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Different Methods to Determine Pesticides in Fruits and Vegetables: A Review

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Abstract - *In human's daily life fruits and vegetables are indispensable. So there arise an extensive need for them. In order to increase the production and to extend the life of fruits and vegetables, there require various types of toxicants. Constant use of these pesticides are hazardous to our environment and also have adverse effect on human health. Main purpose of this paper is to document and examine the different techniques used to detect the pesticides in fruits and vegetables. These techniques help to increase the efficiency and ensures the quality of fruits and vegetables.*

Key Words: **Color Identification Technology, *Deep learning, D-SERS, Photoconductivity.***

1. INTRODUCTION

Pesticide uses in agriculture field to eliminate the pest and to avoid spoiling of the agricultural products. Most of the pesticides, used today, have series of negative impacts on human being. Rise in the use of these pesticides causes many environmental and health issues. Toxicants in fruits can cause several diseases such as leukemia, lymphoma and cancer. Commonly used pesticide in India is Monocrotophos, which belongs to organophosphate family. As this is extremely toxic, its usage is banned in many countries.

To date, various methods have been developed for finding the level of pesticides and for the detection of quality of fruits. Different types of chromatography techniques are commonly used for this purpose. Other approaches like color identification, Deep learning, Terahertz time domain spectroscopy, Nano-SERS chip technique, Conductivity Sensor, Photoconductivity method, Digital image processing etc are also used.

2. LITERATURE REVIEW

[1] Color Identification Technology: This paper uses color identification technology to find pesticides in fruits and vegetables. The system consists of Acetylcholinesterase pesticide testing method, applying Raspberry pi 3B and network camera for color identification process. The test solution is prepared from acetylcholine, acetylcholinesterase and yellow coloring reagent. Fruit sample is dipped into test solution and each pixel in camera images are converted to RGB values. The solution is dark yellow, lower blue value (225,225,0) in the absence of pesticide. In the presence of pesticide, solution becomes light yellow with higher blue value (225,225,200). The integral area of blue value over time is used for converting pesticide residue concentration. The proposed system is cost effective and requires less testing time.

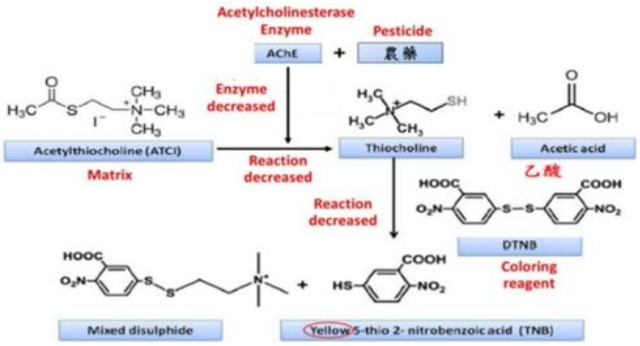


Fig -1: The reaction formula for pesticide detection

[2] IoT-Deep Learning based techinque: In this method sensors are used to detect the level of pesticides and Deep learning algorithm is applied to determine diseases in fruits. The proposed system consists of four sensors, (temperature, pH, gas, moisture), Arduino UNO and Wi-Fi module. Four sensors are connected with Arduino UNO to detect the presence of pesticides. The values from sensors are sent to cloud server MATLAB Think Speak through Wi-Fi module. The information about pesticide value is sent to cloud. Application displays pesticide values and standard consumable range of them. This method is designed to obtain better accuracy and real time output. It gives highly accurate results and real time sharing of information.

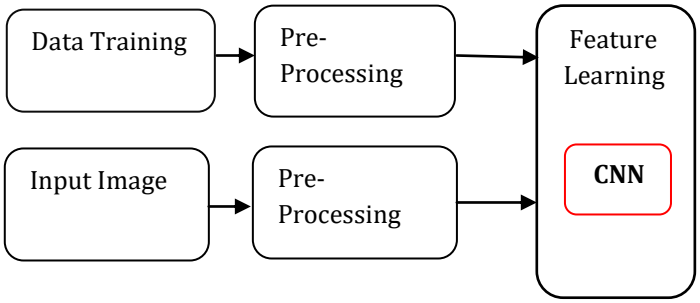


Fig-2: Design Methodology of Deep Learning

[3] Nano-SERS Chip and Smartphone-Based Raman Sensor: In this proposed system, detection of pesticide residue is generally conducted by Nano SERS (Surface Enhanced Raman Scattering) system integrated with a cellphone. The SERS system consists of SERS terminal, adapter and SERS chip. Firstly, the sample is diluted with acetonitrile to 10ppm. The trace amount of diluted solution was dropped to the surface of SERS chip and Raman spectrum of each pesticide residue was collected after drying. This chip is inserted into SERS terminal and measurement of pesticide residue can be detected by one click through the cellphone application. This method is proven for fast and on-site detection of pesticide residue. The prompted system is time-consuming and expensive.

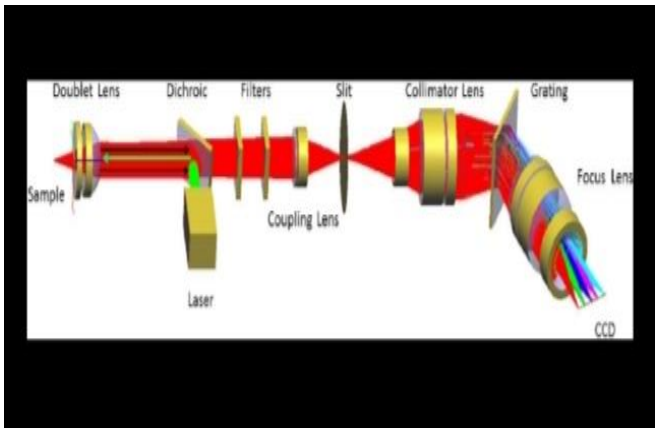
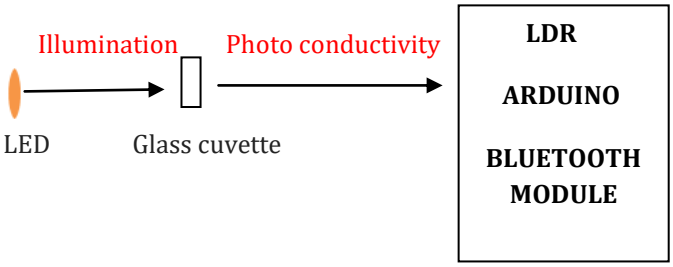


Fig-3: Optical system of the smartphone based SERS terminal

[4] Non-destructive approach using IoT: This system find pesticides by the principle of photoconductivity, an optical phenomenon in which material become more electrically conductive in the presence of light. In this non-destructive method, light is made to incident on the fruit and the intensity of the refracted light is measured using LDR. The intensity of resistance of light varies with pesticide level. When pesticide level increases, resistivity values also increases. The obtained values from LDR is sent to cloud storage using Bluetooth module. Here, the consumer knows about the quality of fruits that they consumes.



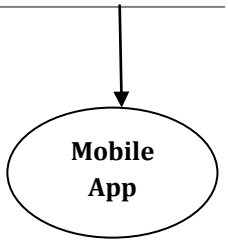


Fig-4: System Architecture

[5] D-SERS substrate: Dynamic surface enhanced Raman spectroscopy (D-SERS) is a technology to find the pesticide residues at different peels. This method is low cost and highly efficient for sample collection. Commonly used practical SERS substrate is Ag NP-decorated filter paper which is used for the precise detection and identification of pesticide. A paper based device is swabbed across the different surface to collect sample. Ag NP-decorted filter paper combined with D-SERS are used in the SERS experiments. D-SERS are used because of its high detection sensitivity of pesticides and mainly used for laboratory purposes.

[6] Sensor Integration Method: This method proposes a smart device to detect the quality and pesticide level of fruits and vegetables. In the proposed system, three methods are integrated to provide better efficiency. Hence this device has three modules. First module detect the quality of fruits by using near IR sensor. Second module spot the artificially ripened fruits using ethylene gas sensor. Finally, third module detect pesticide residue content using conductivity sensor.

The proposed system consist of raspberry pi, infrared sensor, ethylene gas sensor, conductivity sensor and LCD display. Infrared signal is made to incident on fruit and the reflected signal from fruit is visualized by software sig view. Ethylene sensor detects the ethylene content in fruits and the conductivity sensor senses the pesticide residue level. Both the values are compared with threshold value. If the values are greater than the threshold, LCD display shows "Reject" and hence consumer can identify the freshness of fruit.

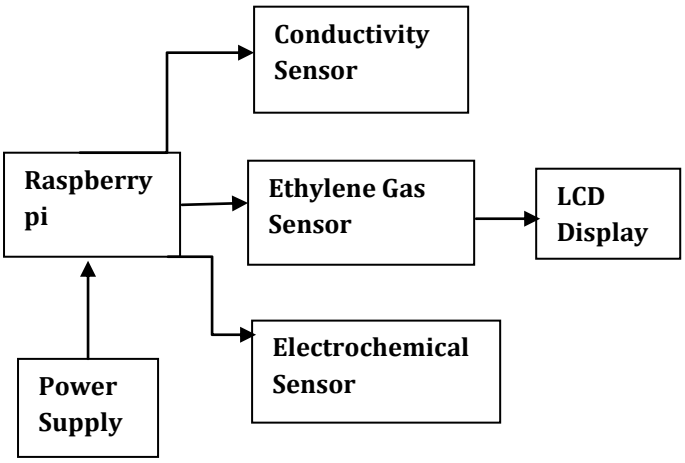


Fig-5: Block Diagram

[7] THz Near-Field Enhancement: A destructive approach based on THz (terahertz) used for pesticide detection. The THz absorbance spectrum of various pesticides are identified and methomyl molecule selected for further analysis. THz spectroscopy is done by simply placing the sample on chip. Methomyl solution is dropped to the dried apple peel. Then it is attached to nano slot antenna and located at THz focus. Nanoscale slot antenna is designed for strong resonance at certain frequency. The changes in reflected THz beam at interface between sensing chip and sample allow to determine the amount of pesticides. It provides a real time, highly sensitive monitoring technique for pesticides detection in fruits.

[8] Fluorescence Data Resolved by Unfolded Partial Least-Squares: In this proposed system a chemometric assisted spectrofluorimetric method has been developed for detection of fluorescent pesticides like carbaryl, carbendazim, and thiabendazole in orange and banana. Methanol can be used for sample pre-treatment. Emission excitation fluorescence matrices were obtained and resolved by using a second order multivariate calibration method. This is based on unfold partial least square combined with bilinearization for obtaining second order advantage. Determination of pesticides is done in the presence of inner filter effect, background interaction, strong spectral overlapping, and unexpected components.

The purpose of this approach is to develop a simple, sensitive, and selective system, suitable for routine laboratory uses.

3. CONCLUSIONS

Pesticides used in fruits and vegetables have an adverse effect on human health, and there exists different techniques to find them. This paper discussed about various methods used to detect the pesticide levels in fruits and vegetables. From the deliberated techniques, twelve different kinds of pesticides can be identified by using Nano-SERS chip, it provides a real time output for the consumers, but it is a complex process. Photoconductivity technique discussed here is practically difficult to implement. The laboratory technique like chromatography is highly sensitive and reliable. This technique is based on solid phase extraction and gas chromatograph, but it is time consuming.

When comparing these techniques, sensor integration is the most efficient and simple method. This method uses conductivity sensor to detect the pesticides level in fruits. This provide a real time output to the consumers and it is inexpensive.

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