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PLANT DISEASE CLASSIFICATION USING SOFT COMPUTING SUPERVISED MACHINE LEARNING

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Abstract: *The presence of pathogens in the plant bodies is one of the leading issues in the agriculture sector as it leads to a lot of yield misfortunes. Researchers are always concerned about the diseases introduced in the plants by pathogens for example infections, microorganisms and parasites. Various studies have been carried out to show the extent of harm caused by pathogens in the plants. Also they have explored various means to diminish the effect of pathogens in plants.*

Few analysts have created ID and scoring framework for monitoring and examining the advancement or quality by anticipating the infection. Here we have proposed a method of identifying the disease with the help of Artificial Intelligence (AI) and Image Processing. For the classification and disease detection the k-means clustering algorithm and SVM classification have been used. The reason to carry out this work is to display the use of AI in the revelation of plant opposition.

Key Words: Artificial Intelligence (AI), disease detection, k-means clustering, feature extraction, Support Vector Machine (SVM)

1. INTRODUCTION

Identification of the plant diseases is the key to preventing the losses in the yield and increasing quantity of the agricultural product. It is very difficult to monitor the plant diseases manually. Identifying the disease manually requires one to be an expertise in identifying the plant disease, has to carry out tremendous amount of work that require excessive processing time. Hence, image processing is used for the detection of plant diseases. Disease detection involves the steps like image acquisition, image pre-processing, image segmentation, feature extraction and classification[1].

The old and classical approach for detection and recognition of plant diseases is based on naked eye observation, which is very slow method also gives less accuracy.

Automatic detection of plant diseases is essential to detect the symptoms of diseases in early stages when they appear on the growing leaf and fruit of plant.

2. PROPOSED SYSTEM

This project introduces the concept of Image processing in identifying the disease of the plant. A MATLAB based system is used which focused on leaf diseased area and used image processing technique for accurate detection and identification of plant diseases[6]. The MATLAB image processing starts with capturing of digital high resolution images. Healthy and unhealthy images are captured and stored for experiment. Then images are applied for pre-processing for image enhancement. Captured leaf images are segmented using k-means clustering method to form clusters. Features are extracted before applying K-means and SVM algorithm for training and classification[7]. Finally diseases are recognized by this system.

The concept of image processing with data mining technologies assists us in following purposes:

i) Recognizing infected leaf and stem

ii) Measure the affected area

iii) Finding the shape of the infected region

iv) Determine the color of infected region

v) Influence on the size and shape of the leaf.

This paper intends to study about the prediction of the plant diseases, at an untimely phase using k-mean clustering algorithm.

The user is supposed to select a particular diseased region in a leaf and the cropped image is sent for processing. The image processing provides various methods to study crop diseases/traits. It would be useful for identifying different diseases on crops[2]. In addition, the infected area and affected percentage is also measured.

3. METHODOLOGY

To carry out the proposed work we concentrated on predicting the diseases like Alternaria alternate, Anthracnose, Bacterial blight.

The step by step process of the work carried out is shown in the figure 1

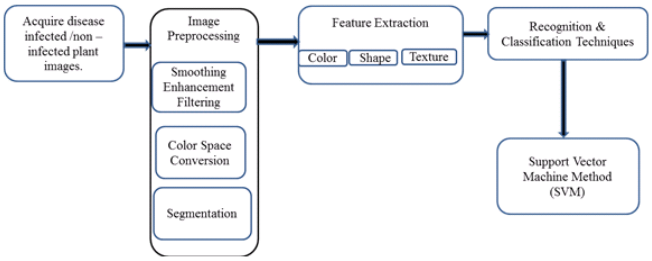

Fig1: Block Diagram

As shown in the block diagram the work is majorly divided into 4 segments:

1. Acquiring the image of the diseased leaf
2. Carrying out the image processing techniques
3. Extraction of the features
4. Finally applying the SVM classification technique to identify the disease.

The process can be further subdivided into

- Acquisition of RGB Image
- Conversion of RGB image to HSV image format
- Green Pixels Masking
- Masked green pixels removal
- Segmentation of components
- Extract the variable segment
- Evaluation of texture statistics

The detailed explanation of the process involved is as follows:

Image Acquisition:

Initially the images of the plant leaf that has to be studied are captured with the camera in a controlled background and are stored in the JPEG format.
The infected leaf is placed horizontally on a black background and is zoomed on so as to make sure that the picture taken contains only the leaf and black background.
This image obtained will be in RGB form.

Color transformation structure for the RGB leaf image is created, and advice-independent color space transformation for the color transformation structure is applied[2].

Image Pre-Processing:

Further it is necessary to remove noise in image. To remove the noise there are various pre-processing techniques. Some of them are: Image clipping which is used for cropping the image and there by inserting the image in the required region[2]. Image smoothing is carried out with the help of smoothing filter. Image enhancement is carried out for increasing the contrast. The RGB images are converted into the grey images using color Conversion formula as shown in equation (1)[4].

$$f(x)=0.299*R+0.587*G+0.114*B \text{--------} (1)$$

Then the histogram equalization which distributes the intensities of the images is applied on the image to enhance the plant diseased leaf images. The cumulative distribution function is used to distribute intensity values.

Image segmentation:

Segmentation means partitioning of image into various parts of same features or having some similarity. The segmentation can be done using various methods like otsu method, k-means clustering, Boundary and spot detection algorithm, converting RGB image into HIS or HSV model. The RGB image is converted into the HSV model for segmenting using boundary detection and spot detection algorithm. Boundary detection and spot detection helps to find the infected part of the leaf. For boundary detection the connectivity of pixels is considered and boundary detection algorithm is applied[2].

a) Otsu Classifier

In Image processing technique Otsu's strategy is utilized to perform clustering based image Threshold. The diminishment of a gray image is done by Nobuyuki Otsu. This algorithm assumes, image contains two classes of pixels. It incorporates bi-modal histogram. We can calculate the optimum threshold by isolating the two classes and their combined spread is negligible or equivalently[2].

b) K-means Clustering Algorithm

This algorithm is used to cluster/divide the object based on the feature of the leaf in to k numbers. This is done by using the Euclidian distance metric[3].

- Load the input images.
- Commute the RGB image into L*a*b color space.
- RGB images are combination of primary colors (Red, Green, Blue).
- RGB image feature Pixel Counting technique is extensively applied to agricultural science.
- The L*a*b* space consists of a radiance layer 'L*', chromaticity-layer 'a*' indicating where color falls
- Along the red-green axis and chromaticity-layer 'b*' indicating where the color falls along the blue-yellow axis. All of the color information is in the 'a*' and 'b*' layers.

- Clustering the variant colors using k-mean method.
- Each pixel is labeled under clusters based on its estimated variant cluster-centers.

Feature Extraction:

Feature extraction plays an important role for identification of an object. In many application of image processing, feature extraction is used. Color, texture, morphology, edges are the features which can be used in plant disease detection[2].

Classification:

Once the feature extraction is done it is used for classification of the disease. For classification purpose Support Vector Machine technique is used. For this the samples in the data base are trained and are classified for the identification of the disease. Based on the training the disease can be identified. Thus classification is used in the implementation of the extracted diseased region in an image which helps in the identification of the type of disease infection in leaves[7].

SVM classifier:

A support vector machine (SVM) is a supervised machine learning model that uses classification algorithms for two-group classification problems[5]. After giving the SVM model sets of labeled training data for each category, they are able to categorize new text. SVM is a fast and dependable classification algorithm that performs very well with a limited amount of data[6] .

4. CASE STUDY AND RESULTS

For our case studies we concentrated on predicting the disease such as

- Anthracnose
- Alternaria alternate
- Bacterial blight

Anthracnose:

Anthracnose is caused by fungi in the genus Colletotrichum, a common group of plant pathogens that are responsible for diseases on many plant species. Infected plants develop dark, water soaked lesions on stems, leaves or fruit as shown in the Figure 2 below:

Fig 2: Leaf with Anthracnose

Alternaria Alternata:

The second disease which we concentrated is **Alternaria Alternata** a fungus which influences the leaf spots over 380 types of species of plant. It can influence leaf spots, rots, blight and other plant parts.

And the infected leaf will appear as shown in the Figure 3

Fig 3: Alternaria Alternata

Bacterial Blight:

Finally we have considered Bacterial Blight a disease which is characterized by small, pale green spots or streaks that appear as water-soaked. This disease expands and appears as dry dead spots as shown in the Figure 4. In some cases it may extend until the full length of the leaf.

Fig 4: Bacterial Blight

RESULTS:

In order to identify the above mentioned diseases a data set has been considered which has information of various leaves like paddy, beans, rose etc., the dataset has the information of both the diseased as well as non diseased leaves. The user gets the image of the diseased leaf and considers that as the input image. Various operations mentioned above applied and the type of the disease is identified.

Fig 5: Input Image

Here the beans leaf image is taken as input image as shown in the Figure 5. Operation like enhancement and contrast are applied to the leaf to enhance the diseased part of the leaf. By enhansing the image we can easily identify the diseased part of the leaf. The image of the contrast enhanced leaf is as shown in the Figure 6

Fig 6 : Contrast Enhanced image

Now using thresholding techniue the enhanced image is converted to binary image as shown in the Figure 7 below:

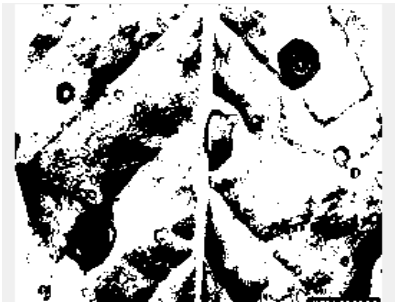

Fig 7 : Binary Image

After obtaining the binary image in order to identify the disease it has to converted into HIS image. This process of converting binary to HIS is known as segmentation. After the segmentation the image looks as shown in the Figure 8 below:

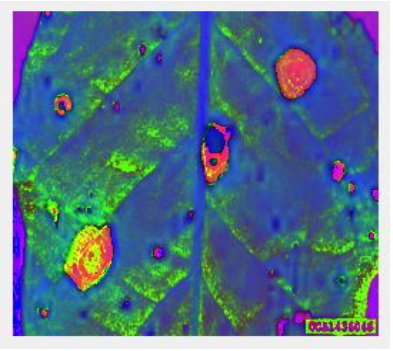

Fig 8: HIS image for classification by color

After segmentation k-means clusturing algorithm has been applied where we get 3 clusters as indicated in the Figure 9 below .

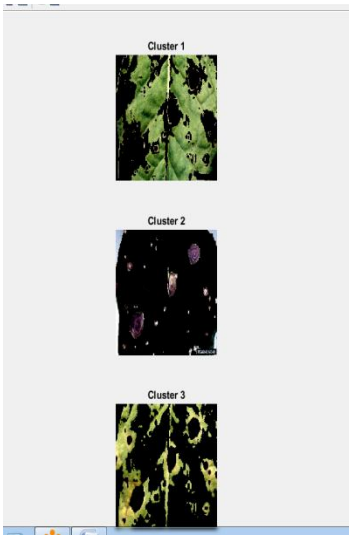

Fig 9: Select cluster from 3 clusters

Finally we have to select one cluster from 3 cluster to identify disease.Now a dialouge box opens as shown in the Figure 10 below

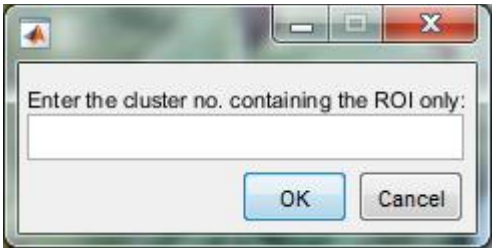

Fig 10: select the cluster having disease

In this dialouge box we have to enter the cluster no which is obtained from the figure 9 shown above.

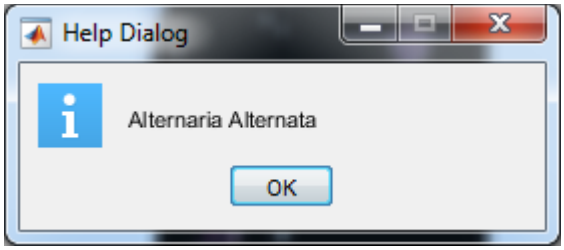

Fig 11: Final leaf disease classified

Once the cluster number is entered we will get the dialogue box as shown in the Figure 11 above. This indicates the name of the disease. Thus one can easily identify the type of the disease and can take appropriate measures to protect the yield.

From the results of work carried out it has been observed that the time taken by the SVM technique to classify the disease is 0.04sec and correctly classified accuracy is 72.92% and incorrectly classified percentage is 27.08%.

After observing various case studies to identify the type of disease using different classification techniques we came to the conclusion that SVM is one of the best classification algorithm.

5. CONCLUSION & FUTURE WORK

This project implements an innovative idea to identify the affected crops. The overall achieved accuracy of the proposed system is higher than 90.96% in line with the experimental results. Feature extraction technique helps to extract the infected leaf and also to classify the plant diseases.

As a part of the future work we are planning to embed voice navigation system that helps send a voice message to guide the person regarding the care he has to take to protect the crop once the disease is identified. Also to develop an open multimedia (Audio/Video) and deliver the information about various types of diseases and discuss about the solution to follow to protect the crops.

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