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IOT Based Pesticides and Nutrients Detection in Fruits and Vegetables

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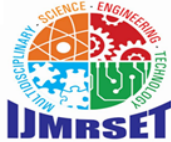
Abstract: IoT-based solution for the detection of pesticide residues in organic fruits and vegetables without the use of artificial intelligence. The system is built around an Arduino controller, which interfaces with a combination of sensors, including gas sensors for pesticide detection, LDR sensors 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.

KEYWORDS:- Arduino controller, LCD screen, IR sensor, Node-MCU with Wi-Fi module, Sensors, Automotive IoT server, etc.

I. INTRODUCTION

The IOT based pesticides and nutrients detection system 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 sensors, including infrared (IR) sensors, to detect harmful pesticides and assess nutrient content. Central to 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 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.



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II. LITERATURE SURVEY

Rohinee M. Misal, Dr. Ratnadeep R. Deshmukh (2016) 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 systems.

Guo Zhao et al. (2015) 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. (2018) 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. (2011) In their paper "Efficient Multimodal Biometric Authentication Using Fast Fingerprint Verification 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. (2016) 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 for pesticide residue analysis. The authors detail the 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.

III. PROBLEM STATEMENT

The problem statement for the 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



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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.

IV. 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 enables seamless connectivity, allowing the collected data to be transmitted to an Automotive IoT server for further analysis and long-term storage. This connectivity facilitates remote monitoring, empowering farmers and consumers to access important information about their food quality from anywhere using a smartphone or computer. By combining sensor technology with IoT capabilities, this system provides a comprehensive approach to enhancing food safety, enabling informed decisions about agricultural practices and consumption.

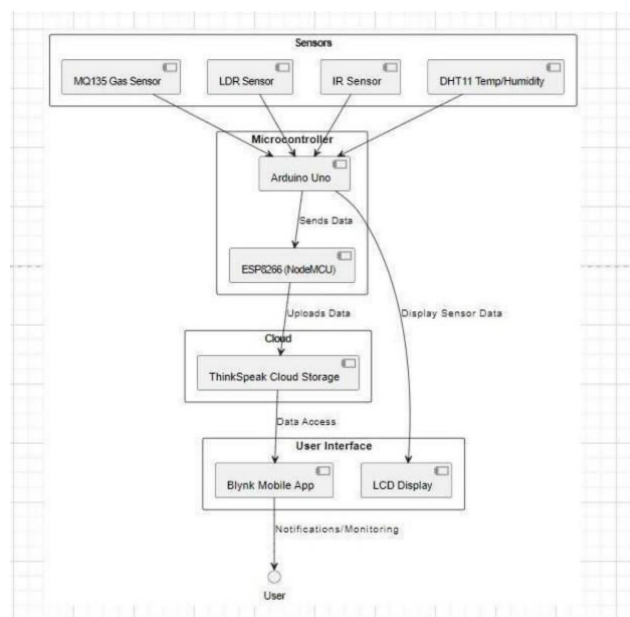


Fig.1: Proposed System Architecture

- **Arduino Controller:** Acts as the central unit to process data from all connected sensors, ensuring effective coordination and management of the system.
- **IR Sensor for Pesticide Detection:** Utilizes infrared technology to non-destructively identify pesticide residues on the surface of fruits and vegetables, providing immediate results.
- **Nutrient Sensors:** Incorporates 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.



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- **Automotive IoT Server:** Stores collected data and provides a platform for further analysis, generating insights that can be accessed remotely via smartphones or computers.
- **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 actions.
- **Scalability:** Designed to be easily expandable, allowing the integration of additional sensors or features as technology advances or user needs change.
- **Data Security:** Ensures secure handling of data transmitted over the internet, protecting user information and maintaining the integrity of the monitoring system.

V. RESULTS AND DISCUSSION

The proposed system determines the pesticide in apple, tomatoes and Cabbage samples collected from both market and agriculture farms. Four samples of each vegetable are investigated. It was discovered that the majority of pesticide-containing samples differ greatly from pesticide-free samples in terms of values. That large variation shows the presence of pesticide in samples and serious threat to human health. Tables 1 Demonstrate the relative percentage difference between in pesticide-containing samples and organic sample. The relative percentage deviation between the pesticide containing sample and the organic samples is very large. Hence, shows the presence of pesticide in the samples collected from market not in organic

Table1 . Shows Relative % Deviation in Various Type of Samples

Sample type	No of samples analyzed	Pesticide containing samples	Organic Sample
tomato	2	10.2%	2.1%
gabbage	2	15.4%	2.5%
grapes	2	20.3%	2.8%

1. SNAPSHOT



Fig 1 . Hardware model

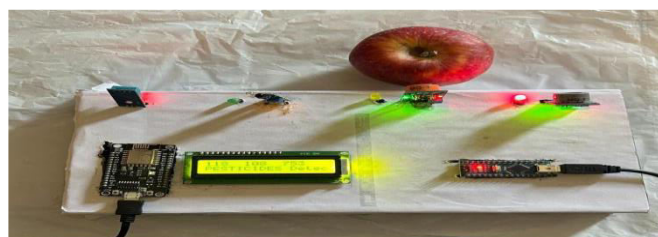


Fig 2. Final Output



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Fig 3. Android Application

VI. CONCLUSION

Pesticides used in fruits and vegetables are harmful to human health, and there are various methods for detecting them. This paper discussed about various methods used to detect the pesticide levels in fruits and vegetables and also demonstrated technical implementations in the research fields of safety of agricultural products as pesticide content detection using IoT. The pesticides are detected using IoT, which is an appropriate solution because we detected the quality of the fruit using the sensor. This proposed system monitor the various parameters of fruit and vegetable like gas, pH and Temperature value of different samples for the presence of pesticide residue. The findings of the testing show that the values of the parameters change with the amount of pesticide in different samples. Pesticide in vegetable and fruits samples were successfully detected using this technology. As compared to other existing systems, the suggested system is the most dependable, real-time, and generates the greatest results. The performance is quite precise.

VII. ACKNOWLEDGMENT

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