International Research Journal on Advanced Engineering Hub (IRJAEH)
e ISSN: 2584-2137
Vol. 03 Issue: 05 May 2025
Page No: 2130 - 2134
https://irjaeh.com
https://doi.org/10.47392/IRJAEH.2025.0312

# Iot Based Pesticides and Nutrients Detection in Fruits and Vegetables

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## Abstract

*IoT-based solution for the detection of pesticide residues in organic fruits and vegetables without the use of artificial intelligence. The system is built around an Arduino controller, which interfaces with a combination of sensors, including gas sensors for pesticide detection, LDR sensors for light intensity measurement, and IR sensors for object identification. The collected data is displayed on an LCD screen for immediate user feedback. To enable remote monitoring and data transparency, a Node- MCU with Wi-Fi connectivity is integrated into the system, allowing the sensor data to be efficiently uploaded to a central server over a wireless network. This innovative framework offers a practical and cost- effective way to ensure the safety and authenticity of organic produce by providing real-time pesticide residue detection and data access The Arduino controller serves as the brain of the system, orchestrating the operation of various sensors that collectively assess the presence of pesticide residues on organic fruits and vegetables. The gas sensor detects the presence of pesticides, while the LDR sensor measures the light intensity, and the IR sensor aids in object identification, enhancing the accuracy of the analysis. The LCD screen provides users with immediate information about the pesticide levels detected on the produce. Furthermore, the NodeMCU, with its WiFi capabilities, ensures that the sensor data is seamlessly transmitted to a centralized server, making it accessible for remote monitoring and analysis. This project offers a practical and efficient solution for consumers and producers alike to verify the quality of organic produce and make informed choices regarding pesticide contamination.*

***Keywords:*** *Arduino, Node MCU, Sensors, Server.*

## 1. Introduction

IOT based pesticides and nutrients detection in fruits and vegetables aims to address the critical issue of food safety by leveraging Internet of Things (IoT) technology to monitor and analyze the quality of agricultural produce. With growing concerns over pesticide residues and nutrient levels in fruits and vegetables, this innovative system utilizes a combination of sensor including infrared (IR) sensors, to detect harmful pesticides and assess nutrient content. Centralto the hardware model is an Arduino controller, which processes sensor data and displays results on an LCD screen for immediate feedback. The Node-MCU Wi- Fi module enables seamless connectivity, allowing data to be transmitted to an Automotive IoT server for further analysis [1-3] and monitoring. By providing real-time insights into the safety and quality of produce, this project seeks to empower consumers, farmers, and regulators, promoting healthier food choices and enhancing overall agricultural practices.This IoT-based system is designed to be user-friendly and efficient, making it accessible for both consumers and farmers. The integration of sensors allows for the continuous monitoring of pesticide levels and nutrient content, ensuring that users receive timely information about the safety of their food. The Arduino controller acts as the central hub, coordinating data collection from the IR sensors and relaying it to the LCD screen for instant viewing. The use of the Node- MCU with a Wi-Fi module facilitates remote access to the data, enabling users to monitor their produce from anywhere via a smartphone or computer. This connectivity not only enhances user engagement but also supports data-driven decisions in agricultural practices. Ultimately, the project aims to contribute to safer food supply chains and raise awareness about the importance of quality control in fruits and vegetables, fostering a healthier society. [4]

## 2. Literature Survey

Rohinee M. Misal, Dr. Ratnadeep R. Deshmukh (2019) In their study, "Nondestructive Detection of Pesticide Residue on Banana Surface Based on Near Infrared Spectroscopy," published in the International Journal of Science and Research, Rohinee M. Misal and Dr. Ratnadeep R. Deshmukh explore the application of near-infrared (NIR) spectroscopy for detecting pesticide residues on banana surfaces without causing damage to the fruit. The authors highlight the advantages of this nondestructive method, which allows for real- time monitoring of food safety. Their findings demonstrate that NIR spectroscopy can effectively identify specific pesticide residues, thereby providing a viable solution for ensuring the safety of agricultural products. This research underscores the potential of advanced spectroscopic techniques in enhancing food safety protocols and offers insights for further developments in smart agricultural monitoring system. Guo Zaho et al.(2018), The paper titled "A System for Pesticide Residues Detection and Agricultural Products Traceability Based on Acetylcholinesterase Biosensor and Internet of Things," authored by Guo Zhao, Yemin Guo, Xia Sun, and Xiangyou Wang, appears in the International Journal of Electrochemical Science. This study presents a novel detection system that combines an acetylcholinesterase biosensor with IoT technology to monitor pesticide residues in agricultural products. The authors emphasize the system's ability to provide real-time data on pesticide levels, enhancing traceability in the food supply chain. By integrating biosensor technology with IoT, the researchers propose a solution that not only ensures food safety but also improves transparency and accountability in agricultural practices. Their work contributes significantly to the field of smart agriculture, showcasing the effective use of technology in addressing food safety concerns Zaneta Barganska et al. (2021) In the article "Problems and Challenges to Determine Pesticide Residues in Bumblebees," published in Critical Reviews in Analytical Chemistry, Zaneta Barganska, Dimitra Lambropoulou, and Jacek address the complexities involved in detecting pesticide residues in non-target organisms, particularly bumblebees. The authors discuss various analytical techniques and their limitations, highlighting the challenges posed by environmental variables and the biological variability of the bees. They stress the importance of developing standardized methods for residue analysis to ensure reliable and comparable results. This study not only sheds light on the intricacies of pesticide residue detection but also emphasizes the broader implications for environmental monitoring and regulatory frameworks, contributing valuable insights for future research in pesticide impact assessments. Jameer Basha A. et al. (2022) In their paper "Efficient Multimodal Biometric Authentication Using Fast FingerprinVerification and Enhanced Iris Features," published in the Journal of Computer Science, Jameer Basha A., Palanisamy V., and Purusothaman T. explore advanced biometric authentication methods. Although primarily focused on biometric security, the methodologies discussed can be applied to sensor technology in agricultural monitoring systems. The authors present a multimodal approach that combines fingerprint and iris recognition for improved accuracy and security. Their findings highlight the potential for integrating multiple authentication modalities in various applications, including IoT systems in agriculture, where secure access to data is crucial. This research provides a foundational understanding of how biometric technologies can enhance security in IoT frameworks, indirectly supporting food safety initiatives.Deepali Gupta et al. (2023) In the study "Design and Development of Pesticide Residue Detection System Using EC and pH Sensor," published in the International Journal of Engineering and Manufacturing, Deepali Gupta, Balwinder Singh, and Harpreet Singh present a novel detection system employing electrochemical (EC) and pH sensors forpesticide residue analysis. The authors detail the

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design process and functionality of their system, demonstrating its effectiveness in detecting pesticide residues in various agricultural products. Their research highlights the advantages of using low-cost sensors for real-time monitoring, making the technology accessible for small-scale farmers. By focusing on practical applications, this study contributes to the ongoing efforts to improve food safety and pesticide management practices, aligning well with the goals of IoT- based monitoring systems in agriculture.The problem statement for IOT based pesticides and nutrients detection in fruits and vegetables addresses the critical issue of ensuring food safety and quality in agricultural produce. With increasing concerns over pesticide residues and nutrient deficiencies in fruits and vegetables, there is a pressing need for an effective monitoring solution. Existing methods for detecting pesticide residues often involve complex laboratory analyses that are time- consuming and not readily accessible to farmers or consumers. Furthermore, traditional nutrient assessment techniques can be inefficient and may not provide real-time information. This project aims to develop a user-friendly, IoT-based system that utilizes an Arduino controller, various sensors (including infrared sensors), and a Node- MCU with Wi-Fi capabilities to enable real-time detection of pesticide levels and nutrient content in agricultural products. By providing immediate insights into the safety and quality of fruits and vegetables, this system seeks to empower consumers, support farmers in adopting safer practices, and promote healthier food choices.comprehensive approach to enhancing food safety, enabling informed decisions about agricultural practices and consumption. [5]

## 3. Proposed System

The proposed system for the IOT based pesticides and nutrients detection in fruits and vegetables aims to create an integrated solution that ensures the safety and quality of agricultural produce. At its core, the system utilizes an Arduino controller to manage various sensors, including infrared sensors, which detect pesticide residues, and additional sensors that assess nutrient levels in fruits and vegetables. Data from these sensors is displayed in real-time on an LCD screen for immediate feedback, allowing users to quickly determine the safety of their produce. The Node-MCU with a Wi-Fi module (Figure 1) [6]

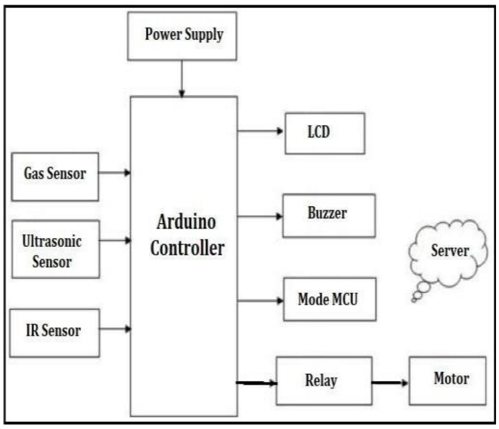


**Figure 1 Proposed System**

- **Arduino Controller:** Acts as the central unit to process data from all connected sensors, ensuring effective coordination and management of the system. [7]
- **IR Sensor for Pesticide Detection:** Utilizes Infrared technology to non-destructive identify pesticides residues on the surface of fruits and vegetables, providing immediate.
- **Nutrient Sensors:** Incorporates
- **Data Security:** Ensures secure handling of data transmitted over the internet, protecting user information and maintaining the integrity of the monitoring system. specific sensors to measure key nutrients like nitrogen, phosphorus, and potassium, ensuring comprehensive quality assessment.
- **LCD Screen Interface:** Displays real-time data from the sensors, allowing users to easily view pesticide levels and nutrient content directly on-site.
- **Node-MCU with Wi-Fi Module:** Facilitates wireless connectivity, enabling data transmission to a centralized Automotive IoT server for remote monitoring and analysis.
- **Automotive IoT Server:** Stores collected data and provides a platform for further analysis, generating insights that can be accessed remotely via smartphones or computers. [8-9]
- **User-Friendly Mobile Application:** Offers an interface for users to view data, receive

alerts about unsafe levels of pesticides or nutrients, and track historical trends.Alerts and Notifications: Implements a notification system to alert users when pesticide residues or nutrient levels exceed safe thresholds, Promoting timely action.

- **Scalability:** Designed to be easily expandable,allowing the integration of additional sensors or features as technology advances or user needs change.

## 4. Results and Discussion

The proposed system is designed to detect the presence of pesticides in samples of apples, tomatoes, and cabbages obtained from both local markets and agricultural farms. Four samples of each type of produce were analyzed. The results revealed a significant variation in sensor readings between the pesticide-contaminated samples and the organic ones. This considerable difference in values indicates the presence of harmful pesticides in the market-sourced samples, posing a serious risk to human health. Table 1 illustrates the percentage difference between the contaminated and organic samples. The high percentage deviation further confirms that the market samples contain pesticides, whereas the organic farm samples are largely pesticide-free. [10]

## Conclusion

Pesticides present in fruits and vegetables pose significant health risks to humans, and several techniques have been developed to detect their presence. This study explores multiple methods for pesticide detection and highlights technical advancements in the field of agricultural product safety, particularly through the use of IoT-based systems. The integration of IoT technology proves to be a practical solution for evaluating the quality of produce, utilizing sensors to assess parameters such as gas concentration, pH level, and temperature. These parameters are monitored to identify the presence of pesticide residues in various fruit and vegetable samples. Experimental results demonstrate noticeable variations in sensor readings, corresponding to differing pesticide levels across the samples. This system effectively detects pesticides in agricultural produce and, when compared with existing solutions, offers improved reliability, real-time monitoring, and higher accuracy. The system's performance is both efficient and highly precise. (Figure 3,4,5)

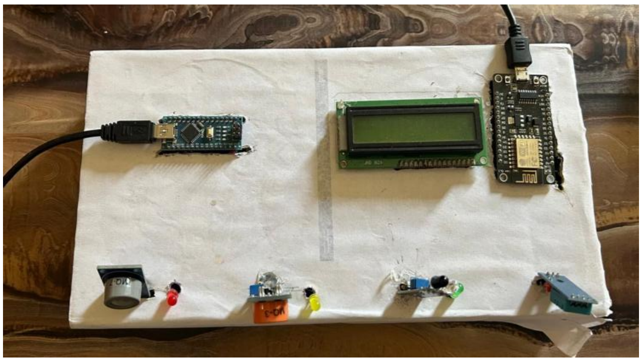

**Figure 3 Snapshot**

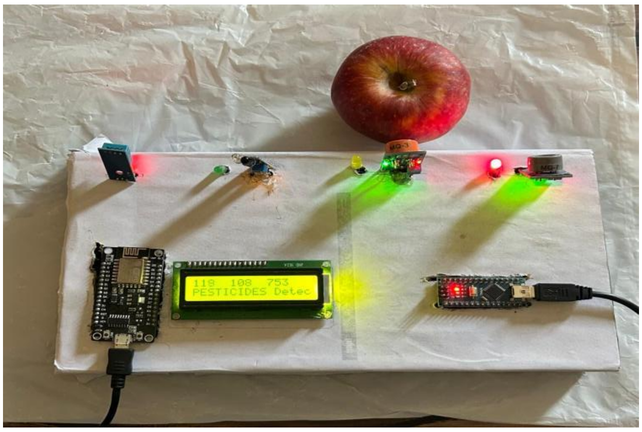

**Figure 4 Final Output**


**Figure 5 Android Application**

## Acknowledgment

We would prefer to give thanks the researchers likewise publishers for creating their resources available. We are conjointly grateful to guide, reviewer for their valuable suggestion and also thank the college authorities for providing the required infrastructure and support.

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