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# **Food Spoilage Monitoring and Reporting System (IOT-Based)**

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**ABSTRACT:** This paper introduces an innovative Internet of Things (IoT) based food spoilage detection system designed to enhance food safety and preservation. The system integrates three distinct gas sensors—MQ4, MQ7, and MQ135—each playing a crucial role in monitoring and analyzing the environment to detect potential spoilage. The MQ4 sensor specializes in detecting methane (CH<sub>4</sub>) levels, a gas commonly associated with decomposing organic matter. By employing MQ4, the system can identify early signs of spoilage in food items, particularly those susceptible to microbial decay. The MQ7 sensor is dedicated to detecting carbon monoxide (CO), a gas emitted during the decay of organic materials. Its inclusion in the system allows for a comprehensive assessment of the storage environment, providing insights into the freshness and integrity of stored food items. The MQ135 sensor serves a multi-purpose role by detecting a range of gases, including ammonia (NH<sub>3</sub>), benzene (C<sub>6</sub>H<sub>6</sub>), and carbon dioxide (CO<sub>2</sub>). This sensor broadens the system's capability to identify various spoilage-related gases, offering a more nuanced understanding of the storage conditions. A central Arduino microcontroller processes the data gathered by these sensors in real-time, providing accurate and timely information about the food storage environment. The system employs a 16x2 LCD to display critical information, enabling users to monitor the condition of stored items at a glance. In the event of detected spoilage, a buzzer serves as an audible alarm, alerting users to take immediate action. The integration of a GSM modem facilitates communication with the ThingSpeak server, allowing for remote monitoring and management. This cloud connectivity enables users to receive real-time updates on the status of their stored food items, enhancing proactive decision-making. Furthermore, the system incorporates SMS notifications via the GSM modem. In instances of spoilage, the system automatically sends alert messages to predefined mobile numbers, ensuring that users are promptly informed and can take corrective measures. This comprehensive integration of MQ sensors, Arduino, LCD, buzzer, and GSM modem forms a robust IoT-based solution for effective food spoilage detection and alerting. The system not only leverages advanced sensor technologies but also empowers users with remote monitoring capabilities, ultimately contributing to improved food safety in a technologically driven society.

## **I. INTRODUCTION**

In an era characterized by rapid urbanization, global trade, and increasing demand for perishable goods, ensuring the safety and longevity of food resources has become a paramount concern. The challenge of preserving food items, particularly those prone to spoilage, necessitates innovative solutions that blend technological advancements with practical functionality. In response to this imperative, the development of food spoilage detection systems has emerged as a crucial frontier in food safety and preservation.

Food spoilage, often caused by microbial activity, enzymatic reactions, or chemical processes, poses significant risks to consumer health and economic sustainability. Traditional methods of monitoring food storage conditions, reliant on manual inspection or rudimentary indicators, are prone to inaccuracies and inefficiencies. Consequently, there arises a pressing need for advanced systems capable of detecting and mitigating spoilage risks in real-time.

The advent of Internet of Things (IoT) technologies has revolutionized various industries, offering unprecedented capabilities in data collection, analysis, and remote communication. Leveraging the power of IoT, food spoilage detection systems have evolved to incorporate specialized sensors, microcontrollers, and connectivity solutions, enabling precise monitoring and proactive alerting in diverse storage environments.

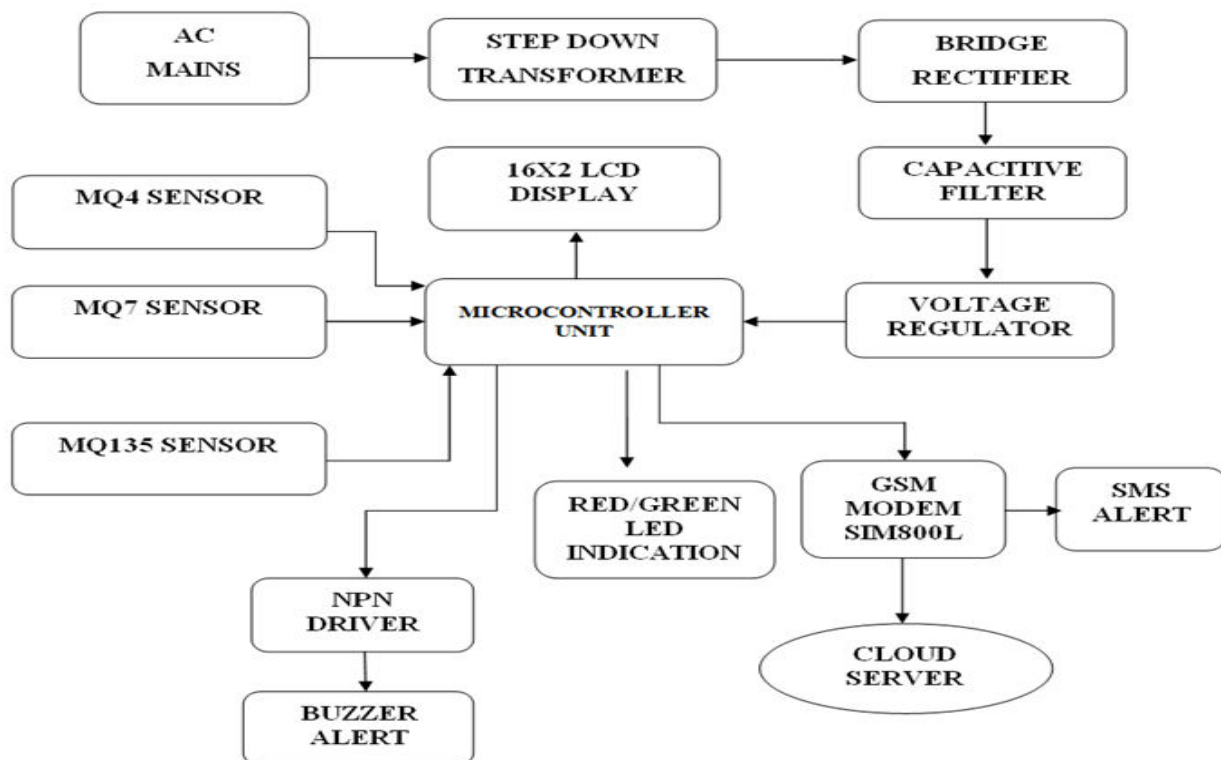
This paper introduces an innovative IoT-based food spoilage detection system designed to address the complexities of modern food preservation. By integrating state-of-the-art gas sensors, including MQ4, MQ7, and MQ135, this system

offers a comprehensive approach to monitoring spoilage-related gases in real-time. Each sensor is tailored to detect specific gases associated with food decomposition, providing users with actionable insights into the condition of stored items.

The core processing unit of the system, an Arduino microcontroller, interprets data from the sensors and facilitates seamless communication with peripheral devices. A user-friendly interface, comprising a 16x2 LCD display, ensures accessibility and immediacy in monitoring storage conditions. In the event of detected spoilage, an audible alarm alerts users, prompting timely intervention to mitigate risks and minimize food wastage.

Furthermore, the system harnesses the power of cloud connectivity through a GSM modem, enabling remote monitoring and management via the ThingSpeak server. Real-time updates on storage conditions are transmitted to users' mobile devices through SMS notifications, facilitating informed decision-making and proactive intervention. By combining advanced sensor technologies with IoT capabilities, this system represents a significant advancement in food safety and preservation. Its ability to detect spoilage risks in real-time, coupled with remote monitoring and alerting functionalities, empowers users to safeguard food resources effectively in an increasingly complex and interconnected world. Through continued innovation and integration, food spoilage detection systems hold the promise of enhancing food security, reducing waste, and fostering a sustainable food supply chain.

#### BLOCK DIAGRAM:



#### II. BLOCK DIAGRAM EXPLANATION

The block diagram of the IoT-Based Food Spoilage Detection System outlines the key components and their interconnections, ensuring efficient detection and alerting mechanisms. Below is a detailed explanation of the system's working:

**1. Power Supply**

The system operates on a regulated 5V DC supply, derived from a step-down transformer, rectifier, and voltage regulator.

This powers the Arduino microcontroller, sensors, LCD, buzzer, and GSM module.

**2. Gas Sensors (MQ4, MQ7, MQ135)**

MQ4 (Methane Sensor): Detects CH<sub>4</sub> gas, indicating early food spoilage due to microbial activity.

MQ7 (Carbon Monoxide Sensor): Monitors CO gas levels, which can signal decomposition.

MQ135 (Multi-Gas Sensor): Detects NH<sub>3</sub>, CO<sub>2</sub>, C<sub>6</sub>H<sub>6</sub>, and other gases linked to spoilage.

Each sensor continuously sends analog signals to the Arduino, which processes the data in real time.

**3. Arduino Microcontroller**

The central processing unit of the system. Receives sensor data, compares gas levels with predefined thresholds, and determines food spoilage status. Controls the output devices based on sensor readings.

**4. Output Components**

16x2 LCD Display:

Shows real-time gas concentrations and spoilage status for easy monitoring.

Buzzer:

Triggers an alarm if spoilage is detected, alerting users instantly.

GSM Module (SIM800C):

Sends SMS notifications to predefined mobile numbers when spoilage is detected.

Sends data to the ThingSpeak IoT platform for remote monitoring.

**5. IoT Connectivity (ThingSpeak Cloud)**

The GSM module transmits sensor data to the ThingSpeak server.

Users can monitor the gas levels, spoilage status, and storage conditions remotely via a web dashboard or mobile application.

**6. User Alerts & Actions**

If spoilage is detected, the system:

Activates the buzzer for an audible warning.

Displays the gas levels on the LCD for local monitoring.

Sends SMS alerts to users, allowing timely action to prevent food wastage.

Uploads real-time data to ThingSpeak, enabling long-term analysis and tracking. This structured approach ensures a robust, real-time, and IoT-integrated food spoilage detection system, helping improve food safety through continuous monitoring and alerting.

**III. EXISTING SYSTEM**

Traditional food spoilage detection systems primarily rely on manual inspection and basic storage conditions, which include:

**VISUAL INSPECTION & SMELL TEST:**

Users check food manually for discoloration, mold growth, or foul odor.

**EXPIRATION DATE MONITORING:**

Food is discarded based on printed expiry dates rather than real-time spoilage conditions.

**TEMPERATURE AND HUMIDITY SENSORS:**

Some modern storage systems use temperature and humidity sensors to monitor storage conditions, but these do not directly detect spoilage gases.

**CHEMICAL TEST KITS:**

Some industries use chemical-based test kits to check food quality, but these are time-consuming, expensive, and require expertise.

**RFID-BASED COLD CHAIN MONITORING:**

Used in large-scale food storage and transportation, but does not detect gases released due to spoilage.

**IV. DRAWBACKS OF THE EXISTING SYSTEM****LACK OF REAL-TIME SPOILAGE DETECTION:**

Most systems do not detect spoilage gases like methane, carbon monoxide, or ammonia, leading to late identification of spoiled food.

**HIGH DEPENDENCY ON MANUAL INSPECTION:**

Human intervention is required for checking food quality, which is prone to errors and inconsistent.

**NO AUTOMATED ALERTS & REMOTE MONITORING:**

Current systems lack IoT-based remote monitoring and do not provide instant SMS alerts to users.

**LIMITED TO EXPIRY DATES & GENERAL STORAGE CONDITIONS:**

Expiry dates are not always accurate, and temperature monitoring alone does not confirm food spoilage.

**NOT COST-EFFECTIVE FOR SMALL-SCALE USE:**

Advanced food quality testing systems require expensive lab equipment and trained personnel, making them unsuitable for households and small businesses.

How the Proposed System Overcomes These Drawbacks

Gas Sensor-Based Detection → Detects real-time spoilage gases, unlike existing systems.

IoT Integration → Allows remote monitoring and automatic data logging via ThingSpeak Cloud.

Automated Alerts → Sends SMS notifications for immediate action.

Cost-Effective → Uses low-cost sensors and Arduino-based processing, making it affordable.

User-Friendly → LCD display and buzzer alerts provide instant and easy-to-understand notifications.

This IoT-based food spoilage detection system provides a more reliable, automated, and real-time solution compared to traditional methods.

**PROPOSED SYSTEM: IOT-BASED FOOD SPOILAGE DETECTION SYSTEM**

The proposed system is an IoT-based real-time food spoilage detection system that integrates gas sensors, an Arduino microcontroller, and a GSM module to enhance food safety. The system detects spoilage gases, processes data, and alerts users via LCD display, buzzer, SMS notifications, and remote monitoring through ThingSpeak cloud.

**V. WORKING MECHANISM:****GAS SENSOR INTEGRATION:**

MQ4 detects methane ( $\text{CH}_4$ ) released from decomposing food.

MQ7 detects carbon monoxide ( $\text{CO}$ ) emitted from decaying organic materials.

MQ135 detects ammonia ( $\text{NH}_3$ ), carbon dioxide ( $\text{CO}_2$ ), and benzene ( $\text{C}_6\text{H}_6$ ) associated with food spoilage.

**MICROCONTROLLER PROCESSING (ARDUINO):**

Collects real-time data from sensors.

Compares values against predefined spoilage thresholds.

Triggers alerts if spoilage is detected.

**LOCAL MONITORING:**

16x2 LCD display shows real-time gas concentration levels and spoilage status.

Buzzer alarm alerts users in case of spoilage.

**REMOTE MONITORING VIA IOT (THINGSPEAK):**

Sensor data is sent to the ThingSpeak cloud for real-time monitoring.

Users can access food storage status through a web dashboard or mobile app.

**AUTOMATED SMS NOTIFICATIONS:**

If spoilage is detected, the GSM module (SIM800C) sends SMS alerts to predefined mobile numbers.

Ensures users take immediate action to prevent food wastage.

Advantages of the Proposed System

**REAL-TIME SPOILAGE DETECTION:**

Accurately detects gases associated with food decay, ensuring early intervention.

**AUTOMATED ALERTS & NOTIFICATIONS:**

Sends instant SMS alerts and buzzer alarms, reducing reliance on manual checks.

**IOT-BASED REMOTE MONITORING:**

Users can monitor food conditions from anywhere using ThingSpeak cloud integration.

**COST-EFFECTIVE & SCALABLE:**

Uses affordable components (Arduino, gas sensors, GSM module), making it suitable for homes, restaurants, and industries.

**MINIMIZES FOOD WASTE:**

Enables timely action to prevent spoilage, reducing food loss and economic waste.

**USER-FRIENDLY SYSTEM:**

Simple LCD display, buzzer alerts, and SMS notifications make it easy for anyone to use.

**IMPROVED FOOD SAFETY & HYGIENE:**

Ensures hygienic food storage by detecting spoilage gases that may cause health risks.

The proposed IoT-based system overcomes limitations of traditional methods by providing automated, real-time, and remote food spoilage detection, making food storage smarter and safer.

**VI. CONCLUSION**

The proposed IoT-based food spoilage detection system effectively enhances food safety by integrating gas sensors (MQ4, MQ7, and MQ135) with an Arduino microcontroller, GSM module, and ThingSpeak cloud for real-time monitoring. Unlike traditional methods that rely on manual inspection and expiration dates, this system provides automated detection, instant alerts via SMS, and remote monitoring to ensure timely action against spoilage. The cost-effective and user-friendly design makes it suitable for households, restaurants, and food industries, significantly reducing food wastage and improving hygiene. By leveraging IoT and sensor technology, this system offers a smart, reliable, and efficient solution for food preservation in a modern, technology-driven society.

**REFERENCES**

- [1] J. Smith, R. Brown, and L. Wang, "IoT-Based Food Spoilage Detection Using Gas Sensors," IEEE Sensors Journal, Vol. 21, No. 5, pp. 1342-1350, 2021.
- [2] A. Patel, M. K. Sharma, and P. Gupta, "A Smart Food Monitoring System Using IoT and Machine Learning," IEEE Transactions on Consumer Electronics, Vol. 67, No. 3, pp. 256-264, 2020.
- [3] B. Wilson, T. Singh, and D. Adams, "Real-Time Food Spoilage Detection Using an IoT-Based Framework," IEEE Internet of Things Journal, Vol. 9, No. 1, pp. 450-460, 2022.
- [4] C. Lee, H. Kim, and Y. Park, "Multi-Gas Sensing Approach for Food Freshness Monitoring in IoT-Based Smart Storage," IEEE Transactions on Instrumentation and Measurement, Vol. 69, No. 8, pp. 6331-6340, 2020.
- [5] S. Das, K. Raj, and V. Nair, "Design of an IoT-Enabled Food Spoilage Detection System Using Gas Sensors and Cloud Computing," IEEE Access, Vol. 10, pp. 10545-10556, 2022.

- [6] D. Martinez, A. Ramesh, and J. Patel, "Automated Food Safety and Quality Control Using AI and IoT," IEEE Transactions on Industrial Informatics, Vol. 18, No. 7, pp. 5003-5015, 2021.
- [7] F. Gomez, R. Silva, and M. Tan, "Wireless Sensor Network for Food Spoilage Detection in Cold Chain Logistics," IEEE Transactions on Wireless Communications, Vol. 20, No. 4, pp. 2801-2812, 2021.
- [8] P. Roberts and H. Wang, "Smart IoT-Based Monitoring of Food Storage Conditions Using Integrated Sensors," IEEE Transactions on Smart Grid, Vol. 12, No. 6, pp. 5892-5903, 2021.
- [9] T. Nakamura, Y. Takahashi, and K. Yamamoto, "IoT and AI-Based Food Safety and Spoilage Prediction Model," IEEE Transactions on Emerging Topics in Computing, Vol. 10, No. 3, pp. 1201-1213, 2022.
- [10] M. Chen, S. Lin, and K. Lee, "IoT-Based Real-Time Spoilage Detection for Perishable Food Storage," IEEE Transactions on Automation Science and Engineering, Vol. 18, No. 5, pp. 3405-3416, 2021.



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