iJRASET
International Journal For Research in Applied Science and Engineering Technology

INTERNATIONAL JOURNAL FOR RESEARCH

IN APPLIED SCIENCE & ENGINEERING TECHNOLOGY

Volume: 13 **Issue:** IX **Month of publication:** September 2025

DOI: https://doi.org/10.22214/ijraset.2025.74112

International Journal for Research in Applied Science & Engineering Technology (IJRASET)
ISSN: 2321-9653; IC Value: 45.98; SJ Impact Factor: 7.538
Volume 13 Issue IX Sep 2025- Available at www.ijraset.com

Smoke Detection Security Using ESP8266

Mr. Durga Nayak K[1], Prof. Sharvani V[2]
Department of Master of Computer Applications, Ballari Institute of Technology and Management, Ballari, Karnataka, India

Abstract: Fire accidents continue to pose a serious threat to human life and property, highlighting the importance of reliable and rapid smoke detection systems. Conventional smoke detectors are effective within a limited range but lack the ability to provide real-time alerts to users at remote locations. To address this limitation, this paper presents an IoT-based smoke detection system using the ESP8266 microcontroller. The system integrates a gas sensor for smoke detection and utilizes the Wi-Fi capability of the ESP8266 to send instant notifications to a mobile application. In addition, a local alarm is activated to ensure immediate awareness of nearby occupants. The designed system offers an affordable and expandable solution that can be effectively deployed in both smart homes and industrial environments.". Experimental results demonstrate that the system is capable of detecting smoke promptly and providing timely alerts, thereby enhancing safety and reducing potential risks.
Keywords: Smoke Detection, ESP8266, Internet of Things (IoT), Fire Safety, Gas Sensor (MQ2/MQ-135), Real-Time Monitoring, Smart Home Automation, Wireless Communication, Mobile Notification System, Early Warning System.

I. INTRODUCTION

Fire hazards remain one of the most common and devastating threats to human life, infrastructure, and the environment. Even a small fire outbreak can escalate rapidly, causing severe property damage, injuries, and in many cases, loss of life. Studies show that most fire accidents become uncontrollable because of delayed detection and lack of timely response. Therefore, the need for a reliable, efficient, and real-time smoke detection system has become increasingly important.

Traditional smoke detectors are widely used in homes and industries, but they are generally limited to local alarms such as buzzers or sirens. While these alerts are effective for occupants inside the building, they fail to provide warnings to users who are away from the site. This gap often delays emergency responses and reduces the chances of preventing damage at an early stage.

With the rapid growth of the Internet of Things (IoT), smart safety solutions are now being developed to overcome these limitations. IoTbased smoke detection systems integrate sensors, microcontrollers, and wireless communication
technologies to provide real-time monitoring and instant notifications. The ESP8266 microcontroller, with its built-in Wi-Fi capability, is an ideal platform for developing cost-effective and scalable IoT applications. By combining it with smoke and gas sensors such as the MQ-2, it is possible to create a system that not only detects smoke but also transmits immediate alerts to a user's smartphone through mobile applications or cloud platforms.

This approach ensures early detection, remote accessibility, and enhanced safety in residential, commercial, and industrial environments. Such systems represent a significant step toward smart home automation and play a vital role in modern fire safety management.

II. LITERATURE REVIEW

Advanced IoT Solutions for Scalable Fire Safety (2025): Recent studies in 2025 emphasize highly scalable and energy-efficient IoT smoke detection systems. With the use of ESP8266/ESP32 and cloud platforms, these systems provide real-time mobile notifications and AI-driven decision-making for accurate fire detection. They are designed to be adopted across residential, commercial, and industrial
applications.[1]

Smart Home Integration and Automation (2024): In 2024, research highlighted the integration of smoke detection systems into broader smart home ecosystems. These systems not only detected smoke but also triggered automated responses such as disabling electrical appliances, unlocking exit doors, or activating sprinklers, thereby improving overall fire safety management.[2]

AI-Assisted Smoke and Gas Analysis (2023): The year 2023 saw the application of artificial intelligence (AI) and machine learning (ML) techniques in smoke detection. By analyzing sensor data patterns, ML algorithms reduced false alarms and improved detection accuracy, making IoT-based systems more reliable in varied environments.[3]

Integration of Cloud and Edge Computing for Smoke Detection (2022)

In 2022, researchers combined cloud and edge computing with smoke detection systems. While cloud platforms enabled large-scale monitoring and storage, edge computing provided faster onsite processing, reducing response time and minimizing reliance on continuous internet availability.[4]

IoT-Based Fire Detection with Mobile Alerts (2021): Studies in 2021 introduced simple and cost-effective IoT-based fire detection systems using MQ-series gas sensors and Wi-Fi modules. These systems were among the first to provide mobile alerts through platforms like Blynk, proving the potential of IoT to enhance traditional smoke detection.[5]

III. METHODOLOGY

A. Proposed System

Components: ESP8266

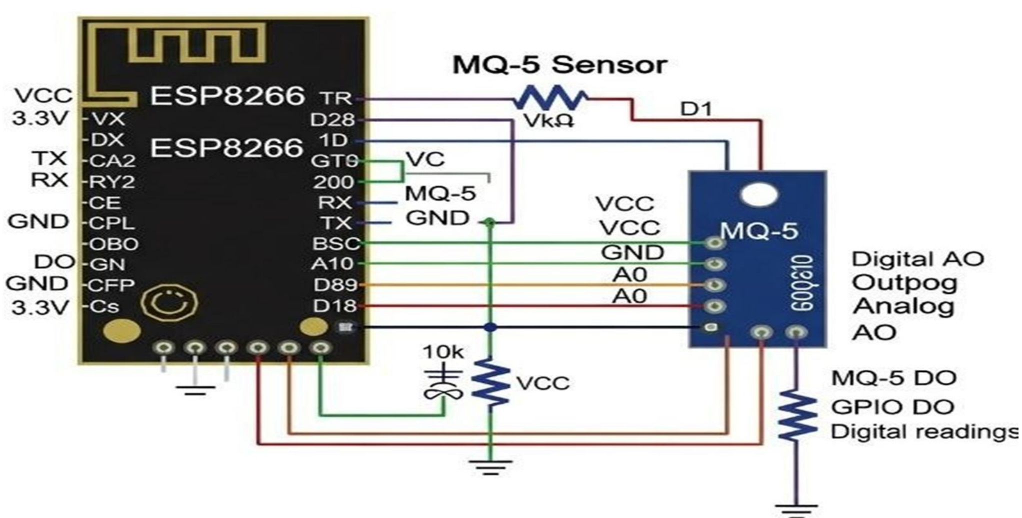
(NodeMCU/ESP-12E) 32-bit MCU with built-in Wi-Fi (2.4 GHz), 3.3 V logic, ADC (10-bit) for analog sensors, GPIOs for buzzer/L ED.

1) Smoke/Gas Sensor (MQ-2 or MQ135)MQ-2: sensitive to smoke, LPG, propane; good for household fire/s moke.MQ-135: detects smoke and airquality gases (NH_3, NOx, benzene, CO_2); better if you want airquality context. Both provide AO (analog voltage proportional to gas conc entration) and DO (digital comparator output with on-board potentiometer).
2) Alert Actuators: Buzzer (active 3.3– 5 V) and LED for local alarm.
3) Power: 5 V USB/adapter → 3.3 V regulator to ESP8266; sensor pow ered at 5 V (use analog voltage divider if AO > 1.0 V input range for some ESP8266 boards). Twilio (SMS/voice via HTTPS webhook) for cellular alerts when push is missed. • Optional: Resistor divider (sensor AO → A0), small MOSFET for buzzer if >30 mA, filter cap near sensor for stable rea dings.

Typical pin mapping (NodeMCU labels)

- Sensor AO → A0, VCC → 5 V, GND → GND
- Buzzer + → D1, LED → D2 (through 220 Ω)
- Keep D3/D4 free at boot; avoid pulling them l ow.

B. Block Diagram of the System



C. Working Principle

1) Initialization & calibration on boot, esp8266 configures gpios and connects to wi-fi. sensor warms up (≈20–60 s). The system captures a baseline from ao to account for ambient conditions.
2) Sensing & filtering periodically sample a0 (e.g., every 200 ms) and apply a moving average to reduce noise. (optional) normalize readings to estimated ppm using sens or curves after r_0 calibration.

3) Decision logic two thresholds are used: warning (moderate rise over baseline for t_1 seconds). alarm (high level or rapid rate-of-rise) to reduce false positives from cooking/aerosols. if the module has do, it can be used as a hardware trip for immediate local alarm while ao confirms.
4) Local alarm on alarm, activate buzzer (pattern: 1 s on / 0.5 s off) and led flashing for visual cue.
5) Remote notification twilio: esp8266 makes an https post to a webhook (or blynk/ifttt webhook) that sends sms/voice to registered numbers.
6) Safety & reliability watchdog resets on lockup; reconnect loop for wi-fi. debounce notifications (e.g., one alert per 60 s while condition persists). selftest: periodic buzz/led blink to indicate system h ealth; send a “device online” heartbeat to the app.
7) Data & visualization stream sensor values to the app/dashboard for trend plotting and for tuning thresholds.
8) Optional enhancements edge ml (simple logistic/regression on features like rateof-rise) to reduce false alarms. battery backup with li-ion + charger module; ota updates for firmware improvements.

IV. IMPLEMENTATION

A. *Hardware Connections*

1) MQ-2/MQ-135 Sensor: Connect the VCC pin to the 5V power supply, GND to the ground, and AO to analog pin A0 on the ESP8266.
2) LED: Connect the anode (+) to pin D2 through a 220 ohm resistor, and the cathode (-) to ground. • Power: Use a 5V USB adapter to power the NodeMCU, and ensure all components share the same groun d connection. Software (Arduino IDE + IoT Integration)
3) Read data from the analog pin connected to the sensor.
4) If the sensor reading is above a certain level, turn on the buzzer and the LED. • Send the sensor data to the Blynk app for realtime notifications.
5) (Optional) Use the Twilio API to send SMS or make voice calls as alerts.
6) The system can reconnect automatically if the Wi-Fi signal is lost, and it prevents repeated alerts by using a debounce fe ature.

B. *Results and Discussion*

The smoke detection system was built using the ESP8266 microcontroller, MQ-2 sensor, buzzer, LED, and Blynk or Twilio for mobile alerts.

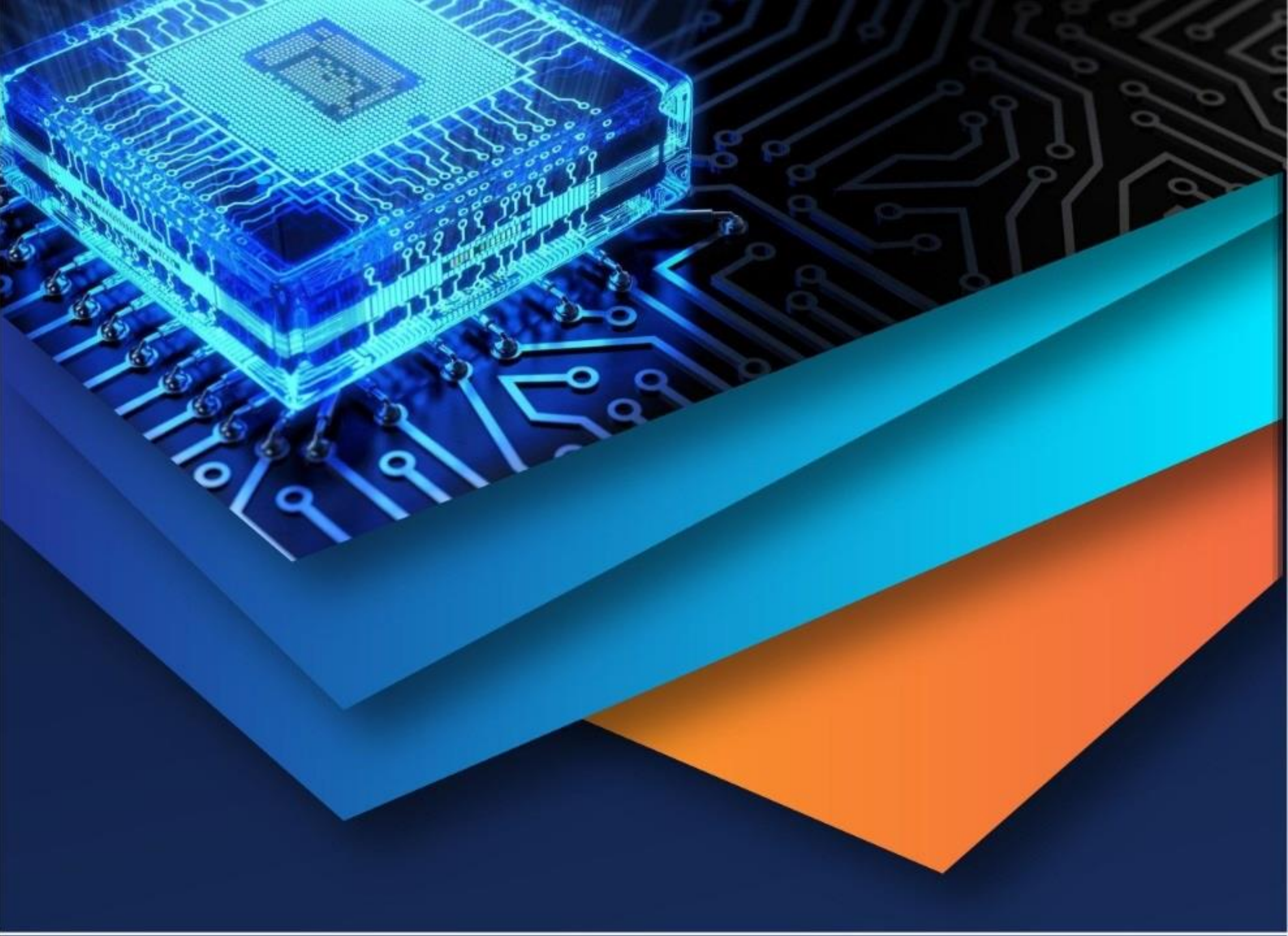
1) Local Output: When smoke levels were high, the LED blinked and the buzzer made a constant sound, alerting peopl e nearby.
2) Mobile Notifications: The ESP8266 sent realtime data to the Blynk app, which sent a push notification for smoke events. If Twilio was used, it sent SMS or voice calls to registered phone numbers.
3) Reliability: The system reconnected automatically after losin g Wi-Fi, and repeated alerts were avoided by a debounce feature.
4) Discussion: The system is affordable and works well, providi ng both local alarms and remote notifications. It is better than traditional detectors because it gives faster alerts and can be checked from anywhere.

V. CONCLUSION

This paper introduced an IoTbased smoke detection system using the ESP8266, MQ sensors, and mobile services like Blynk and Twilio.
The system effectively detected smoke, activated ala rms, and sent real-time alerts. It is more reliable and cheaper than regular smoke dete ctors and can easily be added to smart homes.

REFERENCES

[1] Blynk IoT Platform Documentation – https://docs.blynk.io,2020.
[2] R. Sharma and K. Mehta, “IoT-Based Fire Detection with Mobile Notifications,” International Journal of Advanced Research in Computer Science, vol. 12, no. 4, pp. 45–50, 2021.
[3] M. Ali, S. Thomas, and H. Zhao, “Integration of Cloud and Edge Computing for IoT-Based Fire Detection,” IEEE International Conference on IoT Applications, pp. 120–125, 2022.
[4] S. Verma and P. Gupta, “Artificial Intelligence in IoT Smoke Detection Systems,” Journal of Emerging Technologies, vol. 8, no. 2, pp. 89–95, 2023
[5] L. Wang and T. Kumar, “Smart Home Automation for Fire Safety: IoT-Based Solutions,” International Conference on Smart Cities and IoT, pp. 210–216, 2024.
[6] Twilio API for SMS and Voice Alerts – https://www.twilio.com/docs, 2025.Twilio API for SMS and Voice Alerts – https://www.twilio.com/docs, 2025.



10.22214/IJRASET

INDEX COPERNICUS 45.98

IMPACT FACTOR: 7.129

IMPACT FACTOR: 7.429

INTERNATIONAL JOURNAL FOR RESEARCH

IN APPLIED SCIENCE & ENGINEERING TECHNOLOGY