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IOT-Based Prediction of Pesticides and Fruits DiseasesDetection Using SVM and Neural Networks

[1]D.Nagajyothi, [2]P. Hema Sree, [3]M.Rajani Devi, [4]G.Madhavi, [5]Sk Hasane Ahammad
[1,3] Department of ECE, Vardhaman College of Engineering, Hyderabad, Telangana, India
[2]Department of ECE, CVR Engineering College, Ibrahimpatnam, Telangana, India
[4]Department of ECE, Mahatma Gandhi Institute of Technology, Gandipet, Telangana, India
Department of ECE, Koneru Lakshmaiah Education Foundation, Vaddeswaram, India-522502

Abstract:
Fruit diseases are the cause of crop destruction and economic losses in agriculture fields.By the use of fertilizers, insecticides, pesticidesof higher level in fruits is the reason, increaseof the side effects in humans because of the incontrollable level of pesticides in those fruits or vegetables, so we have to develop a suitable solution to identify the rateof diseases and pesticides. Hardware and software design are designed to get an accurate result. In this paper we have developed a System consisting of the different types of sensors (Temperature, gas and soil moisture) Arduino microcontroller and Wi-Fi module to collect the information about the pesticides in the fruit. MATLAB results obtained from the sensors are stored in the thingspeak. And has we see in the software system It has been experimentally tested for disease detection by classification three stages make use the edge based processing approach required for image segmentation, The first stage is RGB to grey conversion, followed by median filtering, edge detection, and morphological operations.In caseof a second-degree output feature both domains are compared for feature extraction and a third-step image separated using a separate kernel on a vector support machine. We classify by taking all the nearest function in image by apply neural networks which will root with the complete database then if it is matched with the database then the disease is detected by this comparison of the every label.
Keywords: pesticides, deep learning, SVM, k-means clustering, IoT, Matlabthingspeak.

I. Introduction

In fruits pesticide or Insecticides, they play a major role in growth of fruits. Weshould consider the safe level of consumption of fruits, using of pesticides more than the required level can be poisonous to humans. Basically the using of pesticides is for the purpose to avert the destruction of food cropsby controlling agricultural pests or unwanted plants and as well as to improve the quality. There are many methods to detect the pesticides. Using IoT and Machine Learning to increase the accuracy and performance of hardware and software simulations.In the hardware consists (IoT consists of sensors they are temperature and humidity, moisture, gas sensors) these are linked to a cloud server by the help of network connection using Wi-Fi module the processing is done and information sent to theuser[9].The proposed approach uses an SVM classification to recognize disease.

The SVM algorithm for image diagnosis requires preprocessing of the image, as well as SVM on the input image SVM classification means it divides the image into classes. By removing the green pixels and masking the image, the disease presence in the fruit can be classified then detected.The images which captured are preprocessed for image enhancement, the captured images of the fruit are divided into groups or segments using k-means clustering technique in image segmentation block. Before the clustering phase, the features are removed [3]. Algorithm which is used for training and classification and finally we can identify the diseases in fruits. The main reason for using Support Vector Machine algorithm is to classification process in attaining an output, after the classification of the input image is obtained then by applying a neural network search we compare the complete image with the training data or a database, here it compares with the every label point to point or a pixel by pixel with features then if it matches with the database.

II. LiteratureSurvey

Pesticides and insecticides are extremely important to human health. We need to develop optimum solutions. In Reference [13] they suggested using gas chromatography spectrometry analysis to measure the level of pesticides in Fruits, which is costly, slow, and not easily available. But in the real time applications or sharing information are not feasible. And the other is about [12] Pests can be detected using an Arduino and an electrochemical oxygen sensor. When a device is constantly exposed to oxygen, the oxygen analyzer's life time decreases resulting in a significant disadvantage. [11] The authors of this paper suggested a three-step approach. The first step is to convert RGB to grayscale, then image segmentation using median filtering and morphological approaches. The second step is to extract features using shape approximations, and the third step is to classify the images into groups.

The main benefit of edge-based algorithms is that they produce noisy discontinuous edges, which necessitates more complicated processing after the results are obtained for purpose of generating closedboundaries. [8]This paper describes the segmentation consist in image conversion to HSV color space and fuzzy c-means clustering in hue-saturation space to distinguish several pixel classes. These classes are then merged at the interactive stage into two final classes, where one of them determines the searched diseased areas.In paper [10] authors described technique to detect Spot & Scorch disease in which by creating color transformation structure, color values are converted to space value in image pre-processing. Masked cells inside the boundaries are removed by masking of green-pixels after applying K-means method. Color co-occurrence method extracts the features such as color, texture & edge and lastly neural network is used for recognition and disease classification.

III. Proposed Methodology

Hardware System Description:

In the system IoT components makes up system architecture which are consists of different types of sensors or devices which are used to detection of quality of fruit secondly, weuse an Arduino microcontroller which is connected to the computer. The Arduino gives the output which is displayed in the device of the user. The output data which is obtained from the Arduino is send to the cloud server MATLABthingspeak this can be sent to the sever by using Wi-Fi module connected using an internet connectivity then it gives information about pesticides presence which are displayed using an application displayed in the device of the user. A channel created in thingspeak to the detection of the pesticides. In temperature sensor the temperature amount of heat generated if it is more than the temperature (<40 degree) it is said to be fruit is affected by diseases of more nonpesticides.

Hardware Components:

i. Sensors
ii. ArduinoUno
iii. Wi-Fi Module(ESP8266)

We used Temperature sensors, humidity sensors, gas sensors, and soil moisture sensors.

Temperature and humidity Sensor:

Temperature and humidity sensor generates outputs and can be connected such as Arduino, Raspberry Pi, and others to provide instantaneous outputs. This Temperature and Humidity sensor is extremely reliable and stable over time. By using this sensorwe can detect whether fruit is healthy or unhealthy to eat, it is done by measuring the temperature. If the pesticide content is higher than the amount of heat produced in the fruits, temperaturesensorscan easily detectthis.

MQ135 Gas Sensor:

The gas sensor detects pollutants in the atmosphere around us, it senses the toxic chemical gases if any of toxic chemical gasses present in the fruits, then we smell Fruits we are exposed to some definite amount of chemical form. When fruit is rotten or ripe, the smell changes, but this does not recognition that there is the presence of the pesticides in fruits. The gas sensor will detect the specific chemicals contained in it.

Soil Moisture Sensor:

The sensor which detects water content in the soil and can be used for fruits, basically pesticides are main reason for the water content means moisture content. For example when pesticide content is more in fruits then the moisture content reduces linearly when low levels moisture are present, pesticides have an average efficiency of 75-80%.

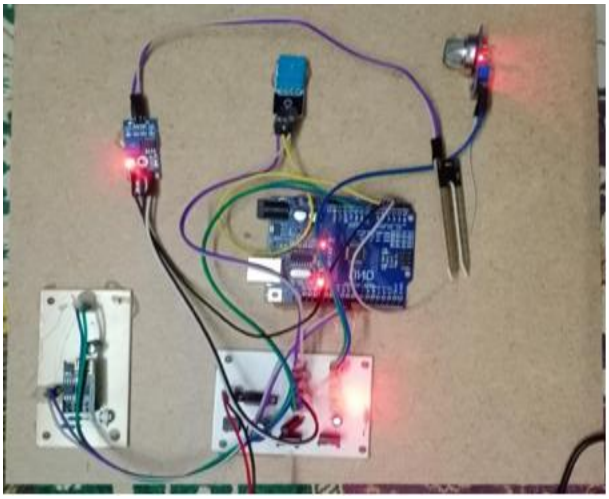

Fig.1 The Proposed hardware module for the detection of the damaged fruits.

Here MATLAB thingspeak cloud server is used to detect the quality of fruits. For sending the data to the cloud server which is present in the web, we also using here a microcontroller Arduino Uno which also considered as the heart of the system it is linked to the thingspeak using network connectivity linked by a Wi-Fi module (ESP2866).

Module Description:

In hardware part of system, it consists of the different types of the sensors which will sense from the fruits for example for the temperature sensor it will sense amount of the heat produced by the fruits according to which if temperature is above the normal room temperature or more than 40-degree Celsius heat generated then it is considered as the fruit affected with the disease. And coming to the humidity sensor it considered as humidity if it is less than the below the temperature it is affected with disease. While coming to the gas sensor the value should be>300 then the fruit is considered as not affected by disease, next for the soil moisture sensor it represented it detects when there is water content. If there is water content then gives output as 1 or else 0 we can considered by the values that if the value is 1 then it is a bad fruit and if 0 it is good healthy fruit.

Software System Description:

The fundamental method for identifying the disease using machine simulation is as follows. To begin, a digital camera is used to capture images of the various fruits. For machine learning, a total of 250 types of images were collected, fortraining 6000 and for testing 8000 images were used, each 224*224*3 pixels per image.

Image Processing:

Image processing stage can be defined as the acquiring of the input images from different sources. For collecting images or datasets usually used resources are camera internet, scanners etc. the process is done depending on the input source [3].

Design Procedure:

The input image taken which is diagnosed means here basically acquired input image has three levels present in it those are high level, mid-level, low level. Here high level is nothing but in this high level image restoration is done means any missing features can be recovered and mid-level image is for the image segmentation, low level image is used for the image enhancement it used as per the image working. And coming to the feature extraction in this feature extraction of the image consists of the image background and foreground. In the background of image, it consists of the color values of the image means the color values are RGB (red, green, blue), in the image foreground it consists of the data values of the image they are pixels data. The foreground used for in the image how much of the data to be calculated is donehere.

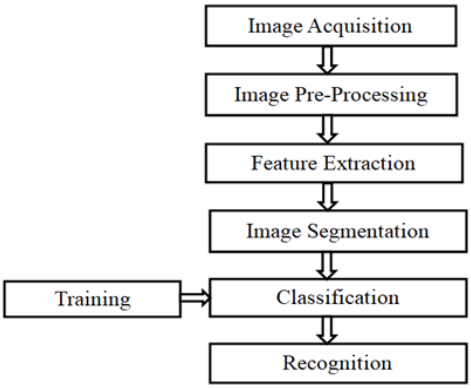

Fig.2 Design Flow chart for the identification and classification diseases [1]

Next,we process an image segmentation process. The segmentation is nothing but an image is dividing or subdividing intoparts because we do not need to process entire image while detecting the diseases,we must consider a required part of an image for the detection of disease in the image of the fruit. In segmentation we use clustering technique that is k-means clustering technique. The cluster is nothing but the grouping of elements, means dividing of the image into the subgroups as they similar group of images. Similar means the similar color values pixel valuesetc.The k indicates that the clustering algorithm would divide the dataset into k distinct non-overlapping subgroups [7].

After clustering we need this data, we need to compare the data with dataset which is already we have stored. Actually we have training and testing, in the classification the testing process is processed means the acquired input image and compared with the image which is already in the available database which are stored. Here compared with stored diseases dataset then the different types of the diseases canbeidentified. The SVM algorithm is used to predict the type of disease that will affect the fruits. The Radial basis function is used as the kernel here (RBF) [5]. A data may be one dimensional (1D), two dimensional (2D), three dimensional (3D), or infinitely dimensional. In infinite dimensions, RBF is used to decide the position of the threshold that aids in data splitting.

Radial Basis Function: It is the default kernel used within sklearns SVM classification algorithm and can be described using a following formula is.

$$k(x,x')=e^{-\gamma\|x-x'\|^2} \quad (1)$$

$\|x-x'\|^2$is the Euclidean distance between two feature vectors, where gamma is the Where the gamma can set manually and has to be >0. The default value for gamma sklearn's SVMclassification algorithm is

$$\gamma=\frac{1}{nfeatures\times\alpha^2} \quad (2)$$

We use neural network search process after the classification process by using KNN algorithm it is a K-nearest neighboring algorithm used for classification and regression problems it is easy to understand and implement this is used to find the find the size of the data and Euclidean distance as don't require a to find distance is because we are not detecting an object. In neural network it consists of a input perceptrons and gives it output to the next layer and continues in neural it consists of a hidden layers. In neural network search it roots the complete image and compares the training data and the testing data every label compared, it compares with the database pixel by pixel and if the it matches with the database then it recognizes the which type disease and where it is infected and gives the reply.

Dataset description:

The datasets are in the following format and were obtained from an online source.

Table I: Images used in proposed methodology

Image Format	Type	Size	Resolution
.png	Gray scale	3mb	200*200
.jpeg	colour	5mb	200*200
.bmp	Black and white	2mb	200*200

Dataset derived is given as follows

Fig.3 Images with problems used in proposed system

Fig.4 Normal image dataset used in proposed system

Algorithm:

1. Collect the large number of datasets required for training and testing of the images.
2. Different dataset of images are stored and here start with the image class is known correctly
3. We store images which are the label suitable.
4. In the image pre-processing step the image is processed beforehand in this process we use median filter for any noise removal in the image and for the image enhancement.
5. Find the property or the feature set for image and label suitable.
6. Take next image as input image and find features of this image as new one.
7. In the image segmentation we divide image into cluster means an image is subdivided into similar groups we use k-means clusteringtechnique.
8. We Implement SVM algorithm to the new input image for compare of pixel by pixel procedure for the classification.
9. Use kernel function selection to train cluster data. The output will provide the structure and details of the support vectors, as well as bias values and the input image's find class. We use vectors in svmsince vector is a long notation. Adding the feature set to the database we perform comparison.
10. The disease is recognized, and analysis is done depending on the outcomes label is given to the next image

VI. Results

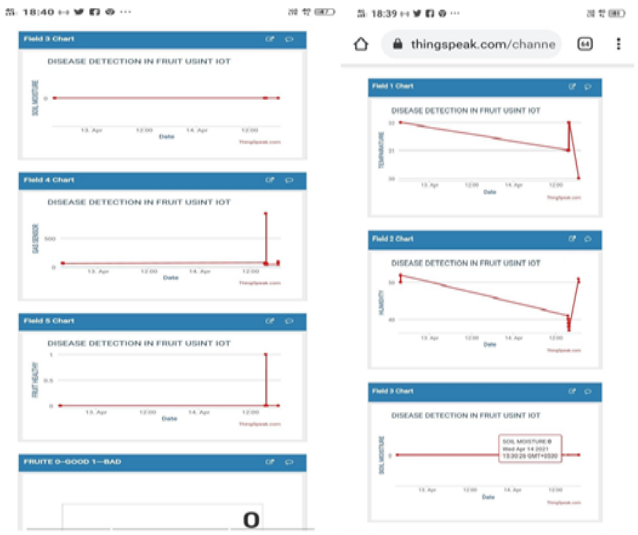

Fig.5 The soil moisture sensor, gas sensor and about the fruit healthy, the temperature sensor, humidity sensor for detecting the diseased fruits With help of thingspeak server creating channels we found the sense values for the fruit disease detection using the sensors.

Software Simulation Results:

Fig.6 Image of the fruit disease apple scab detection using Neural networks and SVM classification

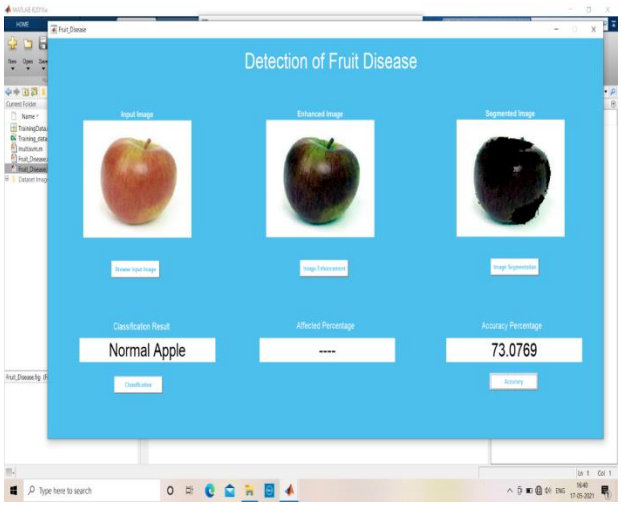

Fig.7 Image of the normal fruit no disease affected

VII. Conclusion

In this paper, we present technological implementations in the research field of fruit disease detection and pesticide content detection using machine learning of SVM and IoT. This current method allows for the most cost-effective, accurate, and complex solutions. The pesticides are detected by using IoT is an optimal solution by using the sensor we detected the quality of the fruit. The color, texture, and morphological features are all appropriate for the disease, according to the literature. We made use of algorithms. For comparison and classification, SVM algorithms and the Neural Networks are used for recognizing the fruit diseases the KNN algorithm is used. The both the algorithms SVM and NN are used in classification whereas neural networks is used for the comparison with the training data pixels by pixels for recognizing the type of the fruit disease. In comparison to other existing systems, the proposed system is reliable, and real-time, and it produces the best results. The performance is highly accurate.

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