Plant Leaf Detection and Disease Identification System

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Abstract **- In an agricultural country like India, agricultural productivity plays an important role in boosting the economy. It is often the case that farmers and growers are not able to take care of their crops, and this leads to serious crop effects, such as crop diseases. Expert training in plant diseases is required to diagnose diseases, as farmers must pay the cost of bringing their crops to the laboratory, it is beneficial to apply technical measures in the field. The most common diseases, such as black spot, mildew, and rot, are simple to notice, but less common illnesses may wreak havoc on plant growth, reproduction, and survival if not caught early enough. Picture processing methods such as resizing and enhancement are used by the system, followed by image segmentation to maintain just the vital areas, and discard the rest. Then, the features of the segmented images extracted and then passed to a supervised learning model called multi-SVM for classification.**

Index Terms - Image Pre-Processing, Segmentation, K-Means, Features Extraction, SVM

I. INTRODUCTION

Everyone needs food to live. The agricultural field is very important. Why does a man do this? This question has many answers, but one of the most important is to eat food that is rich and healthy. A plant can get sick, but if it doesn't get the attention it needs, it can hurt the quality of its crop. And it can also be less productive. People also won't buy it. So, to keep a balance between how many plants there are and how good they are, you need to keep an eye on them. When the leaves become infected, it can be found out how much of it is infected and what steps can be taken to fix it. Another important thing to do before it's too late is to figure out what the disease is. If you don't, you could lose money, have a shorter harvest, and not get as much food from your plants.

It takes a plant pathologist with the right training or experts and labs to figure out what the plant disease is by looking at the infected part, the color, the veins, and other parts of the leaves to figure out what it is. To make a computerized method for identifying plant leaves and diseases, a process that is very similar is used. It's important to think about all the things that make a plant important before you can figure out how important it is. We came up with a way to figure that out.

This helps you figure out if a leaf is healthy or sick, as well as how much of the leaf is diseased. And how many parts of the plant are infected can help us figure out what kind of treatment to use to make the plant healthy again. The main goal of our project is to help farmers get the most out of their crops. The system is made to be simple to use, and the farmers who grow the crop will be able to afford it very quickly.

This article outlines a framework comprised of four fundamental phases. -

1) Image Preprocessing, where the picture is reduced in size and improved to eliminate noise and boost its quality.

2) Image Segmentation, Clustering is done by using the K-Means algorithm, which is very common. The Euclidean Distance method is used to figure out how far apart the cluster points are from each other.

3) Feature Extraction, the use of a co-occurrence matrix (GLCM).

4) Classification with the help of supervised learning model, the multi SVM Classifier with 500 epochs.

The system is good enough to achieve results with a precision of 98.39 percent in identifying the plant disease following the procedure. The suitable soil minerals and fertilizers or pesticides may be provided to farmers with inadequate understanding to ensure proper agriculture.

II. METHODOLOGY

In figure 1, you can see how we came up with the proposed framework. This programme makes use of a variety of machine learning methods, including image processing techniques such as resizing and improving photos, and text recognition algorithms, Segmentation of preprocessed images using the K-Means algorithm, the gray-level cooccurrence matrix was used to extract features, and a multi-class SVM classifier was used to determine the sort of illness that had infected the plant leaf, among other things.

It aids in the development of a leaf sickness detection gadget that employs photograph processing methods consisting of scaling and enhancement, accompanied by using photo segmentation to simply hold the relevant quantities of the photograph and reject the rest. Once the capabilities from the segmented photograph have been retrieved, they're entered right into a supervised studying model known as a multiclass SVM, which is used to categorize the pictures.

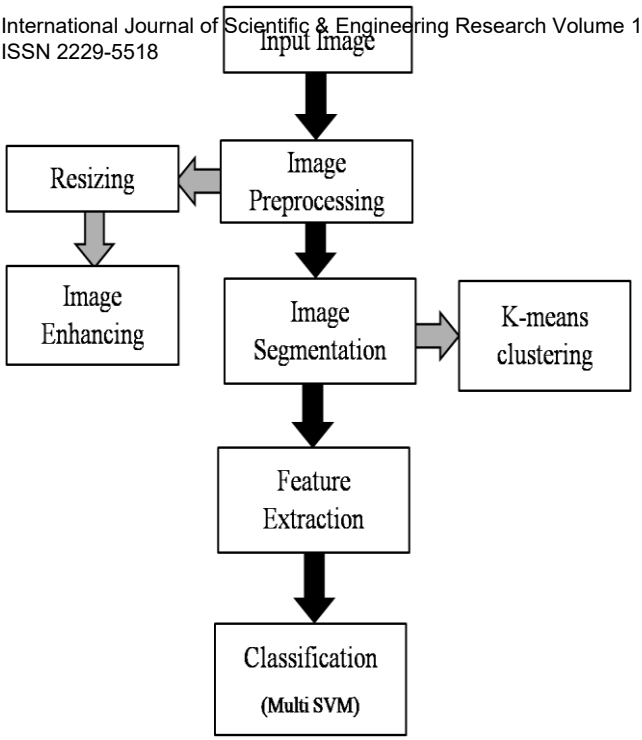

Fig. 1 Flowchart of proposed methodology

Each step involved in the proposed methodology is discussed in detail as follows:

A. Image Pre-processing

1) The pix inside the dataset need to be wiped clean to improve the nice and do away with the unwanted noise. Image pre- processing is the initial assignment performed before designing the model. This procedure might also lower the education time of the model, hence ensuing in elevated version inference speed. The proposed framework follows three steps of picture preprocessing, i.e., photo cropping, image enhancement and image converting. The photograph is firstly cropped on the leaf region with disorder, and then it is converted to gray levels. Then, to increase the contrast, photograph enhancement is executed.

2) Image Resizing: Here image is resized, and it is done by changing its original image.

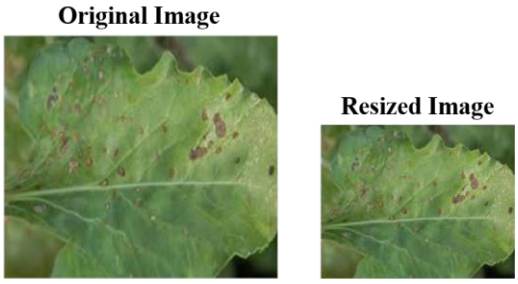

Fig. 2 Image resizing

3) Image enhancement: The resized photo is given because the input, to which smoothing, and filtering is implemented. The pointy edges are removed, and the enhanced model of the picture is received as the output in this step.

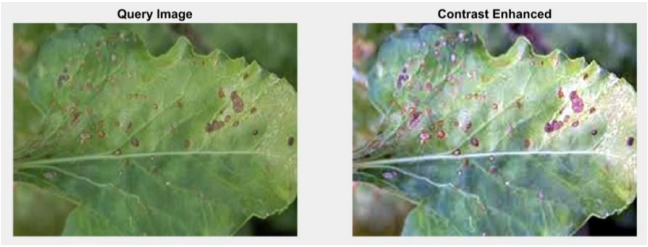

Fig. 3 Image enhancement

4) Image Color Conversion: the enhanced image that is in RGB form is then converted into HSI photograph.

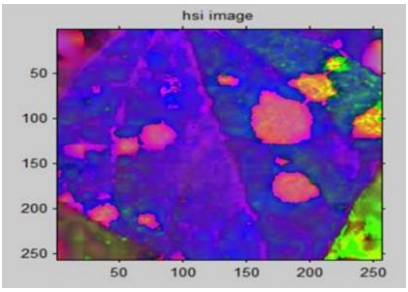

Fig. 4 Image color conversion

B. Image Segmentation

Now not all a part of the picture is beneficial within the detection technique. So, to maintain most effective the significant part of the image for future reason, its miles segmented in numerous partitions as in step with the involved areas. This detects the department of the equal and meaningful regions. For this reason, the pixels of equal type are recognized and grouped collectively. Picture segmentation is important as it enables within the detecting the objects and edges of the image. Inside the proposed undertaking, clustering set of rules called okay- means is carried out for segmentation cause. This algorithm classifies the objects into k training in keeping with set of attributes. The Mathematical aid used with okay method is the Euclidean distance among gadgets and associated cluster.

i) *K-Means Clustering Algorithm:* This algorithm is used for the implementation to help become aware of the clusters of infected quantities on the plant's leaf. On account that no earlier understanding approximately such styles or clusters was available, therefore, the ok-way algorithm is chosen. The algorithm is mentioned stepwise, as comply with:

ii) The information is to be clustered in K corporations, in which K is predefined

iii) Arbitrarily, K data points are selected as the centers of the clusters.

iv) Data points are allocated to their close by cluster using the distance function.

v) Clusters are reformed and the new centroid for each cluster is evaluated depending on the Euclidean distance.

vi) Steps 3 and 4 are repeated until, not much change in the centroids is noticed.

vii) Return those centroids and stop the algorithm.

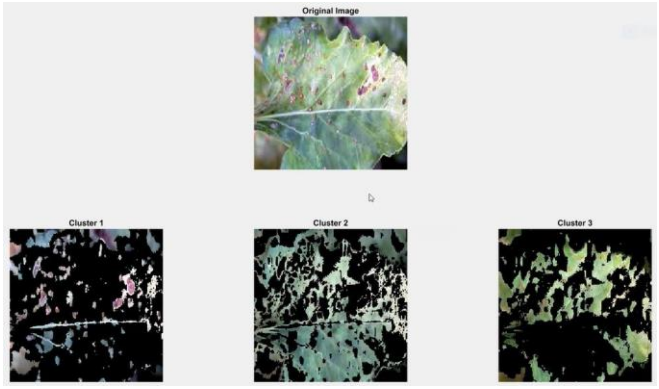

Fig. 5 Clusters formed

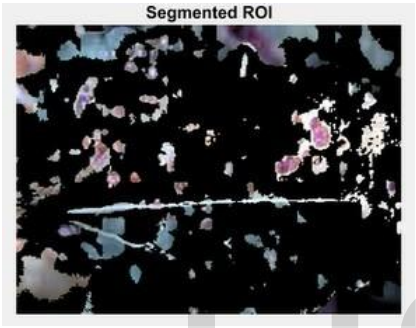

Fig. 6 Segmented region of interest

1) Euclidean Distance Function: K-Means algorithm is a set of rules and is a powerful technique, however, the no. Of clusters to be defined in advance. Also, it requires mathematical assistance for the clustering process. Right here, within the proposed methodology, the proximity fashionable considered is Euclidean distance. And it's miles calculated with the assistance of the equation given under:

$$D(x, y) = \sqrt{\sum |x_i - y_i|^2} \quad (1)$$

C. *Feature Extraction*

Functions are the traits or attributes of the records gadgets. For a plant leaf and ailment detection, features may be coloration, texture, morphology, and structure. Right here, one of the earliest techniques of extracting the features, the Co-occurrence matrix method is used. A grey-level co-occurrence matrix indicates exclusive distributions of grayscale values or shades at a given offset. A GLCM is likewise referred to as, co-occurrence distribution.

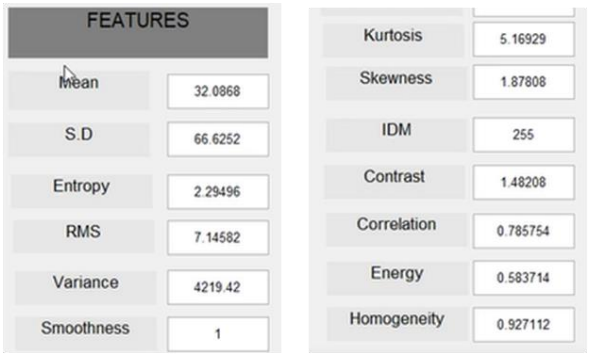

Fig. 7 Features extracted

D. *Classification*

A multi-elegance 500 epochs SVM (Support Vector Machine) is implemented for classification purposes. In machine learning, it comes beneath the supervised studying model. SVMs paintings in a very green way for class and regression evaluation. To provide an output, SVM ought to be associated with a studying set of rules. Experiments and studies display that, SVM is higher at classifications and regressions as compared to different gadget learning models.

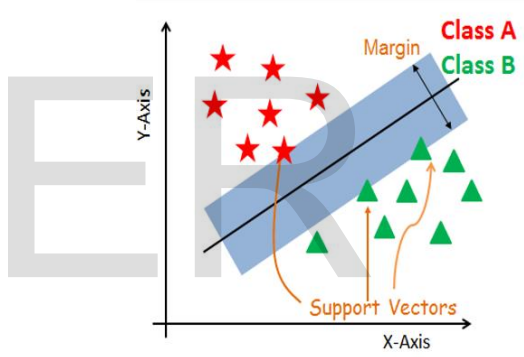

Fig. 8 SVM classifier

III. RESULTS

The results of the plant leaf disease detection are as follows:

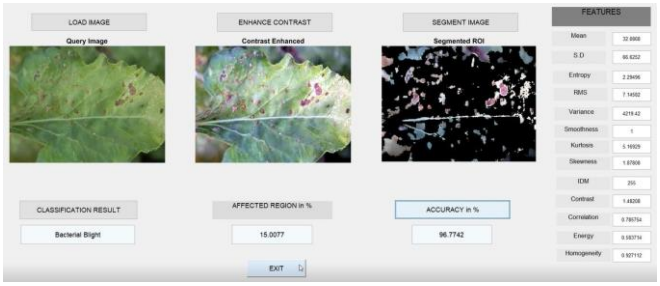

Fig. 9 Results of leaf disease identification

IV. PERFORMANCE OF DIFFERENT TECHNIQUES IN PLANT DISEASE IDENTIFICATION

TABLE I
PERFORMANCE OF DIFFERENT TECHNIQUES

Classifier	Accuracy (in %)
Convolutional Neural Network	83.5
K-Means	93.6
Bayes Network	93
Proposed Method	98.39

V. CONCLUSION

The suggested study employs image processing to detect leaf diseases. This includes image capture, preprocessing, segmentation, feature extraction, and classification. Image processing and computer technology have made it simpler for farmers to identify leaf diseases.

For farmers, precise diagnosis of sickness and the percentage of infected areas make their work simpler, as they can administer the right amount of pesticide. The sickness has been identified, which will aid pest control operations and increase agricultural production. Using the disease identification system concept, users can identify diseases in all leaf types and get accurate percentages of affected leaf areas. So, once diagnosed, users may take exact steps to rectify the condition rapidly and inexpensively.

However, farmers and the country will benefit from this policy in the future. The suggested approach may be improved in the future to be more farmer friendly. Examining the appropriate percentage of the tree's damaged areas allows us to assess insect and disease spread. We hope to detect more crop ailments by increasing our efforts. Clarify the plant's species and what may be done to repair the leaves.

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