IOT based Hygiene Monitoring System

A Smart IoT Solution for Real-Time Sanitation Monitoring

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Abstract: This study introduces a compact and economical IoT-based Hygiene Monitoring System aimed at the assessment of hygiene-related spaces such as public toilets, hospitals' auxiliary rooms, hostels, and waste management facilities. Traditional hygiene monitoring is often done manually and periodically, which might result in delayed cleaning activities. The IoT system uses an ESP32 microcontroller along with a MQ-135 gas sensor for detecting ammonia (NH3), bad odor gases, and air quality deterioration, as well as the DHT11 sensor for measuring ambient temperature and humidity levels. The sensor readings are sent via Wi-Fi to the Blynk app, allowing users to monitor the hygiene status remotely in real time. Based on thresholds, the system determines whether the observed space is in a safe, moderate, or poor hygiene state.

Index Terms - IoT, Hygiene Monitoring, ESP32, MQ-135, DHT11, NH3 Detection, Blynk, Smart Sanitation, Real-Time Monitoring

I. INTRODUCTION

Hygiene maintenance in public and sanitation places is vital for health and safety measures. Dirty washrooms and enclosed sanitation places tend to have unpleasant smell, presence of gases such as ammonia, high level of humidity, and poor air circulation. In most cases, monitoring is carried out using a conventional method known as manual inspection that lacks regularity and does not give continuous feedback. An IoT-enabled monitoring device is thus proposed as a solution to this problem. The project will use the ESP32 controller, MQ-135 sensor for detection of ammonia and gases, and DHT11 sensor for temperature and humidity measurement. Data will be transmitted to Blynk application using Wi-Fi connection.

II. OBJECTIVES

1. To develop an affordable IoT-based hygiene monitoring system.
2. To identify ammonia (NH3) and hazardous gas concentrations via MQ-135 sensor.
3. To record the temperature and humidity via DHT11 sensors.
4. To transmit live sensor data via ESP32 WiFi module.
5. To view the live reading via the Blynk app.
6. To highlight the presence of poor hygiene based on threshold values.

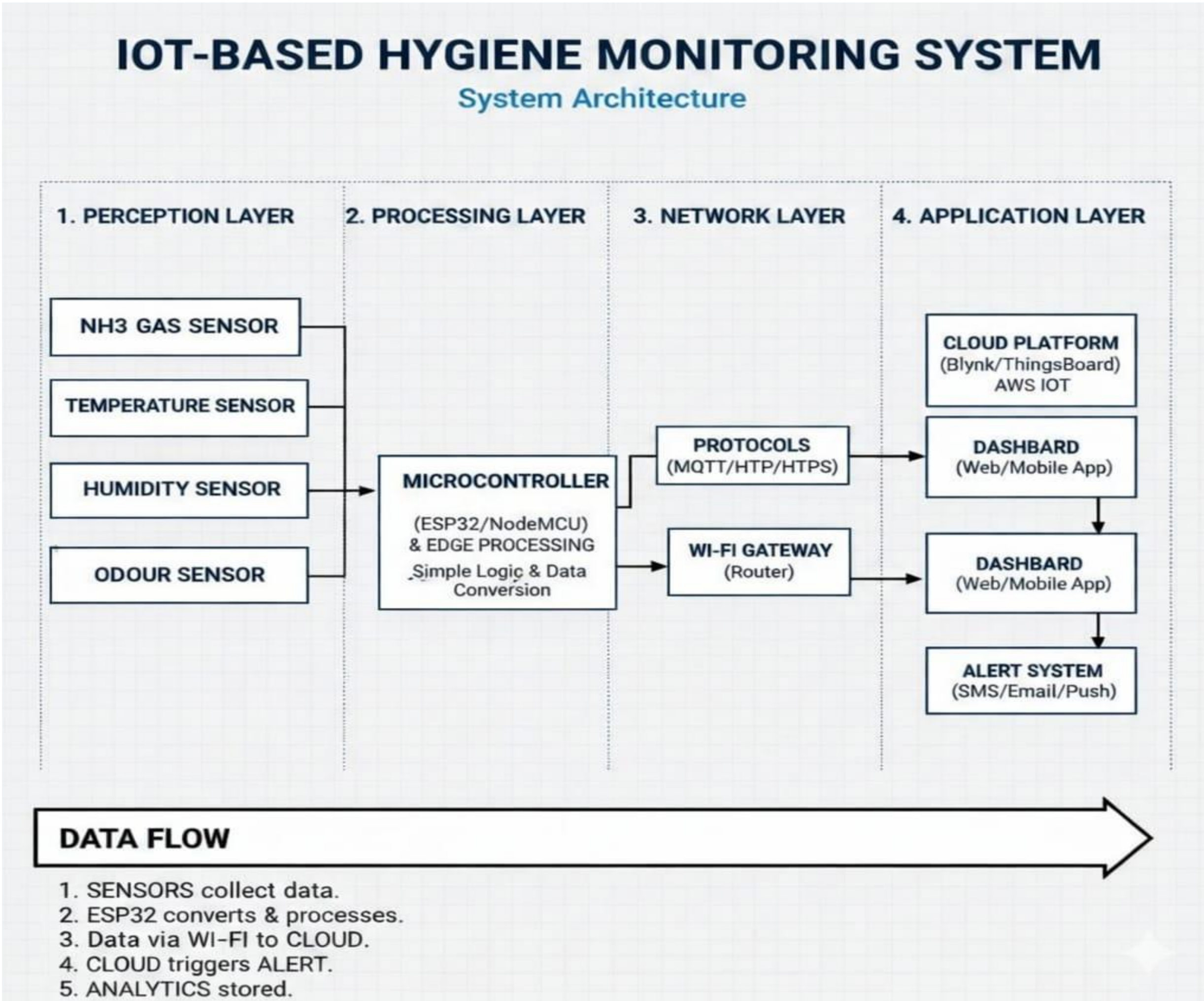
III. PROPOSED SYSTEM AND WORKING

The proposed system consists of an ESP32 microcontroller, MQ-135 gas sensor, DHT11 sensor, 5V power supply, and the Blynk mobile application. The MQ-135 sensor is used to detect ammonia and general air-quality deterioration commonly found in poorly maintained sanitation areas. The DHT11 sensor measures temperature and humidity, which are useful indicators of ventilation and environmental comfort. ESP32 reads all sensor values at regular intervals, compares them with predefined thresholds, and transmits the values to the Blynk cloud via Wi-Fi. The user can view the live readings on the Blynk dashboard. If the gas level increases or environmental conditions become unfavorable, the system indicates that the monitored area requires cleaning or ventilation.

IV. BLOCK DIAGRAM AND CIRCUIT DESCRIPTION

System Flow: MQ-135 + DHT11 □ ESP32 □ Wi-Fi □ Blynk Cloud □ Blynk Mobile App.

Figure 1: Functional block diagram of the proposed system.



The connection of MQ-135 to ESP32's input is done through analog input, while that of DHT11 is connected via digital GPIO pins. There is a 5V regulator that provides power to the controller and the sensors. The system is simple, portable, and good enough for prototypes. Suggested connections from this work include:

Component	Pin	Connected To	Purpose
MQ-135	AOUT	ESP32 GPIO34	Gas / NH3 analog reading
MQ-135	VCC	5V	Sensor power
MQ-135	GND	GND	Common ground
DHT11	DATA	ESP32 GPIO4	Temp & humidity data
DHT11	VCC	3.3V / 5V	Sensor power
DHT11	GND	GND	Common ground

MQ-135 AOUT to ESP32 GPIO34 (Analog)

DHT11 DATA to ESP32 GPIO4

Table1: Suggested pin-to-pin circuit connection table

Hardware setup of “IoT based Hygiene Monitoring System”.

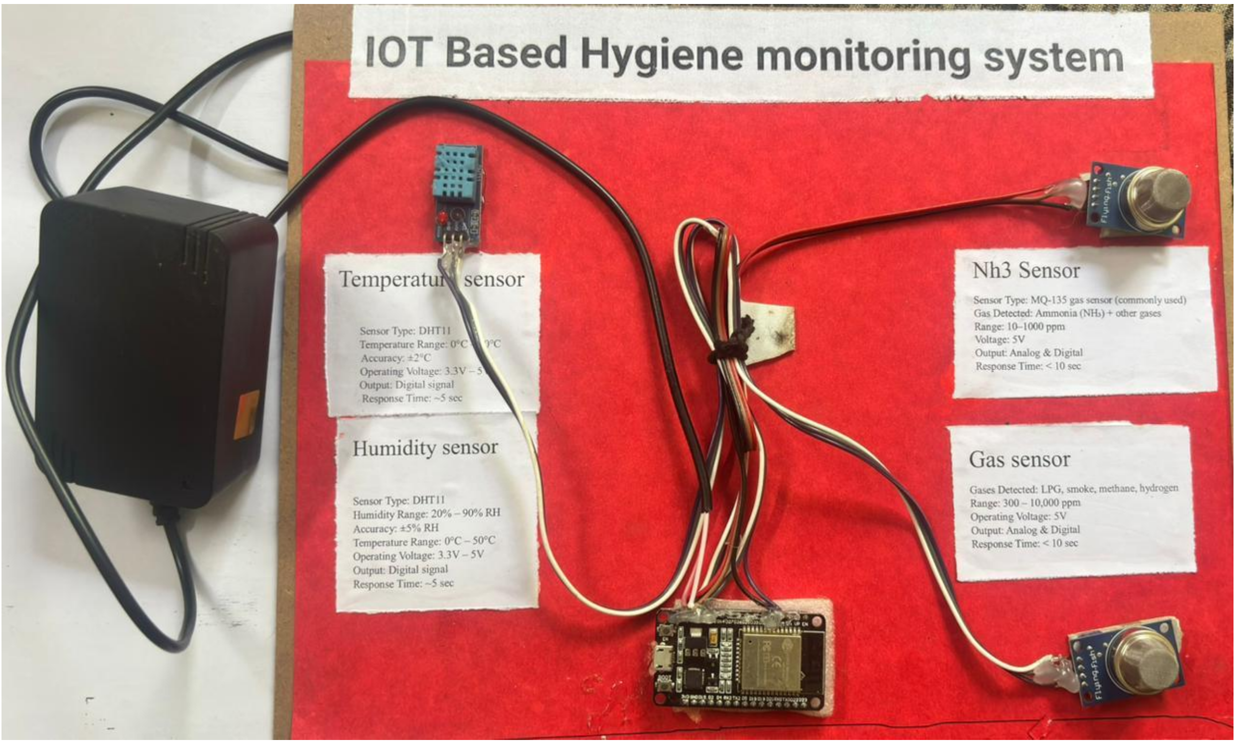


FIG.:-Experimental setup of “IoT based Hygiene Monitoring System”.

V. METHODOLOGY

The project methodology includes sensor interfacing, data acquisition, threshold evaluation, wireless transmission, and real-time monitoring. First, the MQ-135 and DHT11 sensors are connected to ESP32. The controller reads gas concentration, temperature, and humidity at regular intervals. These readings are processed using threshold-based logic to classify the hygiene condition as safe, moderate, or poor. The values are then transmitted to the Blynk platform using the built-in Wi-Fi module of ESP32. The Blynk dashboard displays the readings in real time, allowing the user to monitor the environment remotely. Since the current prototype does not include buzzer, relay, or exhaust control, the system functions as a monitoring and decision-support platform rather than an automatic actuation system.

VI. EXPERIMENTAL RESULTS AND DISCUSSION

The prototype device was tested in normal indoor conditions as well as in the poor hygiene conditions. In normal conditions, the MQ-135 sensor gave an output in the lower limit, and the readings on the Blynk mobile app were stable. In closed or foul air conditions, there was a noticeable increase in the output of the gas sensor while there was also some variation in the readings of temperature and humidity. All these parameters were accurately depicted in the Blynk mobile app. The findings clearly indicate that the system is capable of differentiating between normal and poor hygiene conditions through basic thresholding logic.

Test Condition	MQ-135 (ADC)	Temp (°C)	Humidity (%)	Status
Normal room air	320	29	54	Safe
Closed washroom-like condition	520	30	68	Moderate
Spray / foul gas exposure	780	31	72	Poor

Table 2: Sample experimental readings for hygiene condition analysis.

VII. APPLICATIONS, ADVANTAGES AND FUTURE SCOPE

Applications may be in public restrooms, hospitals, hostels, railway stations, intelligent buildings, and garbage disposal facilities. The most significant benefits of the sensor system are that it is affordable, easily installed, monitorable in real time, wireless enabled, and requires less manual monitoring. Future development possibilities include automated exhaust fan, sound alarm, LED light indicators, data logging through clouds, multi-geographic dashboarding, and predictive hygiene monitoring via artificial intelligence.

VIII. CONCLUSION

IoT based Hygiene Monitoring System is an effective solution for real-time monitoring in environments where hygiene needs to be monitored. With the inclusion of MQ-135 and DHT11 sensor modules, ESP32, and Blynk, it is possible to measure gas concentrations, temperature, and humidity levels. This system is portable, easy to scale up, and is appropriate for both educational purposes for students in their final year and simple smart sanitation applications.

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