

Development of Automated Body Spray Dispensing System Triggered by Human Biomarker Sensing

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ABSTRACT

Bad body odor affects personal hygiene, confidence, and social interactions. This project presents a low-cost, automated Bad Body Odor Detection and Spraying System using an ESP32 and MQ135 gas sensor. The MQ135 detects gases and volatile compounds associated with body odor. When the gas level exceeds a preset threshold, the ESP32 activates a relay to switch on an electric room freshener, which automatically sprays fragrance to reduce unpleasant odors. The system provides a real-time, hygienic, and efficient solution for odor management in homes, offices, hospitals, and public places.

Keywords : Biomarker Sensing, VOC Detection, MOS Gas Sensors, Automated Spray Dispensing, Embedded Systems, Microcontroller (Arduino/ESP32), Real-Time Monitoring, Smart Hygiene System, Sensor-Based Automation

I. INTRODUCTION

Body odor is a common hygiene-related issue that can affect an individual's confidence, health, and social interactions. It is mainly caused by volatile organic compounds (VOCs), ammonia, and other gases released due to bacterial activity on the skin, poor hygiene, sweating, and certain medical conditions. Conventional methods of detecting body odor rely on human perception or expensive laboratory equipment, making continuous monitoring difficult. Recent advances in embedded systems, gas sensors, and IoT technologies have enabled the development of low-cost, real-time odor detection systems. This work presents an automated Bad Body Odor Detection and Spraying System using an ESP32 microcontroller and an MQ135 gas sensor. The system detects odor-related gases and automatically activates a fragrance spray through a relay when the gas concentration exceeds a predefined threshold, providing an efficient and hygienic solution for odor management.

Problem Statement: Traditional body odor detection methods are subjective, inconsistent, and unsuitable for continuous monitoring. Clinical instruments used for odor analysis are expensive and not practical for everyday use. There is a need for an affordable, real-time, and automated system that can detect odor-related gases and respond immediately to maintain a clean and comfortable environment.

Objectives :

- To detect body odor using the MQ135 gas sensor.
- To monitor odor-related gas concentration in real time.
- To process sensor data using the ESP32 microcontroller.
- To automatically activate a relay-controlled fragrance spray when the gas level exceeds a predefined threshold.
- To develop a low-cost, efficient, and automated odor management system.
- To improve hygiene, comfort, and environmental freshness through continuous monitoring.

II. RELATED WORK

1. Simamora et al. (2025) developed an indoor air quality detection robot using ESP32 and gas sensors. The robot continuously monitors air pollutants and navigates indoor environments while collecting environmental data. Limitation: The system focuses on environmental air quality rather than human body odor detection.
2. Hassanloo et al. (2025) proposed a deep learning-based odor detection system using gas sensor arrays. Neural network models were employed to classify different odor categories with improved accuracy. Limitation: The approach requires a large labeled dataset and high computational resources.

3. Mathur et al. (2024) reviewed artificial intelligence-based olfaction techniques for halitosis detection. The study discussed the integration of gas sensor arrays with machine learning algorithms to improve odor classification accuracy. Limitation: The work is primarily a review and does not present a real-time prototype.

4. Yu et al. (2024) investigated sensing technologies such as gas sensors, biosensors, and electronic noses for oral disease and halitosis detection. The study emphasized portable and non-invasive diagnostic systems. Limitation: Limited discussion on embedded IoT implementation.

5. Sharma and Singh (2024) developed a bad odor detector using an MQ135 sensor and an embedded controller. The system generated alerts when odor levels exceeded predefined thresholds. Limitation: The system relied on threshold values instead of intelligent classification.

6. Kusumah et al. (2024) proposed an IoT-based air quality monitoring system using an MQ135 sensor and the Blynk platform for real-time visualization. Limitation: The work focused on environmental monitoring rather than body odor analysis.

7. Muttaqin et al. (2024) developed an ESP32-based laboratory air quality monitoring system using MQ135 sensors. The system continuously monitored indoor air quality and generated alerts. Limitation: The

8. system was not designed for human odor detection.

9. Sarkar et al. (2023) presented an ESP32-based real-time environmental monitoring system using MQ-series gas sensors. The study demonstrated efficient sensor data acquisition and communication. Limitation: It did not incorporate machine learning techniques.

10. Salman and Khan (2023) proposed an ESP32-based IoT pollution monitoring and alert system for detecting harmful gases. Limitation: The application was limited to environmental pollution monitoring.

11. Hakim et al. (2023) developed a highway air quality monitoring system using MQ-series sensors to measure pollutant concentrations.

Limitation: The study focused on outdoor pollution rather than personal hygiene applications.

12. Rangel et al. (2022) designed a portable volatile gas detection device for halitosis monitoring by measuring compounds in exhaled breath. Limitation: The system had limited intelligent data analysis capabilities.

13. Zhang et al. (2022) proposed an electronic nose system with multiple gas sensors and pattern recognition techniques for oral odor detection. Limitation: The hardware complexity increased system cost.

14. Hamrun et al. (2020) developed a halitosis detection device using an MQ136 gas sensor to identify sulfur-containing gases associated with bad breath. Limitation: The system used a single gas sensor, limiting detection accuracy.

15. Karar et al. (2020) introduced GASDUINO, an IoT-based gas monitoring system integrating gas sensors with cloud communication for real-time monitoring. Limitation: The work targeted environmental gases rather than body odor detection.

16. Ojala et al. (1996) introduced texture feature extraction and pattern classification techniques that became foundational for modern machine learning applications. Limitation: The study is theoretical and not specifically related to odor detection.

Research Gap

Most existing studies focus on environmental gas monitoring or halitosis detection using threshold-based methods. Few systems combine ESP32, VOC gas sensors, IoT connectivity, and machine learning to provide a portable, real-time body odor detection system. This research aims to bridge that gap by developing an intelligent, low-cost, and accurate body odor monitoring solution.

III. METHODOLOGY

Phase 1: Research and Component Selection

Literature Review: Research the chemical profile of human body odor to identify target biomarkers and their detectable concentrations.

Sensor Selection: Select appropriate VOC gas sensors (e.g., MiCS-6814, SGX Sensortech) based on sensitivity to target biomarkers, response time, power requirements, and size.

Microcontroller Selection: Choose a capable microcontroller (e.g., Arduino Nano, ESP32) for data processing and control, balancing power, I/O pins, and cost.

Actuator Selection: Source a small, low-power solenoid valve or a miniature pump capable of dispensing a liquid mist in a short burst.

Phase 2: Hardware Design and Prototyping

Sensor Module Assembly: Build the sensor circuit on a prototyping board, ensuring proper signal conditioning (amplification, filtering) for the analog sensor output.

Dispensing Mechanism Fabrication: Design a 3D-printed enclosure that holds a standard body spray canister and integrates the solenoid valve actuator to depress the spray nozzle.

System Integration: Combine the sensor module, microcontroller, actuator, and a power source (e.g., LiPo battery) into a single, compact prototype unit.

Phase 3: Software and Algorithm Development

Data Acquisition: Write firmware to read analog voltages from the sensor(s) at a fixed sampling rate.

Baseline Calibration: Develop a calibration routine to establish a "fresh" baseline sensor reading in a clean-air environment.

Threshold Detection Algorithm: Program the decision logic. The algorithm will continuously monitor sensor data. A significant and sustained increase from the baseline will be interpreted as the presence of body odor, triggering the dispensing mechanism.

User Interface: Implement basic status indicators (e.g., an LED to show power and activation).

Phase 4: Testing and Validation

Sensor Testing: Expose the sensor module to known odor sources (e.g., a swab of diluted acetic acid) to characterize its response.

Functional Testing: Test the full system's response to simulated body odor in a controlled chamber. Metrics will include:

Accuracy: Does it dispense only when the target odor is present?

Response Time: Delay between odor detection and spray release.

Consistency: Can it reliably perform multiple times? **User Trials:** Conduct limited trials with human subjects in controlled settings to evaluate real-world performance.

ARCHITECTURE DIAGRAM

The system consists of an MQ135 gas sensor connected to an ESP32 microcontroller. The sensor continuously monitors odor-related gases. ESP32 processes the sensor data and compares it with a predefined threshold. When the detected gas concentration exceeds the threshold, the ESP32 energizes a relay module. The relay controls a room freshener connected to a 240V AC socket, causing it to spray fragrance automatically.

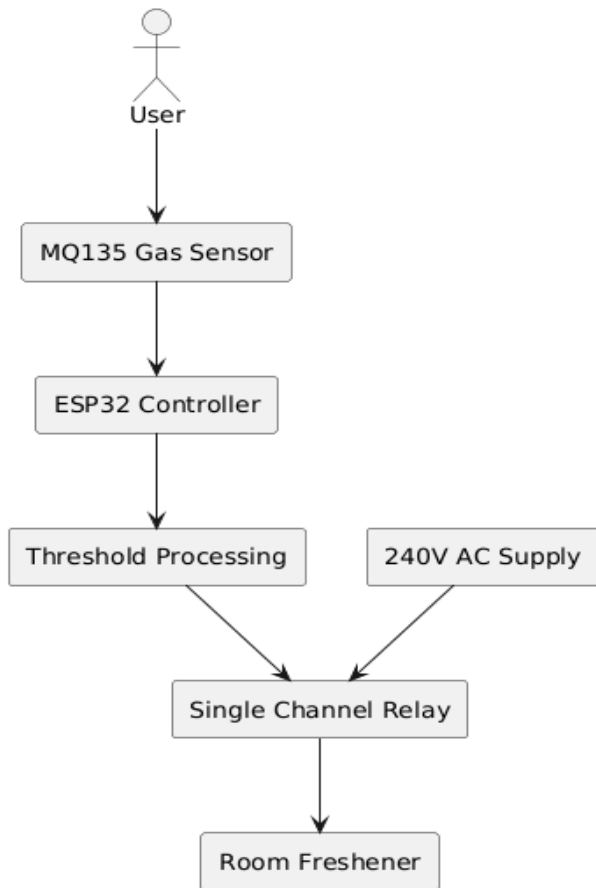


Figure 1 : Architecture diaram

IV.HARDWARE AND SOFTWARE REQUIREMENTS

Hardware Requirements

Sl.No	Component	Specification
1	ESP32	Wi-Fi Enabled Controller
2	MQ135 Sensor	Air Quality / Gas Sensor
3	Single Channel Relay	5V Relay Module
4	Room Freshener	AC Powered Spray Device
5	Breadboard	Prototyping Board
6	Jumper Wires	Connections
7	Power Supply	5V Adapter
8	240V Socket	Freshener Power Source

Software Requirements

Sl.No	Software	Purpose
1	Arduino IDE	Programming ESP32
2	Embedded C	Firmware Development
3	ESP32 Libraries	Controller Support
4	Serial Monitor	Sensor Monitoring
5	Proteus (Optional)	Simulation

V. RESULTS



Figure 2: Complete Prototype of the Automated Body Odor Detection and Neutralization System

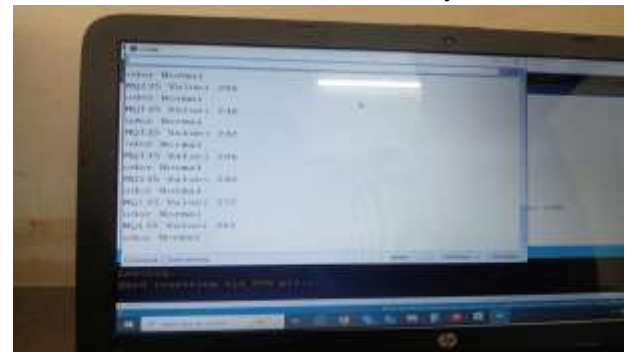


Figure 3: Real-Time MQ135 Sensor Data Monitoring and Odor Classification



Figure 4: ESP32-Based Body Odor Detection System During Testing and Calibration

The Body Odor Detection and Automatic Spray System is an intelligent hygiene monitoring prototype designed to detect unpleasant body odor in enclosed environments and automatically spray a fragrance or deodorizing agent when the odor level exceeds a predefined threshold. The system utilizes an ESP32 microcontroller as the central processing

unit, an MQ135 gas sensor for odor detection, and a 240V relay module to control the spraying mechanism.

The MQ135 sensor continuously monitors the surrounding air and detects various gases associated with unpleasant odors, such as ammonia and other volatile organic compounds. The sensor sends analog data to the ESP32, where the readings are processed and compared against a preset threshold value.

When the detected odor concentration exceeds the threshold, the ESP32 activates the 240V single-channel relay, which switches ON an electric room freshener, perfume sprayer, or deodorizer connected to the mains power supply. The spray system operates for a predefined duration to neutralize the odor and improve air quality. After spraying, the relay is turned OFF automatically, and the system resumes monitoring.

The prototype can be installed in locations such as washrooms, changing rooms, hospitals, offices, gyms, and public spaces where maintaining a pleasant environment is important. The use of the ESP32 also allows future enhancements such as IoT-based monitoring, mobile notifications, cloud data logging, and remote threshold configuration.

Working Steps

- Power ON the system.
- MQ135 sensor continuously senses air quality and odor levels.
- ESP32 reads sensor values and compares them with the threshold.
- If odor level is below threshold, the system remains in monitoring mode.
- If odor level exceeds threshold, ESP32 activates the 240V relay.
- Relay switches ON the automatic spray unit.
- Fragrance is sprayed for a specified duration.
- Relay turns OFF the spray unit.
- System returns to monitoring mode.

VI. CONCLUSION

The proposed Bad Body Odor Detection and Spraying System provides a practical and cost-effective solution for identifying unpleasant breath and automatically neutralizing it through fragrance spraying. By combining ESP32, MQ135 gas sensing technology, relay control, and an AC-powered room freshener, the system achieves reliable odor monitoring and automatic response. The project demonstrates the effective use of embedded

systems for health and hygiene applications and provides a strong foundation for future IoT-enabled smart odor management systems.

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