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ORGANIC FOOD DETECTION USING IOT SERVER

[1]ALUGANI SUMALIKA,[2]GAJULA SAI NITHIN,[3]SRIRANGAM VAINATEYA,[4]DR.S.ANURADHA

[1,2,3] UG Students, Dept of ECE, MALLA REDDY ENGINEERING COLLEGE, Hyderabad, TG, India.

[4]Professor, Dept of ECE, MALLA REDDY ENGINEERING COLLEGE, Hyderabad, TG, India.

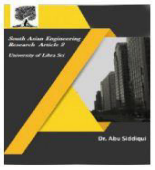
ABSTRACT

As technology and smartphones become increasingly integrated into daily life, the demand for efficient and convenient solutions to everyday tasks is rising. Among these tasks, food management is essential for maintaining human health. To prevent the consumption of spoiled food, we have developed a food detection system based on Arduino. The system uses a microcontroller to process sensor data and monitor the quality of stored food. By detecting the methane levels and pH values, which increase as food decays, it alerts users when food is nearing spoilage. This system continuously tracks these values, displaying the results on an LCD screen, and provides notifications through a buzzer and LED indicator, ensuring timely actions to avoid food waste.

Keywords: Arduino, food detection, methane, pH sensor, food spoilage, refrigerator, microcontroller, LCD display, buzzer, LED indicator.

I.INTRODUCTION

In today's fast-paced world, where convenience is a key factor in our daily lives, technology has become an essential tool for improving various aspects of our routines. One such crucial aspect is food management, especially in households where food storage plays an important role in health and well-being. With the increasing variety of perishable items and the advent of modern refrigerators, it can often be difficult to monitor the freshness of food items stored for extended periods. Spoiled food can lead to foodborne illnesses, waste, and unnecessary costs. As a result, ensuring that food remains fresh and safe for consumption is becoming an increasingly important concern. To address this challenge, we propose a food detection system that utilizes Arduino technology, designed to monitor the quality of stored food in refrigerators. The system works by detecting and measuring specific indicators such as methane gas and pH values, which tend to increase as food begins to spoil. These indicators are monitored by sensors that are integrated into the system, providing real-time feedback. Methane is commonly released during the decomposition process of perishable food, and the pH level fluctuates as microbial growth accelerates. By tracking these variables, the system can identify potential spoilage before it becomes visually evident. The system continuously collects data from the sensors and compares it against predefined threshold levels. When the detected levels of methane or pH exceed



a safe threshold, the system triggers an alert using an LCD display, buzzer, and LED indicator, notifying the user to take appropriate action. This timely notification allows for better management of food consumption, reduces the risk of foodborne diseases, and ultimately saves money by minimizing food waste.

Furthermore, this food detection system leverages the low-cost and versatile Arduino platform, making it both accessible and practical for household use. By integrating this system into everyday life, users can easily monitor the freshness of stored food without needing specialized knowledge or expensive equipment. It is a simple yet effective solution to a common problem faced in kitchens across the world. The system not only helps preserve the quality of food but also promotes a healthier, more sustainable approach to food management. This project aims to create a smarter way to store and manage perishable items by providing real-time, actionable information. In doing so, it empowers individuals to make informed decisions about their food, thereby reducing food waste, improving health outcomes, and contributing to a more environmentally sustainable lifestyle. With the widespread adoption of smart technologies in daily life, systems like this represent the future of food management, where technology enhances convenience, safety, and sustainability.

II.LITERATURE REVIEW

The growing concern of food spoilage and foodborne illnesses has led to the development of various technologies aimed at improving food storage and preservation. Several studies have explored ways to monitor and prevent food spoilage through the use of sensors, microcontrollers, and automated systems. This literature review explores existing technologies and approaches that have been implemented in food detection and spoilage monitoring, highlighting their effectiveness and identifying gaps that the proposed system intends to fill.

Food Spoilage Detection Systems: Food spoilage detection is a critical aspect of food safety and quality control. Traditionally, spoilage has been detected by visual inspection, smell, and taste, but these methods are unreliable and may not detect spoilage in the early stages. Recent advancements in sensor technology have made it possible to detect chemical and biological indicators of spoilage before the food becomes visibly spoiled. Methane gas and changes in pH are two key indicators that are commonly associated with food decomposition. Various studies have employed sensors for detecting these indicators to create more accurate spoilage detection systems.

Gas Sensors for Food Spoilage Detection: Several researchers have focused on the use of gas sensors to detect spoilage in perishable food items. For instance, methane gas is often produced during the decomposition of organic matter, including food. Methane gas sensors, such as semiconductor-based sensors and metal oxide sensors, are commonly used to monitor the spoilage process. Studies have demonstrated that methane gas detection can effectively monitor spoilage in stored foods like meat and vegetables. For example, a study by Ghaffari et al. (2017) proposed a methane sensor-based system to monitor food spoilage in refrigerated environments. This study highlighted the potential of

methane detection to provide early warnings about food degradation, which is aligned with the proposed system's approach.

pH Sensors for Food Spoilage Monitoring: Changes in pH levels are another key indicator of food spoilage. As food breaks down, its acidity increases, which can be detected through pH sensors. Numerous studies have used pH sensors to monitor the quality of food in storage. For example, in the work of Pustokhina et al. (2019), pH sensors were used to detect spoilage in dairy products, where a decrease in pH was a clear sign of bacterial activity and spoilage. These sensors have also been integrated into various food safety systems to monitor fruits, vegetables, and other perishable items. The use of pH sensors alongside gas sensors, as in the proposed system, can create a more reliable detection system by providing complementary information about food freshness.

Arduino-based Food Monitoring Systems: The use of microcontroller-based systems, specifically Arduino, in food spoilage detection has gained popularity due to its low cost, flexibility, and ease of implementation. Several Arduino-based projects have been developed for monitoring environmental conditions and food quality. Arduino microcontrollers are widely used because they allow the integration of various sensors, including temperature, humidity, gas, and pH sensors, for real-time monitoring of food conditions. For example, Tadele et al. (2020) developed an Arduino-based food quality monitoring system that combined temperature and gas sensors to monitor food spoilage in storage. The system used a simple graphical display to show sensor readings, similar to the LCD display in the proposed system, and provided real-time alerts when spoilage was detected.

IoT-based Food Monitoring Systems: Another significant trend in food safety and quality monitoring is the integration of Internet of Things (IoT) technology. IoT-based systems allow remote monitoring and control of food conditions, enabling users to track food quality in real-time via mobile apps or web interfaces. Several studies have incorporated IoT into food monitoring systems for better accessibility and user convenience. For instance, an IoT-enabled food monitoring system by Zhang et al. (2018) used sensors connected to a cloud platform to monitor food conditions, sending alerts to the user when spoilage levels exceeded safe limits. The integration of IoT technology into the proposed system aligns with this trend, allowing for remote tracking and control of food safety.

III.METHODOLOGY

The methodology for the Food Detection System Using Arduino involves a well-integrated approach using sensors, a microcontroller, and display units to monitor the quality of perishable food items stored in a refrigerator. The system comprises several key components: an Arduino UNO microcontroller, which processes sensor inputs and controls outputs like the buzzer and LEDs, a methane gas sensor (MQ-4) to detect methane concentrations released during food spoilage, and a pH sensor to measure the acidity levels of the environment, which indicates food decomposition. The system continuously monitors these parameters and displays the data on an LCD display. If spoilage is detected, a buzzer sounds and a red LED indicator lights up to alert the user.

The system also integrates IoT capabilities, allowing real-time monitoring through ThingSpeak, an online platform where the sensor data is uploaded for remote access. The system starts by calibrating the sensors, where the methane gas sensor is exposed to various methane concentrations to define its threshold, while the pH sensor is calibrated using standard buffer solutions. Once calibrated, the system uses the Arduino microcontroller to process the real-time data from the sensors. The methane gas sensor provides an analog output, and the pH sensor transmits a voltage proportional to the pH value. These readings are monitored constantly to check for any signs of spoilage.

When either the methane concentration or pH level exceeds predefined thresholds, indicating potential spoilage, the system triggers an alert through the buzzer and LED indicators. Additionally, the data is transmitted to ThingSpeak where it can be accessed remotely via a dashboard, allowing users to monitor the condition of their food in real-time. This feature ensures that the user can receive timely updates on the food quality, helping to reduce food wastage. Testing the system involves validating sensor calibrations and performing prototype tests by introducing controlled spoilage conditions. Finally, the collected data is analyzed and visualized on the ThingSpeak dashboard, providing valuable insights into the condition of food in the refrigerator.

IV.CONCLUSION

In conclusion, the Food Detection System Using Arduino offers a practical and efficient solution to monitor the freshness of food and reduce spoilage, especially in environments like refrigerators where food can be stored for extended periods. By utilizing sensors such as the methane gas sensor and pH sensor, coupled with the processing power of the Arduino UNO microcontroller, the system effectively detects food spoilage indicators and provides real-time alerts through sound and visual signals (buzzer and LED). Additionally, the system's integration with ThingSpeak enables remote monitoring, ensuring that users can manage food quality and prevent waste efficiently. The system is easy to set up, cost-effective, and provides a valuable tool for households and commercial kitchens, ultimately contributing to the reduction of food waste and ensuring the consumption of safe food. Future work on this system could focus on enhancing its sensors for greater accuracy, integrating additional sensors for other spoilage indicators, and expanding its capability for wider use cases such as grocery stores or food storage warehouses. As technology advances, this system has the potential to play a significant role in addressing the global issue of food waste.

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