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IoT-based Fire and Gas Detection Using Blynk

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Abstract

This article provides a Blynk platform-based internet of things (IoT) solution for gas and fire detection. The suggested system has sensors that are linked to a microcontroller and can detect gas leaks as well as fires. These sensors provide wireless data transmission to a central processing unit. Safety and monitoring systems are only two of the many facets of daily life that the IoT has transformed in recent years. The goal of this project is to leverage the Blynk platform to create an IoT-based fire and gas detection system. The system has sensors to identify fire and other gases, including methane (CH_4) and carbon monoxide (CO), which are dangerous in commercial, industrial, and residential settings. These sensors send real-time data to an IoT node that has a Wi-Fi module installed. The IoT node then connects to the Blynk mobile app. Users can remotely monitor real-time data, receive alerts, and take appropriate action in the event of an emergency with the Blynk platform. The method provides a practical and effective way to improve safety precautions in a range of settings, including commercial, residential, and industrial ones.

Keywords: Internet of things (IoT), smart sensor, home automation, data visualization, wireless connectivity

INTRODUCTION

A busy commercial complex, an industrial plant in full swing, or even your own house – There is a serious risk to life and property in each of these environments due to the looming potential of fire and gas leaks. Although traditional detection systems have been useful to us, they frequently lack the intelligence and agility needed to react quickly and effectively to changing threats. The application of internet of things (IoT) technology has become a major development in the field of safety and security, providing creative solutions for real-time monitoring and response systems. The detection of fire and hazardous gases in a variety of settings is one important application area, where prompt detection and action are essential to avert certain catastrophes [1, 2].

Conventional gas and fire detection systems frequently depend on independent sensors with constrained connectivity and observational powers. These systems can now take advantage of cloud-based platforms and networked devices to offer improved functionality, accessibility, and dependability thanks to IoT. The goal of this project is to construct an IoT-based fire and gas detection system utilizing the Blynk platform, which is a popular option for IoT applications because of its ease of use and adaptability [3, 4].

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This project's main goal is to create and put into place a reliable system that can identify fires and other gases, like methane (CH_4) and carbon monoxide (CO), in commercial, industrial, and residential contexts. Using specialized sensors and their integration with IoT nodes that have Wi-Fi modules installed, the system allows for remote monitoring and real-time data transmission via the Blynk mobile application. This method not only improves detection responsiveness but also gives customers the ability to receive timely alerts and notifications straight to their cellphones.

Introducing IoT-powered gas and fire detection, made possible by the flexible Blynk platform. This innovative solution transforms the way we secure our environments by fusing the intelligence and connectivity of IoT technology with the dependability of traditional sensors [2, 4–9].

BACKGROUND AND MOTIVATION

The growing demand for effective, real-time monitoring, and control of safety concerns in a variety of locations, including commercial buildings, residential areas, and industrial facilities, is the driving force behind the development of an IoT-based fire and gas detection system using Blynk. Flexibility, scalability, and accessibility are sometimes lacking in traditional fire and gas detection systems, which can cause reaction times to be delayed and associated hazards to rise.

Developers can create a more sophisticated and user-friendly solution for fire and gas detection by utilizing IoT technology, which involves connecting physical devices to the internet to collect and exchange data, along with platforms like Blynk, which provide tools for building mobile applications to control and monitor IoT devices [10].

INTERNET OF THINGS–BASED FIRE AND GAS DETECTION

We used several sensors to make a fire alarm in this project. Every time this project detects smoke or fire, an alarm will be sent out. Additionally, it is equipped with an LED and a buzzer that will function as both a visible and auditory alert. Now let us get started developing an IoT-based fire and smoke detection system with a Node MCU [6].

SECURITY RISKS

To ensure the safety and reliability of the IoT-based fire and gas detection system, implementing robust security measures, as outlined in Table 1, is crucial.

Table 1. Security threats, impacts, and mitigation strategies for IoT-based fire and gas detection systems using Blynk application.

Threat	Description	Impact	Mitigation
Unauthorized access	Attackers might be able to access the Blynk application or internet of things (IoT) devices without authorization. This might enable them to manipulate sensor data, turn off the fire and gas detection system, or even set off false alerts.	Loss of life, property damage, disruption of operations	• Put in place robust permission and authentication procedures for the Blynk app as well as devices • Make use of safe communication methods (like TLS/SSL) • Update the Blynk app and device firmware on a regular basis to fix security flaws
Man-in-the-middle (MitM) attacks	Communication between the Blynk app and IoT devices may be intercepted by hackers. They could be able to use this to insert malicious commands or steal sensor data.	Loss of life, property damage, disruption of operations	• Employ secure communication protocols that encrypt data while it is in transit, such as TLS/SSL • To guarantee data integrity, use message authentication codes (MACs).

Data breaches	Attackers may be able to access private information kept on IoT devices or the Blynk cloud, including sensor readings and user credentials.	Loss of life, property damage, disruption of operations, privacy violations	• Use robust data encryption both in transit and at rest • Make regular backups of your data and keep it safe • Prevent vulnerabilities that an attacker could exploit by using secure coding methods
Social engineering attacks	Attackers may deceive users into clicking on harmful links or disclosing private information. They could be able to access the Blynk app or the IoT devices as a result.	Loss of life, property damage, disruption of operations	• Educate users about social engineering attacks and how to avoid them • Implement strong spam filters to prevent phishing emails
Denial-of-service (DoS) attacks	Attackers might overload the Blynk app or IoT devices with traffic, rendering them unusable for authorized users.	Disruption of operations	• Implement rate limiting to prevent DoS attacks • Design systems to be resilient to DoS attacks

SAFETY DUE TO INTERNET OF THINGS–BASED FIRE AND GAS DETECTION USING BLYNK

Putting in place a Blynk-powered IoT fire and gas detection system provides a reliable safety solution. Real-time monitoring and alerting are made possible by connecting sensors with the Blynk platform that can identify gas leaks and fires. This ensures that potential risks are quickly addressed. Users may remotely access and monitor sensor data via Blynk's user-friendly mobile application interface. They can also receive rapid notifications in the event of an emergency and even automated responses, such as setting off alarms or initiating emergency protocols [7]. By enabling prompt detection and response to fire and gas-related accidents, this seamless integration improves safety by reducing risks and protecting people and property.

The system utilizes the Blynk platform for real-time monitoring and alerting of fire and gas risks. Figure 1 presents a graph illustrating the relationship between the resistance ratio (Rs/Ro) and temperature (°C) at different humidity levels: 30% RH, 60% RH, and 85% RH.

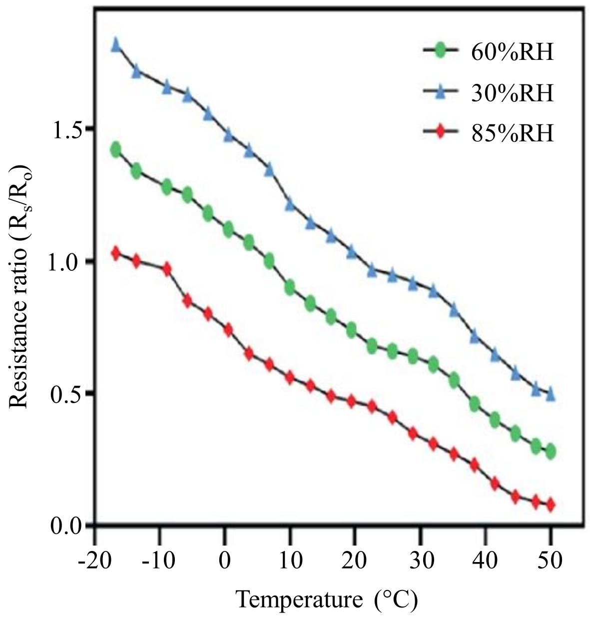

Figure 1. The relationship between the resistance ratio (Rs/Ro) and temperature (°C) under different levels of humidity: 30%RH, 60%RH, and 85%RH.

Sensor performance with varying humidity and temperature: Figure 1 illustrates how the sensor's resistance changes with temperature under different humidity conditions. This information is crucial for assessing the performance of the IoT-based fire and gas detection system in real-world environments with varying temperature and humidity levels.

IMPLEMETATON SETUP

Supplies

- ESP8266 NodeMCU x 1
- Flame Sensor x 1
- MQ2 Smoke Sensor x 1
- 5V Buzzer x 1
- LED any color x 1
- Transistor BC547 x 1
- Resistor 1 kohm x 2
- Jumper cables
- Breadboard

ESP8266 Node MCU

Node MCU, an open-source IoT platform, is ESP8266 shown in Figure 2. It consists of hardware built around the ESP-12 module and firmware running on Express if System’s low-cost, WiFi-enabled ESP8266 Wi-Fi SoC. Its pins for communication and controlling other peripherals attached to it include General Purpose Input/Output (GPIO) pins, Serial Peripheral Interface (SPI), Inter-Integrated Circuit (I2C) communication channels, Analog-to-Digital Converter (ADC) inputs, Pulse Width Modulation (PWM) outputs, and Universal Asynchronous Receiver/Transmitter (UART). The CP2102 IC on board Node MCU offers USB to TTL capabilities. Two GPIO pins are used in this IoT fire alarm to obtain digital data from the gas and flame sensors.

Flame Sensor

One tool that can be used to identify the presence of a fire or other strong light source is a flame sensor as shown in Figure 3. Although there are other ways to create a flame sensor, this project uses an infrared radiation-sensitive sensor module. The module generates a steady digital output signal using an LM393 comparator chip. The driving ability of this comparator is 15 mA. This flame detector sensor can be utilized for a variety of applications, such as fire alarms and other projects that require fire detection equipment.

Smoke Sensor

We used a MQ2 smoke sensor shown in Figure 4 in this project. Methane, butane, and liquified petroleum gas (LPG) are among the gases that this sensor is capable of detecting. For a better interface, we utilized a MQ2 gas sensor module in this project.

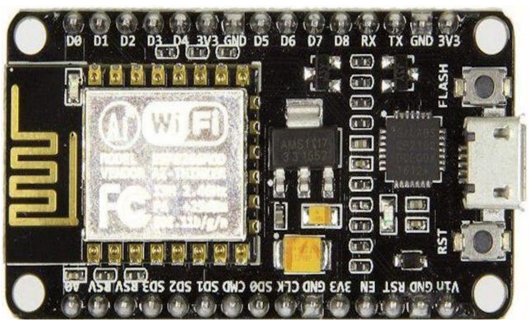

Figure 2. ESP8266 Node MCU.

Figure 3. Flame sensor.

Figure 4. Smoke sensor.

Circuit Diagram

Here, the connections are straightforward: the red and black wires are all for the GND and VCC connections. To turn on an exhaust system or any other AC appliance, you can also connect an extra relay module. You can add and edit the code. The MQ2 gas sensor's A0 pin and the flame sensor's D0 pin are being used, which is shown in Figure 5.

WORKING METHODOLOGY

The working methodology used in this proposed system is described below.

Hardware Assembly

Assemble the following parts: breadboard, jumper wires, smoke sensor, gas sensor (specific to the target gas), LED (optional), buzzer (optional), microcontroller (ESP8266/ESP32), and power supply. Using the pin configurations for each sensor, LED, and buzzer, connect them to the microcontroller. Pin layouts and connection diagrams can be found in online tutorials or component datasheets. Use a suitable voltage battery or AC adapter to power the microcontroller.

Software Development

Typically, the code will include the following: the sensors, Blynk, and microcontroller libraries. Configure the code with the Blynk credentials (auth token). Implement routines to process sensor data putting reasoning into practice to contrast sensor readings and threshold values. When thresholds are crossed, an LED and buzzer (if connected) sound a local alert. Using WiFi to send sensor data and the status of gas and fire detection to the Blynk app.

Blynk App Configuration

Install the Blynk app on your tablet or smartphone after downloading it. In the Blynk app, start a new project. To display sensor readings (e.g., Virtual Gauge) and send out alerts (e.g., Notification), choose the relevant widgets. Customize the widgets in the Blynk app interface to your liking. Link your project using the auth token you incorporated into the code in the app settings.

Testing and Deployment

Using the Arduino IDE, upload the code to your microcontroller board. Make sure the Blynk app is connected to your project by opening it. In a controlled setting, simulate gas or smoke to test the system.

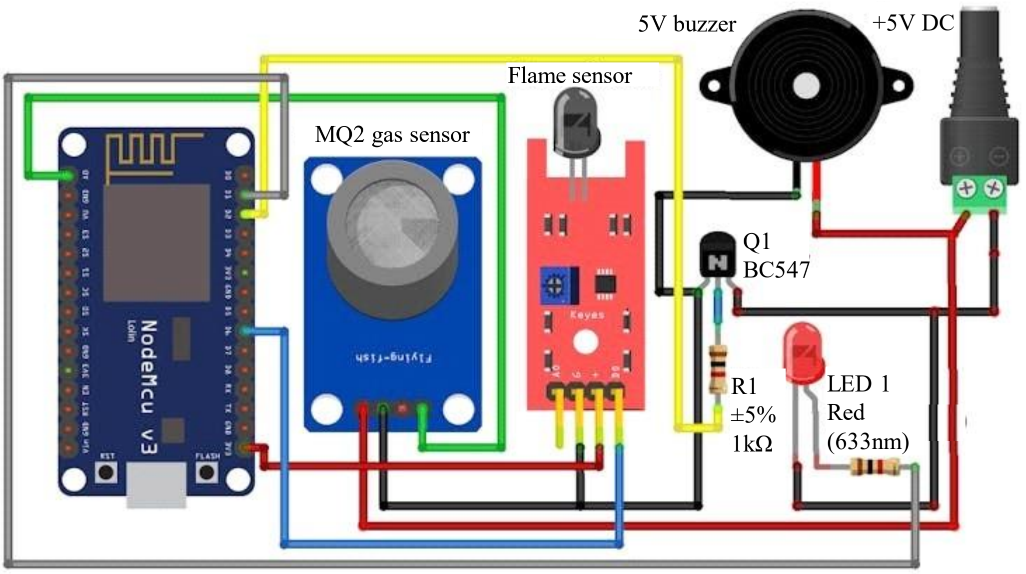

Figure 5. Circuit diagram of proposed system.

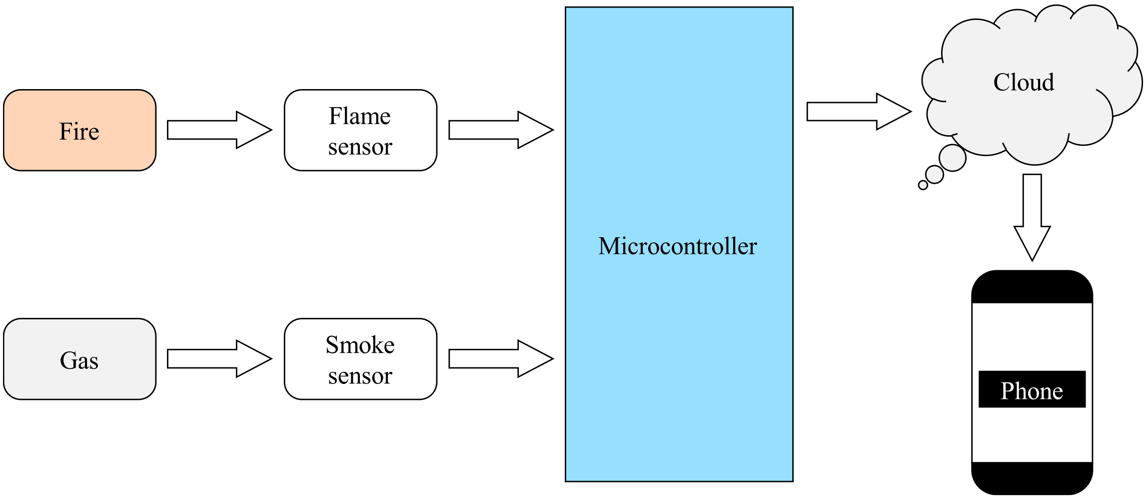

Figure 6. Block diagram of proposed system.

Then, check the sensor readings and app-displayed notifications. After you are satisfied with the system's functionality, install it in an appropriate spot, making that the power supply and sensor positioning are correct as shown in Figure 6.

CONCLUSION

Finally, the use of the Blynk platform with ESP8266 for IoT-based fire and gas detection shows promise as an improvement to safety protocols in a variety of settings. Rapid fire and gas hazard detection is made possible by the seamless integration of real-time monitoring and remote-control functionality made possible by the ESP8266 microcontroller and the user-friendly Blynk interface. This solution guarantees prompt risk mitigation by enabling prompt response via mobile devices in addition to proactive notifications. Its characteristics, which are both scalable and configurable, allow for versatility in a variety of contexts, from industrial to domestic, thereby making a substantial contribution to the evolution of safety standards in IoT-enabled environments.

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