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Smart Plant Disease Detection

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***Abstract*--- It is not always possible for the farmers to predict the situation that can arise and their prediction can fail. The main reason is plant disease. So, to assist the farmers in safeguarding the plants from diseases becomes the motivation. Leaf images are vital in the automatic diagnosis of plant diseases, according to the majority of researchers. There has been development in technology used in automatic plant disease detection such as Deep Learning, Machine Learning, Computer Vision, Internet of Things (IoT), Expert Systems. The purpose of this system is to detect leaf disease using the machine learning technique based on Raspberry Pi controller for processing the plant leaf image to detect diseases.**

***Index Terms*— Machine Learning, Leaf Disease Detection, IoT, Raspberry Pi**

I. INTRODUCTION

A huge population in India depends on agriculture. People have a lot of choice when it comes to selection in Fruit and Vegetable crops. The cultivation can be improved by providing technology as a support. The pathogen causes disease in a plant in any environmental condition. In major scenarios diseases are visible on the leaves, fruits, therefore detecting disease is important in successfully cultivating crops. Sometimes contaminated soil and water in the environment is also responsible for diseases in plants. There are a variety of approaches for detecting illnesses in their early beginnings that damage plants. The conventional method of detecting diseases in plants involves observing through your naked eyes and it's non-effective for a large crop. Using image processing method, the disease detection in plant is efficient, and accurate. This method saves time, effort, labor and use of pesticides. Many authors have proposed different techniques using digital image processing for accurate plant disease identification.

II. PROBLEM STATEMENT

The global economy mainly depends on the agricultural sector. Rising incidents of plants getting affected by diseases that are discovered recently or did not exist before is an increasing concern in the agriculture sector. The environment is changing continuously which is harmful to the crops and leading farmers towards debt and suicides. Leaf images are vital in the automatic diagnosis of plant diseases, according to the majority of researchers.

III. LITERATURE SURVEY

In paper **[1]** image processing technique for identifying diseases in Rice plantations is presented by the authors. The two most commonly known diseases in the north east India are Leaf Blast (Magnaporthe Grisea) and Brown Spot (Cochiobolus Miyabeanus). For feature extraction of the contaminated regions of the leaf, we used a segmentation, boundary detection, and spot detection method.

The author of this paper outlines the zooming algorithm in which SOM which stands for Self-Organizing Map neural network is used for classification of affected rice images. In SOM there are two ways to build an input vector. Padding of zeros is the first approach and the second method is the interpolating missing points. Interpolation method is applied for fractional zooming in order to normalize the size of the spots. For the purpose of testing, four distinct types of images are applied out of which the zooming algorithm provides higher categorization results for test photos.

In paper **[2]** Image-processing technique for disease detection in leaf and stem has been presented by the authors. A group of leaf images has been used from Jordan's Al-Ghor area. The five plant diseases mentioned are namely: Early scorch, Ashen mold, Late scorch, Cottony mold and Tiny whiteness all of which are tested by the technique of image processing. We begin this technique with image acquisition being the first step followed by K-Means clustering method used for segmentation. The Colour Co-occurrence Method, which is utilized for texture analysis of affected leaves and stems, is employed for feature extraction. The back propagation approach for neural networks in plant disease classification is demonstrated in this research. This image processing methodology produces great accuracy and precision in plant disease classification, with a precision of roughly 93 percent.

In paper **[3]** The authors employed image processing software such as LABVIEW and MATLAB to detect chili plant disease. This method uses leaf inspection to detect disease at an early stage the image is captured with a program named LABVIEW IMAQ Vision, and image

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processing is done with MATLAB. Fourier filtering, edge detection, and morphological processes are examples of image pre-processing procedures. Color clustering is used in feature extraction to discriminate between chili and non-chili leaves. Then image classification and recognition determine how healthy each chili plant is. This technique reduces the chemical use over chili plant which in turn reduces the cost spent on production and thus helps in growing good quality chilies.

In paper **[4]** Image processing technique is used for detecting the Malus Domestica leaves disease which has been presented by the authors. Histogram equalization method is used to measure the values which give the intensity of grayscale images. For texture analysis, the Co-occurrence matrix technique technique is employed, and for colour analysis, the K-means clustering technique is employed. Texture analysis represents the regions of a picture based on texture content. In colour analysis, the sum of squares of distance between objects and the class centroid or related cluster must be reduced Individual pixels and threshold values are compared in the threshold matching process, and if a pixel's value is greater than the threshold, it is designated as an object pixel.

IV. METHODOLOGY

CNN:

Step 1: Convolution Operation

The elements that enter into the convolution operation:

1. Input image
2. Feature detector
3. Feature map

Step 1(b): ReLU Layer

Images are naturally non-linear. You'll observe a lot of non-linear features in an image. (e.g., the transition between pixels, the borders, the colors, etc.). There's a possibility of imposing linearity on an image once it's put through the process of convolution. Rectifier breaks the linearity further.

Step 2: Pooling

Max pooling entails training your CNN that, despite all of the variances described, all images are identical. The network must have a property known as spatial variance for this to work. This property enables the network to detect the item in the image despite changes in the image's textures, distances from the point of capture, and angles and other factors.

Step 3: Flattening

When dealing with Convolutional Neural Networks, this will be a quick rundown of the flattening process and how data moves from pooled to flattened layers.

Step 4: Pooling

After we are done with the flattening step a long vector of input data is passed through the artificial neural network to process it further which is called pooling. Types of pooling: Mean, Max, Sum

Step 5: Full Connection

a complete connection Everything that has been learned so far will be combined in this section. You'll gain a better understanding of how CNNs work and how the neurons that are formed learn to identify images as a result of this.

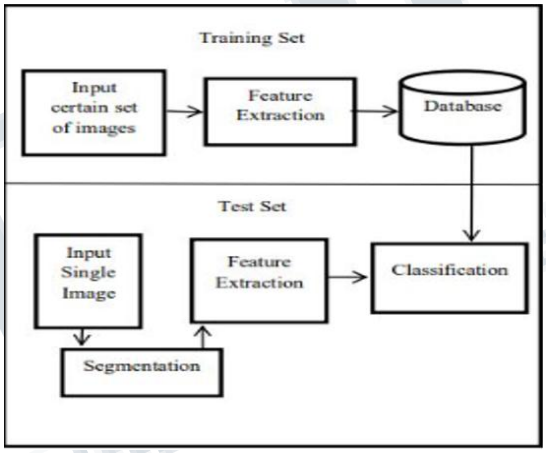
Step 6: Summary

We will conclude by giving a quick recap of the concept covered in the training.

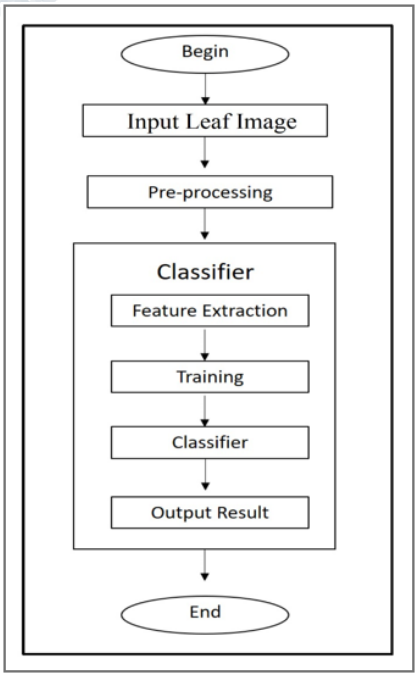
Step 7: SoftMax & Cross-Entropy

Optimization Functions for CNN model. To calculate final accuracy and losses.

V. BLOCK DIAGRAM



Flowchart-



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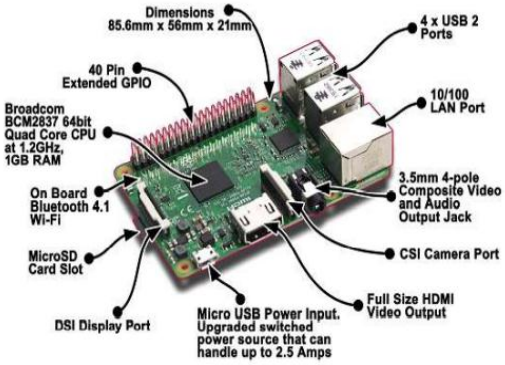


Fig 4.1 Raspberry pi hardware

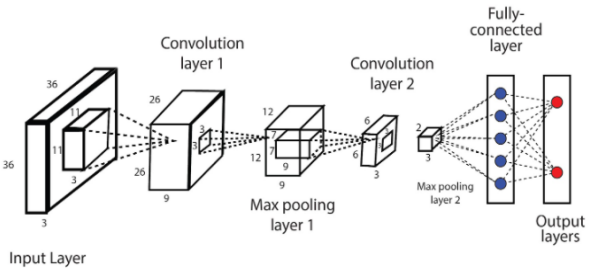
Algorithm

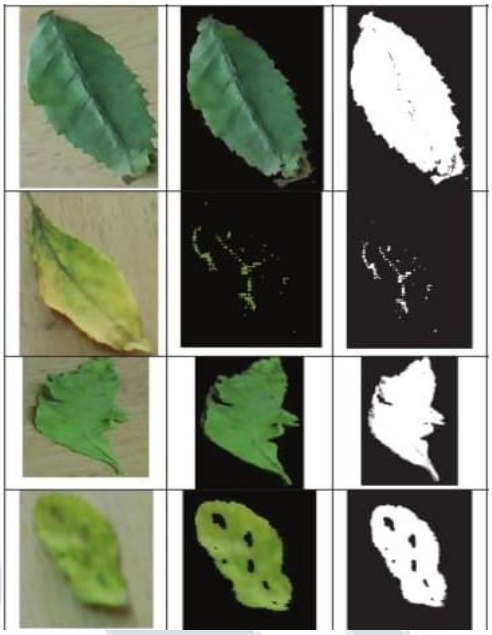
1. Classify cloth dataset under labeled folders such as leaf and unhealthy images, etc.
2. Read dataset
3. Read features of all images and label of it
4. Store it in model file
5. Get input image
6. Read features of input image
7. Compare features of stored features
8. Label be shown as prediction of nearly matched features

Basic Working

Image acquisition
Image preprocessing
Image segmentation
Feature extraction

Convolution Process

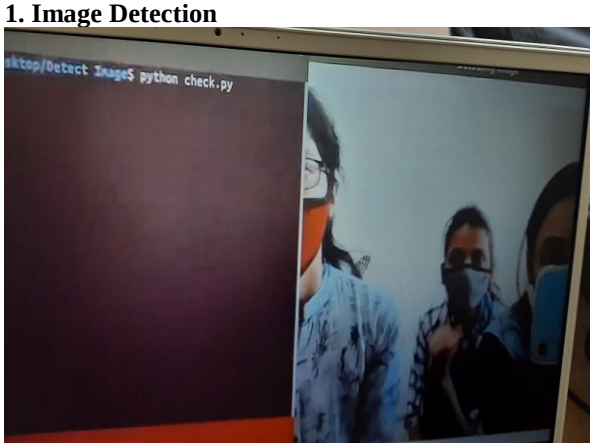




Raspberry Pi Connections

VI. RESULTS

1. Image Detection



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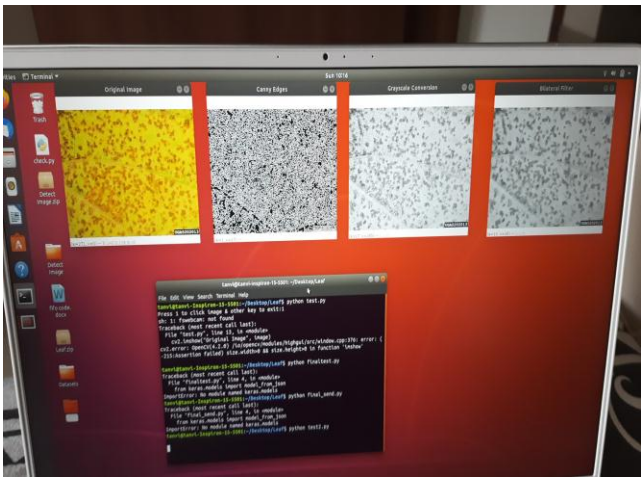
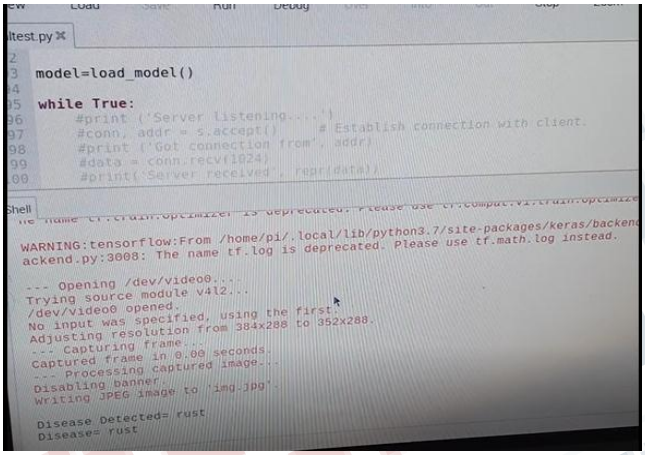
2. Feature Extraction



3. Disease Detection



VII. CONCLUSION

For producing good crop, accurate plant disease identifying and classifying the disease is very important and this can be achieved using image processing. In this case, we're using a Convolution Neural Network (CNN), which is made up of several layers that are used to forecast diseases. We can accurately diagnose and distinguish between different plant diseases using image processing. All observations and tests have been completed, demonstrating that this is the smart agriculture solution. This technique significantly boosts the farmer's overall income by increasing crop yield.

VIII. FUTURE SCOPE

In the future work of our system, we include the edge detection and recognition of different diseases also we work on automatic farming system to the entire farming land using the sensors and controller. With the assistance of this method, we can find all kinds of diseases in various leaves. This may help the farmers in identifying the disease in the leaf in feasible and accurate way. When there is enough sunlight, the highest image quality may be acquired; however, photographing in overcast weather increases the complexity of image pre-processing and reduces the recognition effect. To recognize and anticipate diseases and pests, it is required to combine meteorological and plant protection data such as temperature and humidity.

Acknowledgement

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