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Smoke Detection and Room Humidity Monitoring System Using MQ-135 and DHT22 Based on ESP32

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Abstract **--** This paper presents a smoke detection and room humidity monitoring system using MQ-135 and DHT22 based on ESP32, supported by physical indicator LEDs and the Blynk Internet of Things dashboard. The system initializes the sensor and indicator pins, establishes a Wi-Fi connection, verifies sensor readings, warms up and calibrates the MQ-135 sensor, and then performs periodic monitoring every two seconds. The MQ-135 output is processed as a relative air-quality indicator, while the DHT22 provides room humidity information. The dashboard configuration was improved by removing Blynk virtual LED widgets and retaining only numerical values, status labels, and explanatory text through virtual pins. All physical LEDs remain active on the hardware to indicate gas and humidity conditions locally. The load-resistor value for the MQ-135 calculation was also corrected to 1 kOhm. Functional evaluation indicates that the prototype can provide local indications and remote monitoring information without relying on virtual LED widgets. The system is suitable for educational early-warning demonstrations, although calibration with reference instruments is required before safety-critical use.

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Air quality monitoring;
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I. INTRODUCTION

Indoor air quality and humidity are important factors in room comfort, health, and early hazard awareness. Smoke from combustion, overheating electrical components, or cooking activities can appear before users recognize the danger. A compact monitoring system can therefore support early warning by combining local visual indicators and remote dashboard information [1], [2].

Low-cost Internet of Things (IoT) monitoring systems commonly use microcontrollers and gas or environmental sensors to acquire air-quality-related parameters in real time [3], [4], [5]. In this work, the ESP32 was selected because it provides analog input capability and Wi-Fi connectivity in a compact development board [6], [7], [8]. The MQ-135 sensor was used to detect changes related to smoke and several air contaminants, while the DHT22 sensor was used to obtain room humidity [9], [10].

The main improvement in this paper is the dashboard and firmware revision. Virtual LED widgets in Blynk were removed so that virtual pins are used only as data channels for sensor values, status labels, and explanation text. This is consistent with the Blynk concept that virtual pins are data channels rather than physical GPIO pins [11], [12]. The physical LEDs remain connected to the ESP32 output pins, allowing the prototype to keep local indications even when the dashboard interface is simplified.

II. MATERIALS AND METHOD

A. System Design

The system consists of an ESP32 development board, MQ-135 gas sensor, DHT22 humidity sensor, five physical LEDs, a 1 kOhm load resistor for MQ-135 calculation, a 5.6 kOhm series resistor for ADC protection, jumper wires, and a breadboard. The MQ-135 analog output is read by the ESP32 through GPIO 34, while the DHT22 signal is read through GPIO 32. Three LEDs represent gas status, and two LEDs represent room humidity status.

TABLE I.
Main components used in the prototype.

No.	Component	Purpose
1	ESP32 development board	Main controller, Wi-Fi connection, ADC reading, and communication with Blynk
2	MQ-135 gas sensor	Detects relative changes in smoke-related and air-quality-related gas concentration
3	DHT22 sensor	Measures room relative humidity
4	Physical LEDs	Provides local indication for gas and humidity status
5	1 kOhm load resistor	Used as the MQ-135 RL value in the revised calculation
6	5.6 kOhm series resistor	Provides additional protection for the ESP32 ADC input
7	Breadboard and jumper wires	Supports prototype wiring and testing

B. Monitoring Procedure

The monitoring procedure begins with pin initialization, Wi-Fi connection, sensor validation, MQ-135 warm-up, and R0 calibration. If Wi-Fi connection fails, all physical LEDs are turned on for three seconds before the device retries the connection. If a sensor reading is invalid, all physical LEDs blink for three seconds and the validation process is repeated. After initialization, the system reads the MQ-135 and DHT22 every two seconds and updates the Blynk dashboard only when data or status changes are detected.

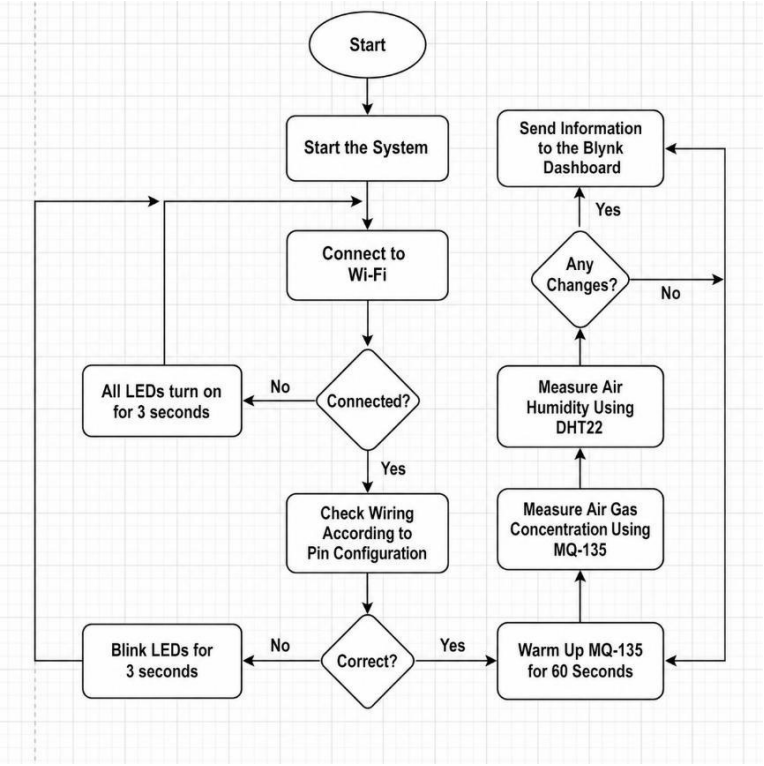


FIGURE 1.
Revised monitoring flow without Blynk virtual LED widgets

C. Sensor Processing

The MQ-135 sensor output is processed from the ADC value into output voltage and sensor resistance. The updated design uses RL = 1 kOhm in the resistance calculation. The sensor resistance is obtained using (1), where Vout is the ADC-derived output voltage and Vcircuit is the circuit supply voltage.

$$Rs = ((Vcircuit / Vout) - 1) \times RL \quad (1)$$

The ratio between Rs and R0 is then processed using a log-log regression model, as shown in (2), to obtain indicative values for CO2, NH3, alcohol, and CO. These values are displayed as relative dashboard percentages. Because MQ-series sensors are affected by calibration, humidity, temperature, and cross-

sensitivity, the resulting values should be interpreted as relative indicators and not as certified gas-specific measurements [9], [13], [14],[15].

$$PPM = A \times (Rs / R0)^{B} \quad (2)$$

D. Blynk Dashboard Mapping

The revised Blynk dashboard removes virtual LED outputs. The dashboard uses only gauges, values, or text labels for numerical readings, status categories, and user-friendly explanations. The final virtual pin mapping is shown in Table II.

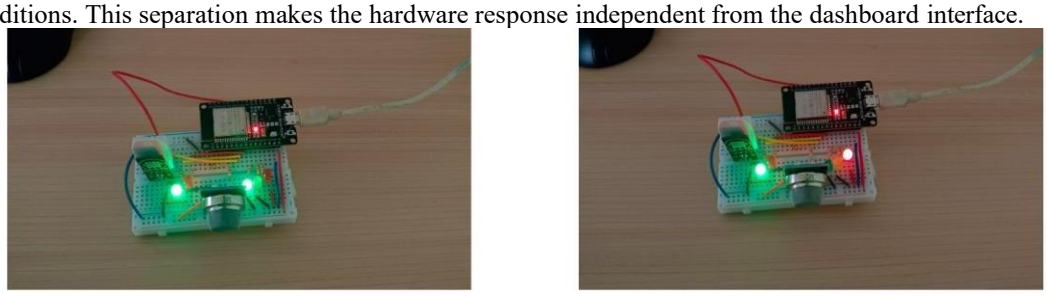
TABLE II.
Final Blynk virtual pin mapping after removing virtual LED widgets.

Virtual Pin	Displayed Data	Dashboard Output
V1	CO2 percentage	Gauge or value label
V2	Gas status: AMAN, WASPADA, or BAHAYA	Text label
V6	Air-quality explanation for general users	Text label
V7	NH3 percentage	Gauge or value label
V8	Alcohol percentage	Gauge or value label
V9	CO percentage	Gauge or value label
V10	Humidity value in %RH	Gauge or value label
V11	Room status: LEMBAB or KERING	Text label
V14	Humidity explanation for general users	Text label

III. RESULTS AND DISCUSSION

A. Prototype Implementation

The prototype was assembled on a breadboard and connected to the ESP32. The physical indicator LEDs remained active after the Blynk virtual LED widgets were removed. The gas-status LEDs indicate AMAN, WASPADA, and BAHAYA conditions, while the humidity-status LEDs indicate LEMBAB and KERING conditions. This separation makes the hardware response independent from the dashboard interface.



(a) Prototype with safe/humid physical LED indication (b) Prototype with gas/humidity physical LED indication

FIGURE 2.
Hardware prototype with physical LED indications during testing.

B. Functional Evaluation

Functional testing was conducted by observing the program stages, local LED indicators, and Blynk dashboard outputs. The evaluation focused on whether the revised system followed the intended logic, not on certified gas-concentration accuracy. Table III summarizes the expected and observed behavior.

TABLE III.
Functional evaluation of the revised prototype.

Test Aspect	Expected Response	Observation
Wi-Fi connection	Device connects to the configured Wi-Fi network before Blynk communication starts	System proceeds to the next stage after connection
Wi-Fi failure handling	All physical LEDs turn on for three seconds and the device retries	Failure handling remains local through physical LEDs
Sensor validation	DHT22 and MQ-135 readings are checked before monitoring	Invalid readings trigger physical LED blinking and repeated checking
MQ-135 warm-up	Sensor warm-up and R0 calibration are executed before the main loop	Monitoring starts after warm-up and calibration
Physical gas LEDs	Green, yellow, or red LED shows AMAN, WASPADA, or BAHAYA	Physical LED indication remains active
Physical humidity LEDs	Humidity LEDs show LEMBAB or KERING	Physical humidity indication remains active

Test Aspect	Expected Response	Observation
Blynk update	Only changed values or status text are sent to virtual pins	Dashboard traffic is reduced and virtual LEDs are not required

C. Discussion

The revised design improves the clarity of the dashboard by separating remote monitoring information from local hardware indication. Blynk now receives only sensor values and descriptive status text, while the ESP32 output pins directly control the physical LEDs. This design is simpler for users because the dashboard displays information rather than duplicating the LED indicators already available on the device.

The use of a 1 kOhm RL value is important because the MQ-135 resistance calculation depends directly on the load resistor. An incorrect RL value changes the computed Rs value and affects all subsequent gas-indicator estimates. However, even with the corrected RL value, the MQ-135 remains a relative air-quality sensor that requires careful calibration and environmental compensation for serious measurement applications [9], [13].

The main limitation of the prototype is the absence of calibration against a certified reference instrument. Therefore, the system should be used as a learning prototype and early-warning demonstration. Future work should include longer-term data logging, calibration in controlled environments, comparison with standard instruments, enclosure design, and notification testing under different room conditions.

IV. CONCLUSION

This paper presented an ESP32-based smoke-indication and room-humidity monitoring prototype using MQ-135, DHT22, physical LEDs, and Blynk. The journal version was revised so that no source code is included in the manuscript. The Blynk virtual LED widgets were removed, while all physical LEDs remained active for local indications. The final dashboard uses V1, V2, V6, V7, V8, V9, V10, V11, and V14 for numerical readings, status labels, and explanatory text. The MQ-135 RL value was corrected to 1 kOhm. Functional testing showed that the prototype can initialize, validate sensors, warm up and calibrate the MQ-135, monitor gas and humidity indicators, display local LED status, and update Blynk only when data changes. The prototype is appropriate for project-based learning and early-warning demonstration, but reference calibration is required before any safety-critical use.

V. ACKNOWLEDGMENT

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