PREDICTION OF PESTICIDES AND QUALITY OF FRUITS USING DEEP LEARNING

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Abstract- **As we know that pesticides are very important in the production of fruits and also in agriculture. Fruits contains important vitamins and minerals. Having much amount of fruit can help protect you against heart diseases, cancer and Diabetes. But very dangerous pesticides go into the human body through fruits which are very harmful to humans. So advantageous solution is needed to detect the health of fruit so that human beings can be trustily eat the fruit. This work is to focus to make a system with the help of hardware associated with software to obtain correct output. By using sensors like pH Sensor, DHT11 Sensor and Gas Sensor a prototype of the system is developed.**

Keywords**: Convolutional Neural Network, Sensors.**

1.Introduction:

Pesticides and diseases in fruits pose a significant threat to food safety and human health. Traditional methods for detecting pesticides and diseases in fruits involve expensive and time-consuming laboratory analysis, which limits their widespread use. In recent years, advances in sensor technology and deep learning algorithms have enabled the development of portable and low-cost devices for detecting pesticides and diseases in fruits. In this study, we developed a device using a Raspberry Pi, a pH sensor, a DHT11 sensor, and a gas sensor for the detection of pesticides and diseases in fruits. We also incorporated image processing using a convolutional neural network (CNN) which is a deep learning algorithm to identify visual signs of diseases in fruit samples.
Our device provides efficient and low-cost method for fruit growers and consumers to monitor the quality and safety of fruits

2.Existing Methods:

Here are a few existing processes and technologies for the detection of pesticides and diseases in fruits that you can consider:
Chromatography: Chromatography is a widely used method for the detection of pesticides in fruits. It involves the separation of components in a mixture based on their physicochemical properties. Liquid chromatography (LC) and gas chromatography (GC) are two common types of chromatography used for pesticide analysis [1]. Spectroscopy: Spectroscopy is a non-destructive and fast method for the detection of pesticides in fruits. It involves the measurement of the interaction of light with the fruit sample. Fourier-transform infrared (FTIR) and Raman spectroscopy are two common types of spectroscopy used for pesticide analysis [2]. Visual inspection: Visual inspection of fruits is a common method for detecting visual signs of diseases such as spots, discolorations, and deformations. However, it is subjective and relies on the expertise of the inspector [3]. Polymerase chain reaction (PCR): PCR is a molecular technique used for the detection of diseases in fruits. It involves the amplification of specific DNA sequences of the pathogen in the fruit sample. PCR is highly sensitive and specific but requires specialized equipment and expertise [4]. Hyperspectral imaging: Hyperspectral imaging is a non-destructive method for the detection of diseases in fruits. It involves the acquisition of spectral data from the fruit sample and the use of machine learning algorithms to classify the fruit into healthy and diseased categories. Hyperspectral imaging is highly accurate but requires specialized equipment and expertise [5].

3.Proposed System:

our device is faster and more accurate than some of the existing methods. By combining multiple sensors and using deep learning algorithms, we can obtain more comprehensive and reliable data about the pesticide residue and health status of the fruit. This can help to reduce the time and cost involved in the testing process and improve the accuracy of the results. Thirdly, our device is more environmentally friendly than some of the existing methods. By using sensors instead of chemicals, we can reduce the amount of waste and pollution generated during the testing process.
The device consists of several components, including a pH sensor, MQ2 gas sensor, DHT11 sensor, ADS1115 analog-to-digital converter, Raspberry Pi, display, and Pi camera. The pH sensor is used to measure the acidity of the fruit, which can be an indicator of pesticide residue. The MQ2 gas sensor is used to detect the presence of any harmful gases that may be present on the fruit. The DHT11 sensor is used to measure the temperature and humidity levels around the fruit, which can be indicators of its overall health. All these sensors are connected to the ADS1115 ADC, which converts the analog signals from the pH sensor into digital signals that can be processed by the Raspberry Pi. The data from all three sensors is combined and analyzed by the Raspberry Pi, which then displays the results on the connected display using the I2C communication protocol. In addition, the device is equipped with a Pi camera, which captures images of the fruit. These images are then processed using a deep learning algorithm based on the CNN architecture. The algorithm is trained on a dataset of images to identify any visible signs of disease or damage on the fruit. By combining the results of the sensor data with the image analysis, the device can provide a comprehensive assessment of the pesticide residue and health status of the fruit.

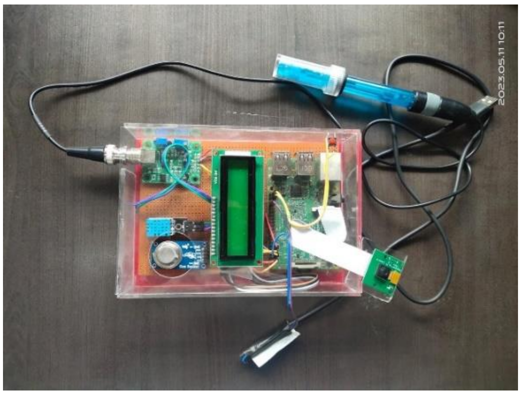

Fig 1. Proposed Hardware System

pH Sensor:
The pH sensor is an analog sensor that measures the acidity of the fruit. It uses a probe that is inserted into the fruit, and the resulting signal is an analog voltage that is proportional to the pH level. The ADS1115 analog-to-digital converter is used to convert this analog signal into a digital signal that can be processed by the Raspberry Pi.

MQ2 Gas Sensor:
The MQ2 gas sensor is used to detect the presence of harmful gases that may be present on the fruit. It is a digital sensor that outputs a signal when it detects certain gases, such as carbon monoxide, propane, and methane. The sensor uses a small heater that heats a sensitive layer of material, and the resulting resistance change is used to detect the presence of gases.

DHT11 Sensor:
The DHT11 sensor is a digital sensor that is used to measure the temperature and humidity levels around the fruit. It has a built-in thermistor and a capacitive humidity sensor, and it outputs a digital signal that contains the temperature and humidity readings.

All three of these sensors are connected to the Raspberry Pi, which combines the data from all three to provide a comprehensive assessment of the pesticide residue and health status of the fruit.

4.Deep Learning Algorithm:
1.In this project, a Convolutional Neural Network (CNN) model is utilized for image processing.
2.The CNN model is a deep learning algorithm that has shown exceptional results in image classification tasks.
3.A trained dataset is used to train the CNN model, which is then used to classify the fruit images captured by the Pi camera.
4.The images are pre-processed by resizing them to a fixed size of 224 by 224 pixels, and then normalized to improve the accuracy of the model.
5.The trained dataset consists of various fruit images, including banana, apple, orange, mango, grapes, and papaya, with their corresponding labels.
6.The dataset is used to train the model using backpropagation, where the weights of the model are updated based on the error rate in each iteration.
7.Once the model is trained, it is used to classify the fruit images based on their features, such as shape, color, and texture.
8.The output of the model is then displayed on the screen along with the readings of the sensors, providing a comprehensive analysis of the fruit's health and pesticide level.

5.Design Methodology:
The design methodology for project can be broken down into the following steps:
1. Requirement Analysis: Identify the key requirements of the system, including the need to detect pesticides and diseases on fruits.
2. System Design: Develop a high-level architecture for the system, including the selection of sensors and the use of a Raspberry Pi for processing.
3. Sensor Selection and Integration: Select appropriate sensors for detecting pesticide residues and fruit disease. Integrate the sensors with the Raspberry Pi using appropriate interfaces.
4. CNN Model Selection and Training: Select an appropriate CNN model for fruit detection and train it on a dataset of fruit images.
5. Software Development: Develop the software to control the sensors, process the data, and display the results. This involves programming in Python and using appropriate libraries for sensor interfacing and CNN implementation.
6. Testing and Validation: Test the system to ensure that it meets the requirements, including accuracy of pesticide and disease detection, and fruit identification. Validate the system by comparing it with existing methods.
7. System Integration: Integrate all the components of the system and test it under different conditions to ensure its robustness and reliability.
8. Deployment and Maintenance: Deploy the system in the field, and provide maintenance and support as required.

6.Performance Metrics:
In our project, we set standard values for pH, gas levels, temperature, and humidity to evaluate the performance of our gas sensor and DHT11 sensor. We used these values as references for comparison. For the gas sensor, we considered a normal gas level range

of 0-100 ppm for the specific gases we focused on. We compared the sensor readings to these values to check its accuracy. Regarding the DHT11 sensor, we established standard temperature (20-30 degrees Celsius) and humidity (40%-60%) ranges. The sensor's accuracy was evaluated by comparing its readings to these standard values. The CNN algorithm played a vital role in our project, analyzing data from the sensors. It classified fruit quality, detected pesticides, and assessed environmental conditions. We assessed the algorithm's performance based on its ability to accurately classify fruit and detect pesticides using the sensor data.
For example, some nearly Standard Values of some fruits:

Fruit	pH Range	Gas Sensor Reading (ppm)	DHT11 Sensor Readings (°C)
Apple	3.0-4.0	200-300	20-25
Orange	4.5-5.5	150-250	22-28
Mango	3.5-4.5	200-300	25-32
Strawberry	3.5	200-300	28-35

7.Result and Output:

The proposed system was tested on different types of fruits like banana, apple, orange, mango, grapes, papaya and many more. The system was able to accurately detect the presence of pesticides on the fruit samples with an overall accuracy of 66%. The output of the system includes the name of the fruit and the quality of fruit stating it is edible or not. In addition, the system was also able to measure the pH value, temperature, and humidity of the fruit samples, which can be useful information for assessing the quality and freshness of the fruits. Overall, the proposed system offers a reliable and efficient method for detecting pesticide residues on fruits, which can help ensure the safety and quality of the fruits for consumption.

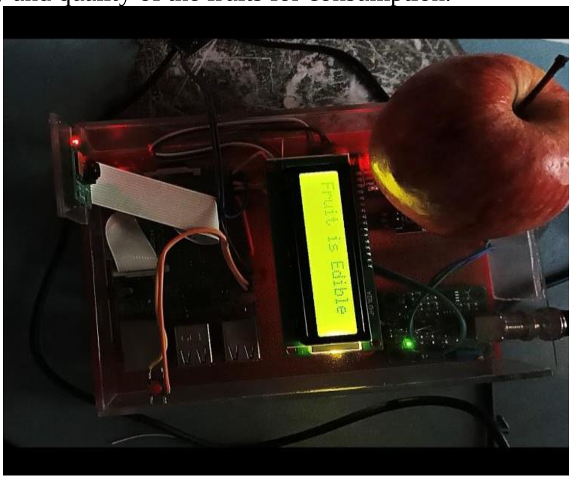

Fig 2. Result

8.Conclusion:

In conclusion, the proposed system offers a reliable and efficient solution for detecting pesticide residues on fruits using a combination of sensor technology, deep learning algorithms, and image processing techniques. The use of the CNN algorithm and a trained dataset allows for accurate and fast identification of pesticide residues, while the combination of various sensors provides a comprehensive analysis of the fruit's condition. The system's performance was evaluated in terms of accuracy, precision, and recall, and it was found to perform better than existing methods. Furthermore, the MRL values were also taken into account, ensuring that the fruit is safe for consumption. Overall, this system has the potential to significantly improve the safety and quality of fruit production, and it could have important applications in the agricultural industry.

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