International Journal of Engineering Research for Sustainable Development
Peer Reviewed International, Open Access Journal.
ISSN : / Website: https://ijersd.com / Volume 1 Issue 1 / February 2025

Original Article

Food Spoilage Detection Using IoT

Ms Renuka Santosh Kamble[1], Ms Arti Kisan Gejage[2], Ms Vaishnavi Santosh Khilare[3], Mis N. S. Bale[4], Mr Pratik Suresh Bhoi[5]

[1,2,3,5]Dept. E & TC Enginnering, Phaltan Education Society's, College of Engineering, Phaltan, Maharashtra
[4]Dept. E & TC N.S.Bale, Assistant Professor Engineering, Phaltan Education Society's, College of Engineering, Phaltan, Maharashatra

Manuscript ID:
IJERSD -2025-010102

ISSN: 2230-9578

Volume 1

Issue 1

Pp. 5-7

February 2024

Submitted: 31 Dec. 2024

Revised: 25 Jan. 2025

Accepted: 25 Feb. 2025

Published: 28 Feb. 2025

Correspondence Address:
Dept. E & TC Enginnering, Phaltan Education Society's, College of Engineering, Phaltan, Maharashtra
renukakamble8080@gmail.com

Quick Response Code:

Web. https://rlgjaar.com

DOI:

DOI Link: https://doi.org/10.5281/zenodo.14538643

Abstract

Quick and simple answers to everyday problems are becoming more and more necessary as our reliance on technology and cellphones grows. Food is one of these essential and fundamental elements that is vital to human existence. Using Arduino, we have created a food detection system to stop people from eating tainted food. To read inputs and turn on sensors, this system makes use of a microprocessor. It helps stop food from spoiling by identifying when specific perishables are kept in the refrigerator for extended periods of time. With the use of a buzzer and an LCD monitor, the system continuously detects signals from the food and shows whether it is rotten or not.

Keyword: *16x2 LCD screen, Arduino UNO, MQ gas sensor, buzzer, transformer, rectifier*

Introduction

Food safety is one of the most significant issues that might have a negative effect on people's health. The suggested system in this paper consists of two parts. Finding out whether or not the solid food is spoilt is the first module's task. Finding out if the liquid food is spoiled is the second module's task. When food spoils, its color, flavor, taste, and nutritional content become inappropriate and unfit for human consumption. When several ingredients in food react with one another or with another ingredient, changing the dish's properties, food spoils. There are various methods for prolonging the shelf life of food, but they are not permanent. Both bacteria and fungi can cause food to degradation. air, temperature, enzymes, and microbes. Fungi and bacteria that cause spoiling eat exposed food and create waste. As long as food and water are available, bacteria and fungi will continue to grow. It is possible to identify food rotting caused by bacteria and fungi using an electronic nose. The cause of food-borne sickness can be pathogenic bacteria. These microbes are room temperature organisms. The growth of pathogenic germs occurs without any discernible changes in taste, smell, or appearance. These microbes primarily thrive on canned food, changing its taste and odor in an imperceptible way. Microbial food decomposition in canned goods can be identified with an electronic nose by analyzing the gases that the food releases. The ripening process in fruits and vegetables is caused by enzymes.

Objective

1. Make sure food products are healthy and safe to protect the public's health.
2. Reduce the chance of contracting a foodborne illness by eating rotten food.
3. Predict shelf life with accuracy and spot ruined food early.

System Architecture

A. Components used

Hardware:

1. Arduino UNO
2. MQ gas sensor
3. 16x2 LCD display
4. Buzzer
5. Transformer
6. Rectifier

Software:

How to cite this article:
Renuka Santosh Kamble (2025), Food Spoilage Detection Using IoT. International Journal of Engineering Research for Sustainable Development, 1(1), 5-7

Arduino IDE

1. Arduino UNO

The Arduino Uno is one of the most popular microcontroller boards in the Arduino family, commonly used in electronics and DIY projects. It provides a simple and accessible platform for beginners and advanced users alike to design and implement various electronic circuits and systems.

- The Arduino Uno is based on the ATmega328P microcontroller, which is an 8-bit AVR microcontroller.
- It has 14 digital input/output (I/O) pins, out of which 6 pins can be used as PWM outputs (Pulse Width Modulation).
- These pins allow users to read or send digital signals (high/low, 0/5V).
- **6 analog input pins** that can read analog signals (0 to 5V) and convert them to digital values (0 to 1023).
- The board can be powered by USB, external battery, or an AC-to-DC adapter.
- It has a voltage regulator, allowing it to run on 5V and 3.3V depending on requirements.
- The Arduino Uno is programmed using the **Arduino IDE (Integrated Development Environment)**, which provides a simple interface for writing, compiling, and uploading code (called sketches) to the board.
- It uses **C/C++** programming language with specific Arduino libraries that make hardware interfacing easy.

Pinout:

- **Digital Pins (0 to 13):** Used for sending or receiving digital signals (high/low).
- **Analog Pins (A0 to A5):** Used for analog signal input (sensor readings, for example).
- **PWM Pins (3, 5, 6, 9, 10, 11):** Can output Pulse Width Modulation (PWM) signals.
- **Reset Button:** Resets the microcontroller and restarts the program

2. MQ4 Gas Sensor

An object's degree of bending or deflection can be measured using a flex sensor, which is usually a flexible strip. In order to provide useful information for a variety of applications, including wearable technology, robotics, and gesture recognition systems, the sensor's main job is to detect changes in its curvature when it bends. A thin, flexible substance with a resistive element implanted in it makes up a flex sensor. Depending on the extent of curvature, the resistive element's resistance varies when bent. Two leads are usually connected to the sensor: one for transmitting and receiving the electrical signal. The resistance change is measured by connecting these leads to an external circuit, like a microcontroller. The principle of resistive change is the basis for how the sensor functions. The degree of bending has a direct correlation with the resistance of a bent flex sensor.

3. 16x2 LCD Display

A 16x2 LCD display is a type of Liquid Crystal Display (LCD) that has 2 rows and 16 columns, allowing it to display up to 32 characters (16 characters per row). It is widely used in electronic projects and embedded systems for displaying alphanumeric characters, numbers, and simple graphics.

16x2 Layout: It can display up to 16 characters per row and 2 rows, hence the name "16x2". This allows it to display a total of 32 characters.

Alphanumeric Display: Primarily used for displaying text, digits, and simple symbols. It supports a wide range of characters, including uppercase and lowercase letters, digits, and basic punctuation.

4. Buzzer

An electrical gadget that emits sound, a buzzer is usually characterized by a continuous buzzing sound or a succession of brief, repeating tones. A speaker cone or diaphragm and an electromagnet—a coil of wire wound around a magnetic core—make up this device. A magnetic field created by an electric current flowing through the coil interacts with the magnetic core to cause the diaphragm to vibrate and emit sound waves. Although buzzer parts differ in terms of manufacturing and design, they typically work on the basis of electromagnetic. In many different applications, they are frequently employed to provide audio alerts, notifications, or alarms. For example, buzzers are used in industrial equipment, electronic devices, home appliances, and security systems to signal particular occurrences or circumstances.

5. Transformer

The case's two coils are positioned so close to one another that electricity flows via the primary winding, or the 120-volt side, creating a magnetic flow in the process. The low voltage output is produced by the current flowing through the secondary winding of the second coil. More windings are seen in the primary coil than in the secondary. The secondary coil produces a significantly lower voltage output due to its fewer windings. The voltages that secondary windings typically generate range from 8 to 24 volts.In order to enable a significantly reduced size, an electronic low voltage transformer additionally incorporates an electronic device known as an inverter.

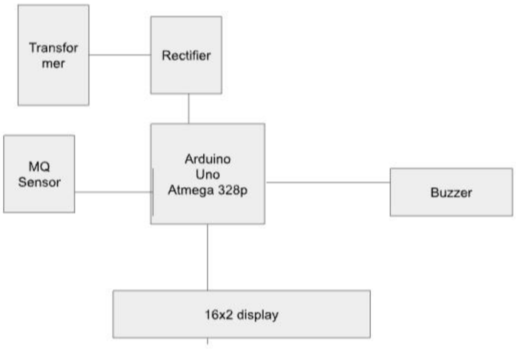
6. Rectifier

One tool for converting Alternating Current (AC) to Direct Current (DC) is a diode bridge. A bridge configuration consisting of four or more diodes that yields the same output polarity for either input polarity is called a diode bridge. Bridge rectifiers are employed in their most common use, which is to convert an alternating current (AC) input into a direct current (DC) output. Instead of using a rectifier with a 3-wire input from a transformer with a center-tapped secondary winding, a bridge rectifier uses a two-wire AC input to accomplish full-wave rectification, which reduces weight and expense.The polarity of the output of a diode bridge is the same regardless of the polarity at the input, which is its fundamental characteristic. The traditional model of current flow, which was first developed by Benjamin Franklin and is still used by the majority of engineers today, assumes that current flows from the positive to the negative pole through electrical conductors. It is actually almost always the case that free electrons in a conductor move from the negative to the positive pole. The precise direction of current flow, however, is immaterial in the great majority of applications.

Working Principle

In essence, this project discusses using sensors to prevent food rotting by continuously detecting signals from the food and showing the methane's pH value on a 16*2 LCD panel with an LED and buzzer.

B. **Block Diagram**



Methodology

A number of gases are released as solid food spoils, with methane being one of the most dangerous. Since the MQ Gas sensor is a semiconductor sensor that can detect methane gas at lower concentrations as well, we employed it in this work to measure the concentration of methane gas. Methane gas is detected by the MQ sensor between 300 and 10,000 parts per million. The Arduino UNO, MQ gas sensor, transformer, rectifier, buzzer, and 16x2 LCD display are necessary pieces of hardware for system construction. The 5V and GND pins of the Arduino are connected to the 5V and GND pins of the power supply board to power the Arduino Uno. The MQ sensor's VCC and GND connections are linked to the 5V and GND pins of power supply board, and the MQ sensor's analog output pin is linked to the Arduino Uno's analog pin A0. Digital pins 8, 9, 10, 11, 12, and 13 of the Arduino are linked to the LCD display's data pins D4, D5, D6, D7, enable, and reset pins, respectively. A potentiometer is linked to the LCD display's VE pin. Since we are using 4-bit output, the LCD display's data pins D0, D1, D2, and D3 are not in use. The food to be examined is situated close to the MQ gas sensor. Food is considered rotten if the amount of methane gas produced from it above 300 parts per million. The outcome of the food's testingis shown on the LCD screen.

Results

Sensors can be used to continuously check the food's quality, and an LCD display can conveniently show the results. A notice about food rotting will appear on the LCD screen if any of the sensors—including the MQ gas sensor—detect aberrant readings. This instant notification makes it possible to take swift action to stop food from spoiling. Additionally, customers may see the sensor values on the Arduino IDE's serial monitor, ensuring the safety of their food and reducing the possibility of eating rotten food.

Conclusion

According to the project's findings, food poisoning has been linked to a number of illnesses, so precautions must be taken to lessen and avoid sickness. Using sensors to assess the freshness of common household foods, such fruits, is one efficient method. It is now feasible to identify gas emissions that signify food rotting with the aid of Arduino sensors. It is possible to identify the early indicators of food deterioration and avoid eating ruined food by using sensors to detect the presence of these gases.

Acknowledgments
I am Renuka Santosh Kamble & All Author's thankful to Prof. Dr. N. G. Narve, Principal, College of Engineering, Phaltan for granting permission to carry out the work.

Financial support and sponsorship
Nil.

Conflicts of interest
The authors declare that they have no conflicts of interest related to this research.

Reference:

1. Electronics Aosong (2024). Digital Humidity and Temperature Sensor DHT22. [Online]. Accessible: http://www.aosong.com/en/products/details.asp?id=113 T In 2019, Zhao, Y., Zhang, Y., and Chen, Q. IoT-based Perishable Food Supply Chain Monitoring System. Conference on Industrial Cyber-Physical Systems (ICPS), IEEE, 2019. Yang, Y., Zhang, L., and Liu, W. (2020). Fresh food spoilage detection system based on gas sensors. IEEE

2. U. N. E. Programme. *Food Waste Index Report*. 2021. Available online: https://www.unep.org/resources/report/unep-food-waste-index-report-2021 (accessed on 25 February 2023).
3. Kustar, A.; Patino-Echeverri, D. A review of environmental life cycle assessments of diets: Plant-based solutions are truly sustainable, even in the form of fast foods. *Sustainability* 2021, *13*, 9926.
4. Costantini, M.; Vazquez-Rowe, I.; Manzardo, A.; Bacenetti, J. Environmental impact assessment of beef cattle production in semi-intensive systems in Paraguay. *Sustain. Prod. Consump.* 2021, *27*, 269–281.
5. Damdam, A.N.; Alzahrani, A.; Salah, L.; Salama, K.N. Effects of UV-C Irradiation and Vacuum Sealing on the Shelf-Life of Beef, Chicken and Salmon Fillets. *Foods* 2023, *12*, 606.
6. Ishangulyyev, R.; Kim, S.; Lee, S.H. Understanding food loss and waste—Why are we losing and wasting food? *Foods* 2019, *8*, 297.
7. Stenmarck, Â.; Jensen, C.; Quested, T.; Moates, G.; Buksti, M.; Cseh, B.; Juul, S.; Parry, A.; Politano, A.; Redlingshofer, B.; et al. *Estimates of European Food Waste Levels*; IVL Swedish Environmental Research Institute: Stockholm, Sweden, 2016.
8. Wickramasinghe, N.N.; Ravensdale, J.; Coorey, R.; Chandry, S.P.; Dykes, G.A. The predominance of psychrotrophic pseudomonads on aerobically stored chilled red meat. *Compr. Rev. Food Sci. Food Saf.* 2019, *18*, 1622–1635.
9. Yim, D.G.; Jin, S.K.; Hur, S.J. Microbial changes under packaging conditions during transport and comparison between sampling methods of beef. *J. Anim. Sci. Technol.* 2019, *61*, 47–53.
10. Wang, J.; Wang, H.; He, J.; Li, L.; Shen, M.; Tan, X.; Min, H.; Zheng, L. Wireless sensor network for real-time perishable food supply chain management. *Comput. Electron. Agric.* 2015, *110*, 196–207.