

# On-Demand Mouth Odor Control with an Automated Freshening Spray

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## ABSTRACT

Bad mouth odor (halitosis) is a common oral health problem that affects millions of people worldwide and often leads to social discomfort, reduced self-confidence, and poor oral hygiene awareness. Conventional methods of detecting bad breath are either subjective or require expensive clinical instruments, making continuous monitoring difficult. This paper presents an On-Demand Mouth Odor Control with an Automated Freshening Spray system that provides an intelligent, low-cost, and automated solution for real-time odor detection and control. The proposed system utilizes an MQ135 gas sensor to detect odor-related gases present in exhaled breath. An ESP32 microcontroller continuously processes the sensor readings and compares them with a predefined threshold value. When the detected gas concentration exceeds the threshold, a relay module is activated to switch on an automatic room freshener spray for a predefined duration, thereby neutralizing the unpleasant odor without human intervention. The proposed system demonstrates efficient real-time monitoring, fast response, low power consumption, and reliable operation using embedded system technology. It offers a practical solution for improving personal hygiene and environmental comfort in homes, offices, hospitals, clinics, and other indoor environments. Furthermore, the system can be extended with IoT connectivity, cloud monitoring, mobile applications, and artificial intelligence techniques for future smart healthcare and environmental monitoring applications.

**Key Words:** Halitosis, MQ135 Gas Sensor, ESP32, Embedded Systems, Relay Module, Automatic Freshener Spray, Gas Detection, IoT, Smart Healthcare, Odor Monitoring.

## 1.INTRODUCTION

Halitosis, commonly known as bad mouth odor, is a common oral health problem caused by bacterial activity, poor oral hygiene, dry mouth, smoking, and certain medical conditions. It can negatively affect an

individual's confidence, social interactions, and overall quality of life. Traditional methods of detecting bad breath rely on subjective human assessment or expensive clinical equipment, making continuous and real-time monitoring difficult.

This paper presents an **On-Demand Mouth Odor Control with an Automated Freshening Spray** system that provides a low-cost and automated solution for odor detection and control. The system uses an **MQ135 gas sensor** to detect odor-related gases and an **ESP32 microcontroller** to process sensor data. When the detected gas concentration exceeds a predefined threshold, a relay module automatically activates a freshener spray to neutralize the unpleasant odor.

The proposed system offers real-time monitoring, automatic operation, low power consumption, and reduced human intervention. It is suitable for use in homes, offices, hospitals, and other indoor environments, and can be further enhanced with IoT connectivity and smart healthcare features in the future.

### 1.1 Problem Statement

Bad mouth odor (halitosis) is a common oral health issue that affects personal confidence, social interactions, and overall well-being. Existing detection methods are either subjective, relying on human judgment, or require expensive clinical equipment that is not suitable for continuous monitoring. There is a need for a low-cost, automated, and real-time system that can accurately detect unpleasant mouth odor and immediately activate a freshening mechanism to improve personal hygiene and indoor environmental comfort.

### 1.2 Objectives

- To develop an automated system for detecting bad mouth odor using the MQ135 gas sensor.
- To monitor odor-related gas concentration in real time.
- To process sensor readings using the ESP32 microcontroller.
- To automatically activate a freshener spray when the odor level exceeds a predefined threshold.
- To reduce manual intervention through an embedded automation system.

- To provide a low-cost, reliable, and efficient solution for improving personal hygiene and indoor environmental comfort.
- To create a scalable system that can be enhanced with IoT and smart healthcare features in the future.

## 2. RELATED WORK

1. Shin et al. (2021) developed a metal oxide gas sensor for detecting volatile sulfur compounds (VSCs), the major cause of halitosis. Their sensor demonstrated high sensitivity and accuracy in identifying bad breath but focused only on diagnosis and did not include an automated odor control mechanism.
2. Asmazori (2021) proposed an IoT-based gas monitoring system using an MQ135 gas sensor and ESP32 microcontroller. The system provided real-time gas monitoring and wireless notifications, making it suitable for environmental monitoring. However, it lacked an automatic mechanism to neutralize detected odors.
3. Rahman et al. (2022) designed a portable bad breath detection device using an MQ135 sensor and Arduino. The device effectively detected odor levels and displayed the results to users. However, it required manual intervention after odor detection and did not support automatic odor elimination.
4. Karnati (2023) introduced an IoT-based air quality monitoring system integrated with machine learning for real-time gas analysis. The system improved monitoring accuracy through cloud-based data processing but was developed for environmental air quality rather than mouth odor detection.
5. Lee et al. (2023) developed an artificial intelligence-based electronic nose system to classify different levels of halitosis. The study achieved high classification accuracy using machine learning techniques, but the system required sophisticated hardware and did not provide automatic odor control.

6. Sarkar et al. (2023) presented a portable IoT-based monitoring system using an MQ135 gas sensor for measuring carbon dioxide and other environmental parameters. The system enabled real-time monitoring and cloud storage but was intended for environmental applications rather than oral hygiene.
7. Nugraha et al. (2024) developed an ESP32-based smart air quality monitoring system using MQ-series gas sensors. The system continuously monitored indoor air pollutants and displayed the readings through an IoT platform. However, it did not include any automatic action to eliminate detected odors.
8. Pranav Prasad et al. (2024) proposed an IoT-based toxic gas detection system using MQ135 sensors for industrial safety. The system successfully detected hazardous gases and generated alerts but was designed for industrial environments instead of personal mouth odor monitoring.

### 2.1 Research Gap

The studies mainly focus on gas detection, reviewed halitosis diagnosis, or IoT-based monitoring. Most systems provide only monitoring or alert functions and require manual action after odor detection. The proposed On-Demand Mouth Odor Control with an Automated Freshening Spray overcomes this limitation by integrating real-time odor detection with automatic freshener spray activation, providing a complete and low-cost solution for personal hygiene and smart healthcare applications.

## 3. METHODOLOGY

### Phase 1: Research & Component Selection

**Literature Review:** Research the chemical compounds that cause halitosis to identify the target biomarkers for detection.

**Sensor Selection:** Identify and select appropriate gas sensors (e.g., metal-oxide-semiconductor (MOS) sensors) sensitive to Volatile Organic Compounds (VOCs) like hydrogen sulfide. Key criteria: sensitivity, response time, size, and power requirements.

**Microcontroller Selection:** Choose a low-power microcontroller (e.g., ARM Cortex-M series, ESP32) to process sensor data and control the actuator.

**Actuator Selection:** Source a miniature, low-power pump (e.g., a micro-diaphragm pump) or a solenoid valve mechanism capable of delivering a controlled mist.

## Phase 2: Hardware & Mechanical Design

**Circuit Design:** Design the electronic circuit to interface the gas sensor, pump, and battery management system. microcontroller

**Enclosure Design:** Use CAD software to design a compact, ergonomic, and waterproof enclosure. 3D print prototypes for form and fit testing.

**Fluid System Design:** Engineer a micro-fluidic pathway and nozzle to create a fine mist from the liquid spray reservoir.

## Phase 3: Software & Algorithm Development

**Data Acquisition:** Write firmware to read the analog/digital signal from the gas sensor.

**Algorithm Development:** Program the "decision-making" logic. This involves:

**Baseline Establishment:** Calibrating to the user's normal breath baseline.

**Threshold Detection:** Continuously monitoring sensor readings and triggering the spray when a significant, sustained increase from the baseline is detected.

**Debouncing:** Adding logic to ignore transient spikes and prevent false triggers.

**Power Management:** Implement sleep modes and efficient coding to maximize battery life.

## Phase 4: Integration, Testing, and Validation

**Prototype Assembly:** Integrate all hardware and software into the final prototype.

**Lab Testing:** Test the sensor's response to calibrated odor sources. Measure key metrics: detection accuracy, response time, and spray duration/volume.

**User Testing:** Conduct controlled trials with human subjects to validate the system's real-world performance, user acceptance, and comfort.

## 4. SYSTEM ARCHITECTURE

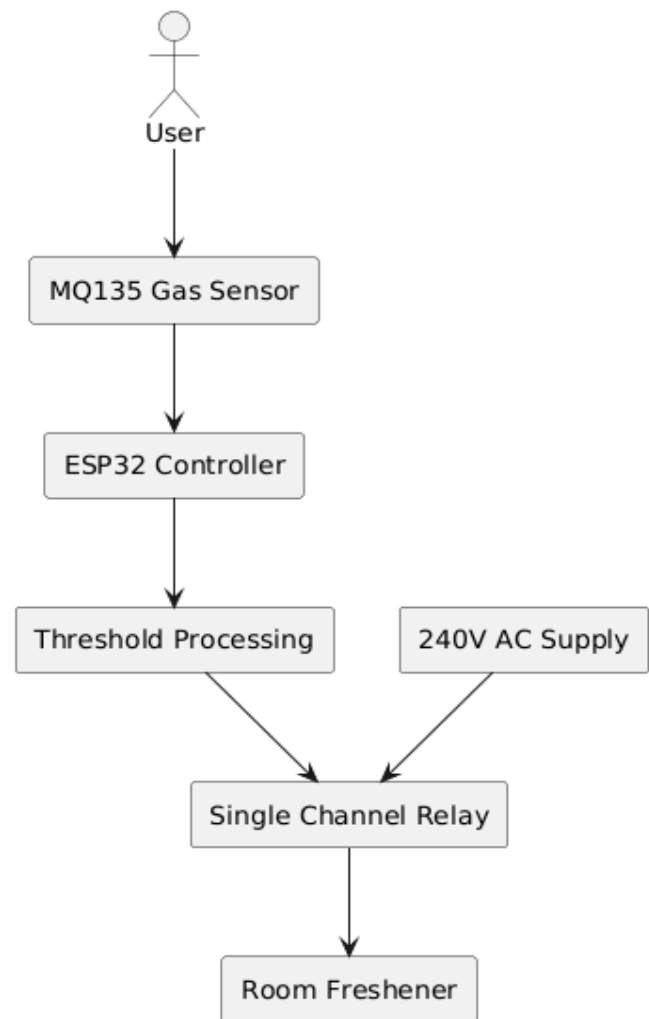


Figure 1: Architecture diagram

The system starts when the **user exhales** near the **MQ135 gas sensor**, which detects odor-related gases in the breath. The sensor sends the detected values to the **ESP32 controller**, where the gas concentration is compared with a predefined threshold. If the detected value exceeds the threshold, the ESP32 activates the **single-channel relay**. The relay uses a **240V AC power supply** to switch on the **room freshener**, which automatically sprays fragrance to eliminate the unpleasant odor. After spraying, the system returns to monitoring mode for continuous real-time detection.

## 5.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           |

## 6. RESULTS



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

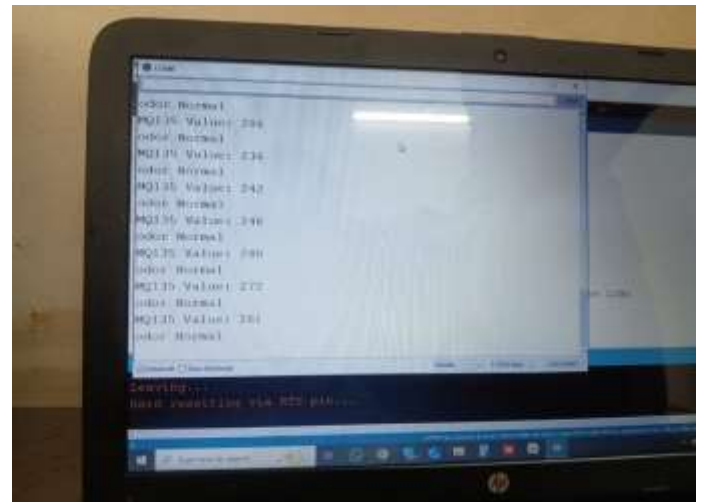


Figure 3: Real-Time MQ135 Sensor Data Monitoring and Odor Classification



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

The proposed **On-Demand Mouth Odor Control with an Automated Freshening Spray** system was successfully designed, implemented, and evaluated using an **ESP32 microcontroller**, **MQ135 gas sensor**, **single-channel relay module**, and an **automatic room freshener**. The hardware components were integrated to form a compact embedded system capable of continuously monitoring odor-related gases present in human breath. The MQ135 sensor accurately detected changes in gas concentration and transmitted the readings to the ESP32 for real-time processing.

The ESP32 continuously analyzed the sensor values and compared them with a predefined threshold. Under normal conditions, the system remained in monitoring mode without activating the freshener. When the detected gas concentration exceeded the threshold, indicating the

presence of unpleasant mouth odor, the ESP32 immediately triggered the relay module. The relay then switched on the room freshener, which automatically sprayed fragrance for a predefined duration to neutralize the odor. After completing the spray cycle, the system automatically returned to monitoring mode, ensuring continuous operation without manual intervention.

During testing and calibration, the threshold value was adjusted under different odor conditions to improve detection accuracy and reduce false activations. The system demonstrated a quick response to changes in gas concentration, stable sensor performance, and reliable relay operation. The experimental results confirmed that the proposed system effectively detects unpleasant mouth odor in real time and automatically performs odor neutralization.

Overall, the developed prototype provides a **low-cost, reliable, and user-friendly solution** for mouth odor detection and control. Its real-time monitoring capability, automatic operation, low power consumption, and minimal maintenance requirements make it suitable for applications in homes, offices, hospitals, clinics, and other indoor environments. Furthermore, the system can be enhanced with **IoT connectivity**, cloud monitoring, and mobile applications for future smart healthcare and environmental monitoring solutions.

### 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.

### 7. Conclusion

The proposed **On-Demand Mouth Odor Control with an Automated Freshening Spray** system provides an efficient and automated solution for detecting and neutralizing unpleasant mouth odor. By integrating the **MQ135 gas sensor, ESP32 microcontroller, relay module, and automatic room freshener**, the system continuously monitors odor-related gases and activates the freshener whenever the detected gas concentration exceeds a predefined threshold. This minimizes manual intervention while ensuring real-time odor control.

The experimental results demonstrate that the system operates reliably with accurate gas detection, fast response, and stable performance. Its low cost, simple design, and ease of implementation make it suitable for use in homes, offices, hospitals, clinics, and other indoor environments. Furthermore, the system has the potential to be enhanced with **IoT connectivity**, cloud-based monitoring, mobile applications, and artificial intelligence techniques, making it a promising solution for future smart healthcare and hygiene management applications.

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