station. Hospital staff are therefore warned even if they are not near the affected area.

Once the gas level drops back below the threshold, the ESP32 switches off the buzzer, the fan and the red LED, and turns the green LED back on. It also sends a "Normal" status update to the cloud, so the system returns to monitoring without manual intervention..

V. CONCLUSION

The IoT-Based Hospital Gas Leakage Alert System offers a practical approach to monitoring gas leakage risks in hospital environments. By combining gas sensors, a microcontroller, local alarm devices, and IoT communication, the system is designed to identify abnormal gas levels and notify hospital personnel promptly. Its continuous monitoring and remote notification capabilities can help reduce response time and support hospital safety management. The system can be enhanced through additional sensors, cloud monitoring, backup power, and carefully engineered automatic control features. For real hospital deployment, it must be used alongside appropriate certified safety equipment and established emergency procedures.

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