

IoT Based Enhance Food Adulteration and Freshness Monitoring System

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Abstract: Food adulteration and spoilage are major concerns affecting public health and food safety. Traditional methods of detecting food quality are time-consuming and require laboratory testing. This paper proposes an IoT-based system that can monitor food freshness and detect adulteration in real time using various sensors. The system uses MQ135 gas sensor, DHT11 temperature and humidity sensor, and pH sensor to analyze food quality parameters. The collected data is processed by an Arduino microcontroller and alerts are sent through a GSM module when abnormal values are detected. The proposed system is cost-effective, portable, and suitable for real-time monitoring in households and food industries.

Keywords: IoT, Food Adulteration, Freshness Monitoring, Arduino, MQ135, pH Sensor, GSM

I. INTRODUCTION

Food safety is a critical issue worldwide due to the increasing cases of food adulteration and spoilage. Adulterated food can cause severe health problems including food poisoning and long-term diseases. Conventional laboratory testing methods are accurate but not suitable for real-time monitoring due to their high cost and time consumption.

With the advancement of Internet of Things (IoT) technology, it is now possible to continuously monitor food quality using sensors and microcontrollers. This project presents an IoT-based system that can detect food freshness and adulteration by measuring environmental and chemical parameters in real time.

II. LITERATURE REVIEW

Food quality monitoring has been an active area of research due to increasing cases of adulteration and contamination. Traditional methods such as chemical analysis and laboratory testing are highly accurate but require skilled personnel, expensive equipment, and significant time. These limitations make them unsuitable for real-time or continuous monitoring.

Several researchers have proposed sensor-based systems to detect food spoilage by measuring parameters such as gas concentration, temperature, humidity, and pH levels. Some systems use wireless sensor networks to transmit data, while others rely on cloud-based platforms for remote monitoring. However, many of these systems are complex, costly, or lack real-time alert mechanisms.

Recent advancements in Internet of Things (IoT) technology have enabled the development of smart and portable food monitoring devices. IoT allows multiple sensors to be connected to a microcontroller and data to be transmitted over communication networks such as GSM, Wi-Fi, or Bluetooth. These systems provide continuous monitoring and instant alerts, improving food safety and reducing health risks.

The proposed system in this paper focuses on developing a low-cost, portable, and efficient solution that integrates multiple sensors with Arduino and GSM communication to provide real-time detection of food adulteration and spoilage.



III. PROPOSED SYSTEM

Several researchers have proposed systems for food quality monitoring using chemical and electronic sensing techniques. Previous studies mainly relied on manual testing or complex laboratory equipment. Recent research has introduced IoT-based monitoring systems, but many of them lack real-time alert mechanisms and are expensive to implement. The proposed system aims to provide a low-cost and efficient solution with real-time monitoring and alert functionality.

Proposed System

The proposed system consists of multiple sensors connected to an Arduino microcontroller. These sensors continuously monitor food quality parameters and send the data to the microcontroller for processing.

3.1 Components Used

Arduino UNO
MQ135 Gas Sensor
DHT11 Temperature and Humidity Sensor
pH Sensor
GSM Module
LCD Display
Power Supply

IV. SYSTEM ARCHITECTURE

The system is designed such that all sensors are interfaced with the Arduino. The Arduino processes the sensor data and displays the values on the LCD screen. If the sensor readings exceed predefined threshold values, an alert message is sent to the user through the GSM module.

V. METHODOLOGY

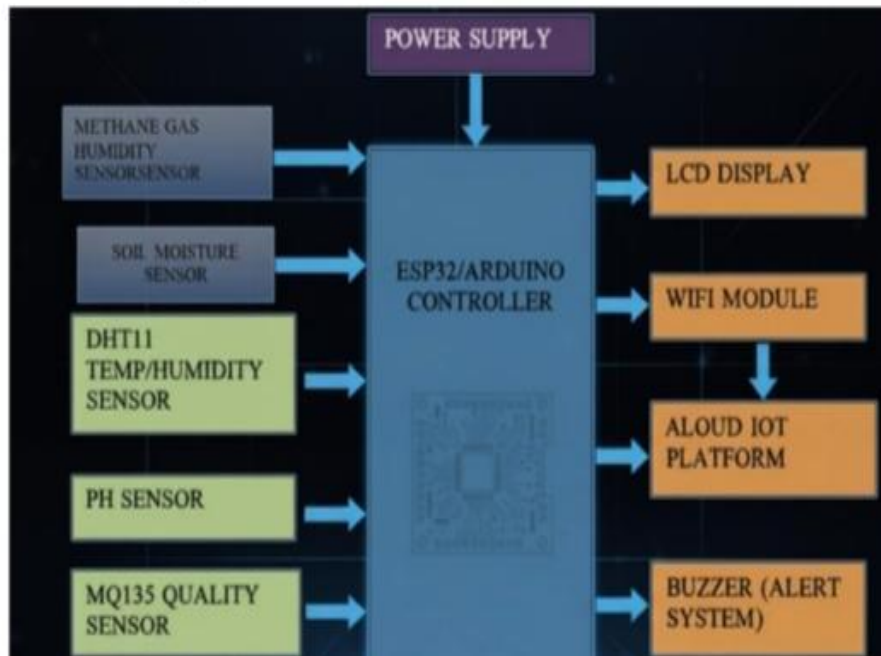
The working of the system is divided into the following steps:

1. Sensors detect environmental and chemical parameters of the food.
2. Arduino reads and processes the sensor data.
3. The system compares the readings with preset threshold values.
4. If adulteration or spoilage is detected, an alert message is sent via GSM.
5. Sensor values are displayed on the LCD for real-time monitoring.

VI. CIRCUIT DIAGRAM

A detailed circuit diagram is designed to show the interconnection of Arduino with MQ135, DHT11, pH sensor, LCD display, and GSM module. Each sensor is connected to appropriate analog or digital pins for accurate data acquisition.





VII. WORKING PRINCIPLE

The MQ135 sensor detects harmful gases released from spoiled food. The pH sensor measures acidity levels to detect chemical adulteration. The DHT11 sensor monitors temperature and humidity which affect food freshness. The Arduino continuously processes this data and compares it with predefined safe limits.

VIII. RESULTS AND DISCUSSION

The system was tested using different food samples such as milk and stored vegetables. When milk was adulterated or spoiled, the pH value changed significantly and the system successfully detected the abnormal condition. The MQ135 sensor detected foul gases released during spoilage. Alert messages were successfully sent to the user's mobile phone through the GSM module.

IX. ADVANTAGES OF THE PROPOSED SYSTEM

- Real-time monitoring of food quality
- Low-cost and portable design
- Easy to operate and maintain
- Instant alert system using GSM

X. CONCLUSION

This paper presented an IoT-based food adulteration and freshness monitoring system that can detect spoilage and contamination in real time. The system is efficient, reliable, and suitable for domestic as well as industrial applications. It reduces dependency on laboratory testing and helps in improving food safety.



XI. FUTURE SCOPE

In future, the system can be enhanced by integrating cloud storage and mobile applications for remote monitoring. Artificial Intelligence can also be used to improve the accuracy of adulteration detection and predictive analysis of food quality.

REFERENCES

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