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Apple Pesticide Detection and Alert System

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Abstract: **Many modern techniques were developed to produce more quantity of food for growing population. Now a day fruits and vegetables have become the major source of nutrients and energy. Many chemicals are used in the production of fruits and vegetables, which are dangerous for consumers. To identify pesticides in organic fruits and vegetables, it is necessary to build low-cost, portable, sensitive, and selective biosensing platform. Many sensors like nano-sensors, pH sensors, humidity and temperature sensors and gas sensors are used to detect the pesticides on the fruits and vegetables. The input data is taken from sensors and send to the microcontroller where the program is written in such a way that it calculates the amount of pesticide present on fruits and display theoutput.**

The software for this project is written in Arduino c program. The safe value of pesticides in fruits or vegetables which can be consumed by humans and animals are mentioned in the Arduino c program. If the pesticide content is above or below the threshold level then the sample contains pesticides. Developing an alert system that triggers messages when pesticide levels surpass predefined thresholds. The message is sent through proper communication channels such as SMS to the stakeholders such as farmers, distributors, retailers, and consumers by using GSMmodem.

Keywords: **Pesticides, nano-sensor, pH sensor, GSM Modem, SMS, Arduino C**

I. INTRODUCTION

The population is growing very fast but the land for growing food is same. Hence many technologies are developed to produce more food for growing population. Chemical fertilizers, insecticides and pesticides are used to enhance the yield production. But consuming these pesticides and chemical though food can lead to many dangerous diseases like cancer and even death in worst conditions. But many are adopting the organic forming, integrated forming system and many newer technologies to improve the fruits and vegetables quality. The fruits and vegetables grown using the organic methods coast double the amount of the normal vegetables and fruits. Producers selling fertilized fruits and vegetables by labelling as organic fruits and vegetables. This can be dangerous to the consumers. Detection of the pesticides on fruits and vegetable plays a major role in agriculture sectors.

II. LITERATURE SURVEY

A. Title 1 : Artificial Intelligence and IoT based detection of pesticide in organic fruits and vegetables.

The paper discusses the experimental methodology, sensor calibration techniques, and data processing algorithms employed to ensure the reliability and accuracy of the detection system. Through comprehensive field trials and validation studies, the effectiveness of the IoT

B. Title-2: Identification of Chemicals in Fruits and Vegetables using IOT

Focus is on the detection of leaf diseases by calculating leaf area through pixel number statistics, aiming to increase throughput and reduce subjectivity arising from human experts. Additionally, a proposed system involves image acquisition, pre-processing, feature extraction, artificial neural network-based training, classification, and diagnosis for disease identification and treatment

III. PROPOSED SYSTEM

To develop a system for detecting pesticides in apples and creating an alert message, the process involves collecting a dataset of images of apples with and without pesticide residue, preprocessing the images to enhance features, extracting features using techniques like Histogram of Oriented Gradients (HOG) or Convolutional Neural Networks (CNNs), training a machine learning model (e.g., SVM, Random Forests, or CNNs) on the extracted features, implementing a detection algorithm using the trained model, generating an alert message upon detection of pesticide residue, testing and validating the system, deploying it in a real-world setting, and monitoring and maintaining its Performance. [1] For the detection of pesticides in apples, a system can be developed that utilizes image processing and machine learning techniques. Initially, images of apples are captured using digital cameras or smartphones. These images undergo preprocessing, where they are resized, filtered, and noise is removed to enhance their quality, the model is used as part of a detection algorithm that analyses the features of new images to determine the presence of pesticide residues. When residues are detected, an alert message is generated, indicating the presence of pesticides and potential health risks. This system aims to automate and improve the accuracy of pesticide detection in apples, thereby enhancing food safety and consumer trust.

IV. BLOCK DIAGRAM

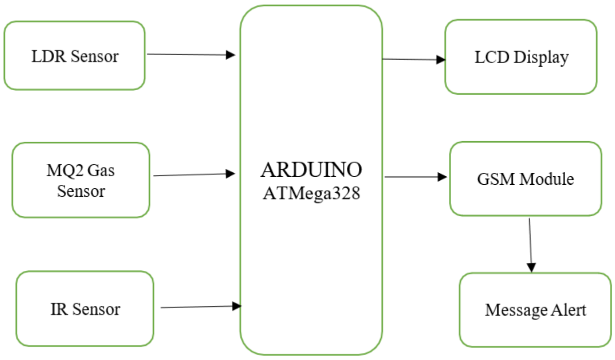

Fig. 1. Block Diagram

The Block diagram of the IoT based detection of pesticides in apple and potato is shown in the below fig.1. The input Sensors of the Arduino UNO are LDR Sensor, MQ2 Sensor, IR Sensor and the output is LCD Display, while sending alerts via the GSM module when necessary. LDR Sensor (Light Dependent Resistor) Detects changes in light intensity. It measures variations caused by the presence of pesticides affecting light transmission.IR Sensor used for detecting infrared radiation changes caused by the presence of pesticides. Gas Sensors, these sensors specifically detect pesticide gases in the environment. Each sensor's output may require signal conditioning, such as amplification or filtering, to ensure accurate readings. Microcontroller/Processor, unit processes the analog signals from the sensors. Analog-to-Digital Converter (ADC) Converts analog sensor signals into digital data for the processor to handle. The processor executes algorithms to interpret the sensor data. It could involvepattern recognition, threshold analysis, or comparison against predefined values to identify the presence and concentration of pesticides. [2]

The IR, MQ2 gas sensor, and LDR sensors interface with the Arduino microcontroller. Analog outputs from these sensors are connected to analog pins on the Arduino. The Arduino processes the analog signals from the sensors and converts them into meaningful data related to pesticide levels. The Arduino code includes calibration, threshold setting, and alert generation logic.

The Arduino sends the processed data to the LCD display for real-time visualization of pesticide levels. The LCD updates as the sensor readings change. The Arduino is connected toa GSM module, which is responsible for sending alert messages when pesticide levels exceed predefined thresholds. [4]The GSM module uses SMS (Short Message Service) for communication. The alert system is triggered by the Arduino when sensor readings surpass the predefined thresholds. The alert system activates the GSM module to send alert messages.

Based on the processed data, the processor makes decisions about the presence or absence of pesticides and their concentration levels. [5] LCD displays the output information such as pesticide presence, concentration levels, and potentially other relevant data for the user. Visual or audible indicators can alert users to the presence of pesticides beyond certain thresholds. Interfaces like buttons or switches can allow users to interact with the system, set thresholds, or calibrate the sensors. The system could include storage capabilities to log data for future analysis or reference. Power supply provides regulated power to the entire system, ensuring stable and reliable operation.

V. WORKING PRINCIPLE

The process of detecting pesticides in fruits and vegetables using sensors like LDR, IR, MQ2 gas sensor, an LCD display, and an Arduino Uno involves a comprehensive approach that integrates sensor data, processing, and display for identification and indication of pesticide residues. Each sensor in this setup plays a specific role: the LDR sensor monitors variations in light intensity, the IR sensor measures infrared radiation, and the MQ2 gas sensor detects gases, including volatile organic compounds found in pesticides.

To initiate the detection process, the sensors require calibration to establish baseline values and sensitivity levels to specific compounds present in pesticides.[6]When exposed to fruits or vegetables suspected of pesticide contamination, these sensors collect data based on changes in light intensity, infrared radiation, and gas concentrations. The Arduino Uno, acting as the central processing unit, reads, processes, and interprets the sensor data using predefined algorithms and thresholds to determine the presence of pesticides. Calibration ensures the accuracy and specificity of the sensors to differentiate pesticide-related variations from background environmental factors. The decision-making process within the Arduino determines if detected variations or concentrations exceed predefined limits, indicating the potential presence of pesticides.

Results of the detection process are then displayed on the LCD screen, providing a visual output that indicates the presence or absence of pesticides and potentially triggers alerts if pesticide levels surpass acceptable limits. Challenges in this process include ensuring sensor sensitivity and specificity, accurate threshold setting to avoid false positives or negatives, and accounting for real-world variations in environmental conditions and pesticide compositions. [7]While this setup offers a fundamental model for pesticide detection, practical implementation often requires more sophisticated and specialized equipment for increased accuracy and reliability in real-world scenarios. Calibration precision, threshold accuracy, and consideration of environmental factors remain crucial for effective pesticide detection using sensor-based systems.

Here's a detailed breakdown of the process:

A. *Sensor Integration and Functionality:*

1) ***LDR Sensor (Light Dependent Resistor):***

LDRs measure light intensity. When fruits or vegetables are contaminated with certain pesticides, they might exhibit altered light absorption or reflection properties due to chemical changes. The LDR sensor detects these variations in light intensity.

*2) **IR Sensor (Infrared Sensor):***

IR sensors detect infrared radiation. Some pesticides might have distinctive infrared absorption or emission patterns. The IR sensor is used to measure these specific changes in infrared radiation caused by pesticide residues on the produce.

*3) **MQ2 Gas Sensor:***

The MQ2 sensor is capable of detecting various gases, *including volatile* organic compounds (VOCs) that are emitted by certain pesticides. It identifies the presence of these gases in the vicinity of the fruits or vegetables.

B. Arduino Uno Processing:

*1) **Data Interpretation:***

Arduino Uno processes and interprets the collected sensor data. It applies predefined algorithms or thresholds to analyse the readings from the sensors.

*2) **Data Acquisition:***

The sensor data, including readings from LDR, IR, and MQ2 sensors, arecollected by the Arduino Uno microcontroller.

*3) **Decision Making and Output Display:***

Determine the likelihood of pesticide contamination based on the changes detected in light intensity, infrared radiation, and gas concentrations.

*4) **Threshold Comparison:***

Arduino Uno compares the sensor readings with predefined thresholds or established patterns that indicate the presence of pesticides. If the readings exceed these thresholds, it signifies potential pesticide contamination.

*5) **LCD Display Output:***

The results of the pesticide detection process are displayed on an LCD screen. This display visually indicates the presence or absence of pesticides in the fruitsor vegetables based on the interpretations made by the Arduino Uno.

*6) **Calibration and Sensitivity:***

Proper calibration of sensors is crucial to ensure they are sensitive enough to detect specific changes caused by pesticides without generating false positives or negatives.

*7) **Threshold Setting:***

Establishing accurate thresholds or criteria based on sensor readings to distinguish between contaminated and uncontaminated produce.

*8) **Environmental Factors:***

Considering environmental conditions that might influence sensor readings, such as temperature, humidity, and external interference, to ensure accuratedetection.

This system provides a basic yet effective method for detecting potential pesticide residues in fruits and vegetables by analysing variations in light intensity, infrared radiation, and gas emissions associated with pesticide presence. Calibration, [1]precise threshold setting, and accounting for environmental factors are essential for reliable and accurate pesticide detection using this sensor-based approach.

VI. RESULTS

This project aims to revolutionize pesticide detection by integrating Light Dependent Resistor (LDR), Infrared (IR), and gas sensors into a comprehensive detection system. The combined sensor array offers a multi-dimensional approach to identifying pesticides in varying environmental conditions. The LDR sensor captures changes in light transmission caused by pesticide particles, while the IR sensor detects alterations in infrared radiation due to pesticide interactions. Gas sensors add specificity by detecting particular pesticide gases. Through sophisticated data processing implemented by the onboard processor, the system offers both qualitative and quantitative analysis of pesticide presence and concentration levels

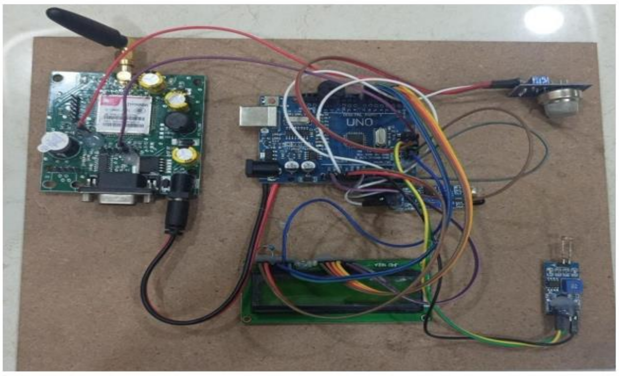

Fig. 2. Detection of pesticide and making an alert message

Algorithmic analysis, real-time processing capabilities, and the intuitive LCD display ensure accurate and immediate feedback to users, detailing pesticide levels and potential alerts as shown in fig.3.2. Evaluating sensor sensitivity, compensating for environmental interferences, and exploring avenues for future improvements form critical aspects of this innovative pesticide detection project. [9]The outputs of the pesticide content monitoring system with IR, MQ2 gas sensor, LDR sensors, LCD display, and GSM integration are the actionable information and alerts generated by the system.

A. LCD Display Output:

The LCD display provides a visual representation of real-time pesticide levels. It enables stakeholders to monitor the current status and changes in pesticide concentrations.

The LCD display, as a crucial output component, serves as a direct interface between the pesticide content monitoring system and its stakeholders, providing them with the necessary information for decision-making and proactive response to changes in pesticide levels.

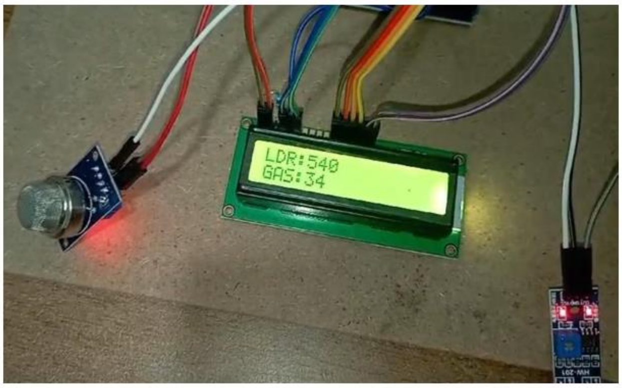

Fig. 3. Displaying pesticide value on LCD

B. Alert Messages via GSM:

The message initiation starts when pesticide levels exceed predefined thresholds, the system triggers an alert. The GSM module sends alert messages via SMS to predefined recipients, such as farmers, distributors, or regulatory authorities.

Fig. 4. Sending Alert Message

Fig. 5. Alert Message Acknowledgement

By employing the GSM module and SMS alerts, the pesticide content monitoring system ensures rapid and reliable communication, enabling stakeholders to take timely actions in response to elevated pesticide levels, ultimately contributing to improved food safety and agricultural practices.

VII. CONCLUSION

The implementation of IoT-based detection systems for pesticides in apple and potato cultivation presents a significant leap forward in ensuring food safety, environmental sustainability, and efficient agricultural practices. This technology offers real-time monitoring and data-driven insights, enabling farmers and stakeholders to make informed decisions regarding pest management. By leveraging sensor networks and data analytics, the system not only detects pesticide levels but also provides a comprehensive understanding of environmental conditions, crop health, and potential risks. [1]The integration of IoT in pesticide detection aligns with the global push for smart agriculture, where technology plays a pivotal role in addressing the challenges faced by the agricultural sector. As we move towards a future of interconnected devices and smart farming practices, the IoT-based detection of pesticides in apple and potato cultivation stands as a testament to the potential of technology to revolutionize and optimize agricultural processes. However, it is crucial to address challenges such as data security, standardization, and accessibility to ensure the widespread adoption of these technologies. Collaborative efforts from researchers, farmers, and policymakers will be essential to overcome these hurdles and unlock the full potential of IoT in creating a sustainable and secure future for agriculture.

VIII. FUTURE SCOPE

The future scope of pesticide detection in fruits and vegetables is evolving rapidly due to technological advancements, particularly in areas like IoT, nanotechnology, spectroscopy, and data analytics. This evolution is driven by the growing concerns about food safety, environmental sustainability, and the need for more efficient agricultural practices.

A. *Enhanced Detection Techniques:*

Explore advanced image processing and machine learning techniques to improve the accuracy and efficiency of pesticide residue detection. This could include deep learning approaches, such as convolutional neural networks (CNNs), which have shown great potential in image analysis tasks.

B. *Real-Time Monitoring:*

Develop the system further to enable real-time monitoring of pesticide residues in apples. This could involve integrating the system with IoT devices or drones for automated and continuous monitoring of orchards.

C. *Mobile Application:*

Create a mobile application that allows users to capture images of apples and instantly receive alerts about the presence of pesticide residues. This would enable consumers to make informed decisions when purchasing apples.

D. *Expansion to Other Fruits:*

Extend the system to detect pesticide residues in other fruits and vegetables. This would broaden its applicability and impact on food safety.

E. *Data Sharing and Collaboration:*

Establish a platform for sharing data and collaborating with researchers, farmers, and regulatory bodies to improve pesticide management practices and food safety standards.

F. *sensor Integration:*

Explore the integration of sensors capable of detecting pesticide residues directly on apples. This could provide a more direct and efficient method of detection compared to image-based approaches.

G. *Multi-Spectral Imaging:*

Investigate the use of multi-spectral imaging techniques to capture more detailed information about the chemical composition of apples, including the presence of pesticide residues. This could lead to more precise and reliable detection.

H. *Automation and Robotics:*

Develop automated systems or robots for inspecting apples in orchards or processing facilities. These systems could use AI and machine learning to detect pesticide residues and sort apples accordingly.

IX. REFERENCES

[1] D. Nagajyothi, "IOT Based prediction of pesticides and fruits diseases detection using SVM and Neural Networks," *International Journel of Mechanical Engineering,* Jan 22.

[2] S. K. V. Selvi, "Organic Farming Technology for Envirnment-friendly agriculture," *International Journal Conference onn advances in Engineering, Science and Management,* 2012.

[3] H. A. B. Mnif w, "Effect of endocrine Disruptor pesticides: a review," *Int J Enviro Res Public Health.*

[4] Sharma, "Worldwide pesticide usage and its impacts on ecosystem," *SN Appl Sci1:1446,* 2019.

[5] N. ST, "Review of pesticide residueanalysis in fruits and vegetables.Pre treatment analysis and detection techniques," *Food ResInt jul 133:109141,* 2020.

[6] Archana, "Different methods to determine pesticide residue in Fruits and Vegetables," *IRJET,* April 2021.

[7] Aradhana, "Quality and pesticide detection in fruits and vegetables," *JETIR,* 2021.

[8] V. K. Sujitha, "An implementation of soft computing approach of smart control for induction motor using ANFIS," *4th International Conference on Smart Systems and Inventative Technology*, 2022.

[9] S. Gnanavel, "Quality detection of fresh fruits and vegetables to improve Horticulture and Agro-Industries," *IEEE Xplore,* 2017.

[10] V. Sujitha, "Analysis of regulated PV fed switched reluctance motor drives using repression resistor converter," *International Journal of Engineering and Technology,* 2014.