JETIR.ORG ISSN: 2349-5162 | ESTD Year : 2014 | Monthly Issue
JOURNAL OF EMERGING TECHNOLOGIES AND INNOVATIVE RESEARCH (JETIR)
An International Scholarly Open Access, Peer-reviewed, Refereed Journal

THE FRESHNESS OF FOOD DETECTION USING THE INTERNET OF THINGS

[1] Prof. Smita Thakare, [2] Payal Jadhav, [3] Gauri Wagh, [4] Snehal Rajnor

[1]Professor, Information Technology, Pune Vidyarthi Griha's College of Engineering, Nashik
[2,3,4]Student, Information Technology, Pune Vidyarthi Griha's College of Engineering, Nashik

Abstract: Food waste is a pressing global issue, with one-third of the food produced globally being wasted, amounting to approximately 1.3 billion tons of edible food. Excessive food waste commonly occurs at hotels, family functions, parties, and other events. The environmental impact of this waste is significant and necessitates effective solutions. Additionally, ensuring the freshness of food products is crucial for food processing, storage, and marketing. This study proposes a rapid and nondestructive method for detecting the freshness and quality of food using an IoT-based system. The proposed system incorporates various sensors and algorithms to assess the freshness of food products. Initially, volatile organic compound (VOC) gases emitted by the food product are retrieved and down sampled to obtain relevant features. Subsequently, a machine learning algorithm is employed to perform freshness detection. To provide real-time information to users, an application is developed to display the results of food item inspections conducted by the IoT device. This application enables users to gain insights into the quality and freshness of the food, thereby reducing food waste and enhancing consumer experience.

Index Terms **- food waste, environmental impact, freshness detection, IoT-based system, sensors, algorithms, volatile organic compounds (VOC), real-time information, application.**

I. INTRODUCTION

Feeding a population of over 1.3 billion people poses a significant challenge in India. Despite being a major producer of fruits and vegetables globally, the country faces a daunting issue of food waste, with 40% of food being wasted. The agriculture ministry estimates an annual wastage of food worth INR 50,000 crores, equivalent to the total food consumption of the U.K. This situation is alarming, especially in a country where millions still suffer from hunger and homelessness. The primary causes of such losses are often minute temperature and humidity changes or the spoilage of a few fruits or vegetables leading to the entire batch being discarded. However, these changes often go unnoticed by farmers and restaurant owners due to their invisibility.

To address this critical issue, an effective solution lies in the implementation of IoT-based food freshness detection. By leveraging IoT technology, a low-cost testing system can be developed to assist farmers and restaurant owners in monitoring both the quantity and quality of stored food. Real-time updates can be provided, enabling immediate action to prevent food loss. Monitoring environmental factors such as temperature, humidity, and gases emitted during the degradation of fruits and vegetables facilitates the continuous assessment of their quality.

This paper proposes a model that focuses on key parameters i.e., Total Volatile Organic Compounds (TVOC). It demonstrates how modern IoT-based technology can be harnessed to prevent food loss and ensure a consistent food supply throughout the year. By deploying this model, stakeholders in the food industry can proactively address issues related to food spoilage, minimize wastage, and contribute to a more sustainable and food-secure future in India.

II. LITERATURE SURVEY

This study [1] presents a wireless sensor network-based system that monitors various environmental parameters such as temperature, humidity, and gas emissions to determine the freshness of food products. The system provides real-time data and alerts to stakeholders, allowing them to take immediate action to maintain food quality.

The research [2] focuses on incorporating IoT technology into smart packaging to monitor the freshness of food products. Sensors embedded in the packaging detect temperature, moisture, and gas levels and transmit the data to a cloud-based platform. The system provides consumers with real-time information about the quality and freshness of packaged food.

The author [3] presented the crucial technology of constructing the platform and relevant implementation, including the associated matching algorithms between the RFID tags and one-dimensional code, building methods of food quality model by the theory of ontology-based context modeling, and the combination and presentation methods of service functions for the different users. The platform presented in this paper can basically satisfy the requirements of food quality supervision through the test.

The authors [4] developed an Android application based on the Internet of Things to monitor environmental elements such as ammonia, methane, alcohol percentage, and TVOC. The ESP32, a well-known and popular development board, serves as the device's brain. Sensors such as the MQ135, MQ3, CCS811, and 162 LCD are connected to the Microcontroller board. ML is used to analyze the app's image and predict the condition of the food. The app includes a chatbot that provides food quality information. Based on the user's location, the app will recommend nearby organic stores.

III. METHODOLOGY

Figure 1 System Architecture

This project aims to address the issue of food spoilage by developing an electronic device integrated with biosensors capable of detecting spoiled seafood, onions, and other food items. The device utilizes sensors that measure various parameters of CO2, including total volatile organic compounds (TVOC) levels. It incorporates a microcontroller ESP8266/32 and electrical and biosensors such as the TVOC sensor. The system architecture diagram illustrates the system's hardware block diagram. It is made up of an ESP32, an LCD screen, and a CCS811(TVOC) gas sensor. Data analytics and machine learning techniques were utilized to classify the data into two distinct categories: fresh (0) and spoilt (1), as well as to further refine the model and predict food quality for future sensor data. Because the recorded data contains missing values, the median imputation technique was used to solve the problem. This information will be transferred to the cloud and shown on the mobile app. Sensor data is sensed by the sensors and delivered to the microcontroller, who then sends the data to the Google Firebase cloud for storage, where the mobile application can verify the readings for peak values and display data.

IV. RESULT

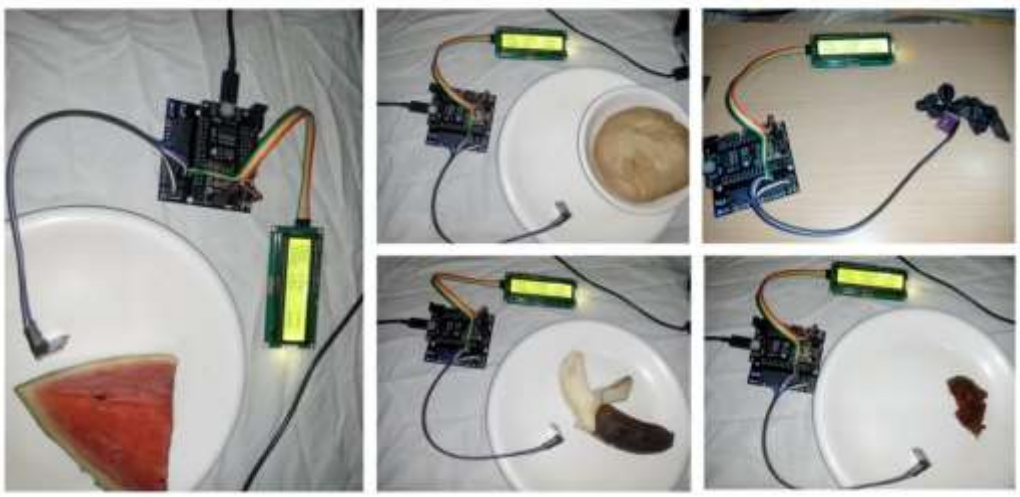

Figure 2 - Food Sampling

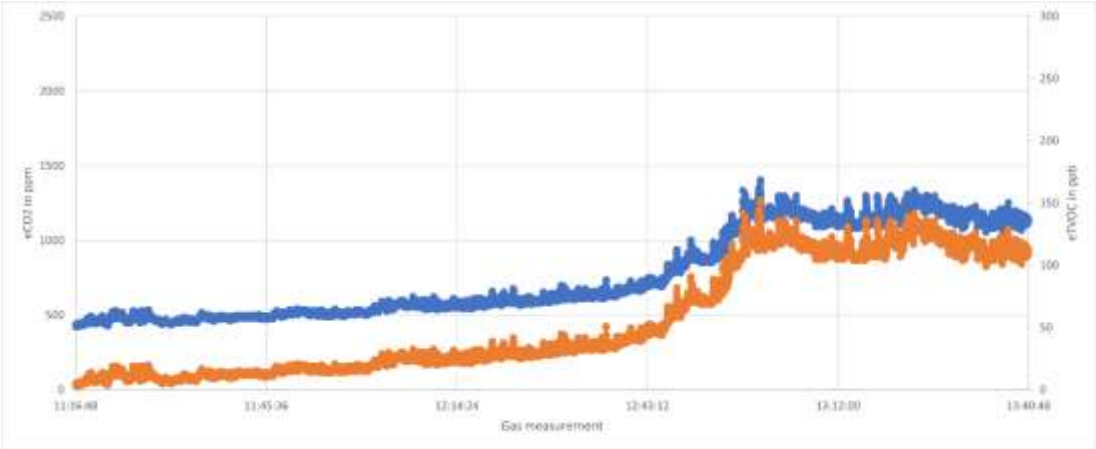

Figure 3 - TVOC and CO2 Graph

The above example shows a measurement over time. In blue, the equivalent CO2 in ppm and in orange the equivalent TVOC in ppb. Note that the measurement started to be accurate around 11:35 on this graph.

No	Food Sample	No. of Reading	Expected Range	Average Result
1.	Jam, jelly, juice	10	200-300 ppm	255.54 ppm
2.	Pickles and chutneys	10	250-350 ppm	249.03 ppm
3.	Spoiled Package food	10	400-1200 ppm	1054 ppm

V. CONCLUSION

Food poisoning has been the source of innumerable diseases. To reduce and avoid illness, we use biosensors and electrical sensors that determine the freshness of household food items like dairy items, fruits, and foods. Detecting naturally emitted gases such as Ethanol as food decay can be used to detect food spoilage. The ESP8266/32 with sensors can detect gas emissions and other important constituents like volatile organic compounds and moisture levels from food items even before the presence of any visible signs of spoilage. Using sensors to detect the presence of these values among foods can help detect food spoilage early and prevent the consumption of spoiled food. These techniques can be further developed to include other types of gas sensors and foods to increase the sensitivity of such detection methods. This system consists of a hardware device and a web application that checks the quality and freshness of food.

VI. FUTURE SCOPE

IoT-based food freshness detection systems can benefit from advancements in sensor technology. Improved sensors can provide more accurate and reliable measurements of various parameters such as temperature, humidity, gas concentrations, and spoilage indicators. Miniaturized and low-power sensors can be integrated into packaging or storage units to monitor the freshness of food in real-time. Combining IoT with blockchain technology can enhance transparency and traceability in the food supply chain. By recording and securely storing data related to food freshness, including sensor readings, location, and handling information, blockchain can provide an immutable and auditable record.

REFERENCES

[1] P. P. Ray, S. Pradhan, R. K. Sharma, A. Rasaily, A. Swaraj and A. Pradhan, "IoT based fruit quality measurement system," 2016 Online International Conference on Green Engineering and Technologies (IC-GET), 2016, pp. 1-5, doi: 10.1109/GET.2016.7916620.

[2] S. K. Panda, A. Blome, L. Wisniewski and A. Meyer, "IoT Retrofitting Approach for the Food Industry," 2019 24th IEEE International Conference on Emerging Technologies and Factory Automation (ETFA), 2019, pp. 1639-1642, doi: 10.1109/ETFA.2019.8869093.

[3] Bing Jia and Yongjian Yang, "The design of food quality supervision platform based on the Internet of Things," Proceedings 2011 International Conference on Transportation, Mechanical, and Electrical Engineering (TMEE), 2011, pp. 263-266, doi: 10.1109/TMEE.2011.6199193.

[4] P. Kagale and S. H. Jangamshetti, "Development and Testing of IoT based Monitoring Interface for Solar Box Cooker," 2020 IEEE Bangalore Humanitarian Technology Conference (B-HTC), 2020, pp. 1-4, doi: 10.1109/B-HTC50970.2020.9297950.

[5] S. M. Mahidul Hasan, M. R. Ahsan and M. D. A. Satter, "IoT-Cloud-Based Low-Cost Temperature, Humidity, and Dust Monitoring System to Prevent Food Poisoning," 2021 3rd International Conference on Electrical & Electronic Engineering (ICEEE), 2021, pp. 21-24, doi: 10.1109/ICEEE54059.2021.9718789

[6] Zompanti, S. Grasso, M. Santonico and G. Pennazza, "A Sensor System for Non-Destructive Monitoring of Food Ripening Processes," 2020 IEEE International Workshop on Metrology for Industry 4.0 & IoT, 2020, pp. 80-83, doi: 10.1109/MetroInd4.0IoT48571.2020.9138308.

[7] P. P. Ray, S. Pradhan, R. K. Sharma, A. Rasaily, A. Swaraj and A. Pradhan, "IoT based fruit quality measurement system," 2016 Online International Conference on Green Engineering and Technologies (IC-GET), 2016, pp. 1-5, doi: 10.1109/GET.2016.7916620.
[8] M. -J. Lee, J. -T. Luo, J. -J. Shao and N. -F. Huang, "A Trustworthy Food Resume Traceability System Based on Blockchain Technology," 2021 International Conference on Information Networking (ICOIN), 2021, pp. 546-552, doi: 10.1109/ICOIN50884.2021.9334025.
[9] Bing Jia and Yongjian Yang, "The design of food quality supervision platform based on the Internet of Things," Proceedings 2011 International Conference on Transportation, Mechanical, and Electrical Engineering (TMEE), 2011, pp. 263-266, doi: 10.1109/TMEE.2011.6199193.
[10] Bing Jia and Yongjian Yang, "The design of food quality supervision platform based on the Internet of Things," Proceedings 2011 International Conference on Transportation, Mechanical, and Electrical Engineering (TMEE), 2011, pp. 263-266, doi: 10.1109/TMEE.2011.6199193.
[11] Bing Jia and Yongjian Yang, "The design of food quality supervision platform based on the Internet of Things," Proceedings 2011 International Conference on Transportation, Mechanical, and Electrical Engineering (TMEE), 2011, pp. 263-266, doi: 10.1109/TMEE.2011.6199193.
[12] M. Abbatangelo, E. N. Carmona, V. Sberveglieri, E. Comini and G. Sberveglieri, "Overview of Iot Mox Chemical Sensors Arrays for Agri-Food Applications," 2019 IEEE International Symposium on Olfaction and Electronic Nose (ISOEN), 2019, pp. 1-3, doi: 10.1109/ISOEN.2019.8823259.
[13] Sarmah and G. Aruna, "Detection of Food Quality and Quantity at Cold Storage using IoT," 2020 International Conference on Wireless Communications Signal Processing and Networking (WiSPNET), 2020, pp. 200-203, doi: 10.1109/WiSPNET48689.2020.9198348.
[14] S. K. Panda, A. Blome, L. Wisniewski and A. Meyer, "IoT Retrofitting Approach for the Food Industry," 2019 24th IEEE International Conference on Emerging Technologies and Factory Automation (ETFA), 2019, pp. 1639-1642, doi: 10.1109/ETFA.2019.8869093.
[15] G. Anand and L. Prakash, "IoT Based Novel Smart Refrigerator to Curb Food Wastage," 2018 3rd International Conference on Contemporary Computing and Informatics (IC3I), 2018, pp. 268-272, doi: 10.1109/IC3I44769.2018.9007271.