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Plant Disease Detection Using Different Algorithms

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***Abstract*—This paper discussing the technique based on digital image processing, which has been utilized for the detection and classification of leaf disease that is present on different agriculture plants. This will help to design different disease control strategy which will be beneficial in agriculture field. Automatic detection and analysis of disease are established on their particular symptoms and the cost intensity is very helpful for farmers. It is a major challenge for the early detection of diseases in agriculture science. An organism like fungi, bacteria, virus etc is the major causes of plant diseases so the enhancement of proper approach in certain areas is very necessary. All these studies are focused on the early detection and classification of the plant lesion diseases.**

***Index Terms*—Plant Disease, Image processing, Threshold algorithm, K-means cluster, Artificial neural network.**

I. Introduction

The external appearance is the most important quality character of agriculture. This outer appearance greatly affects the sale value and consumer behavior in buying any product. Therefore the inspection of quality and grading system are essential in agriculture field to cultivate good healthy plants. Agriculture industry can go through a major production and economic losses which is caused by the plant diseases. This disease management is a challenging task. Usually, the diseases or its symptoms such as colored spots or streaks can be seen on the leaves or on the stem of the plants. In plants, most of the leaf diseases are caused by fungi, bacteria, and viruses. The disease caused due to these organisms is characterized by different visual symptoms that could be observed in the leaves or stem of a plant. Usually, these symptoms are detected manually. Automatic detection of various diseases can be detected with the help of image processing. A crucial role is played by the image processing in detection of plant disease since it provides best results and reduces the human efforts. The image processing could be used in the field of agriculture for several applications. It includes detection of diseased fruit, leaf or stem, to measure the infected area by the disease, to determine the color of the affected area. The degradation of the quantity and quality of the product is affected due to the plant disease. The naked eye observation is done by the experts for the detection and identification of the plants. This detection and identification is time-consuming in huge farms or land areas. In this paper importance of image processing techniques in detection and analysis of plant diseases in the earlier stages and thereby the quality of the product can be increased was discussed.

II. Litrature Review

Many research papers are describing the advancement of image processing for a variety of methodologies. In medical field [1] has been presented an automated system based on Artificial Neural Network for detecting skin diseases. Whereas EK-Means Clustering, Gray Level Co occurrence Matrix, Back Propagation Network is used to detect Lung Tumor [5]. In agriculture field image processing has certain impact threshold value with help of random forest classifier apple fruit diseases are detected by K-Mean cluster technique and features are extracted by color and texture [2], for identification of the presence of diseases by observing the visual symptoms seen on the leaves of the plant [3] has been done with the use of soft computing approach. Reference [4] has been reviewed and summarized techniques of the image processing and machine learning that have been used in disease identification.

III. Methodology

The methodology is used in this paper are two different segmentation techniques such as thresholding and K-means clustering algorithm and classification technique such as Artificial neural network (feed forward back propagation). First the digital images of plant leaves are acquired form field using camera. Then image pre processing is done. After that two different segmentation processes are done to segment the original image and extract useful features to identify the infected parts of the plant leaf. After that classification technique was done using nf toolbox in MATLAB software. Image processing block diagram is shown in Figure1.

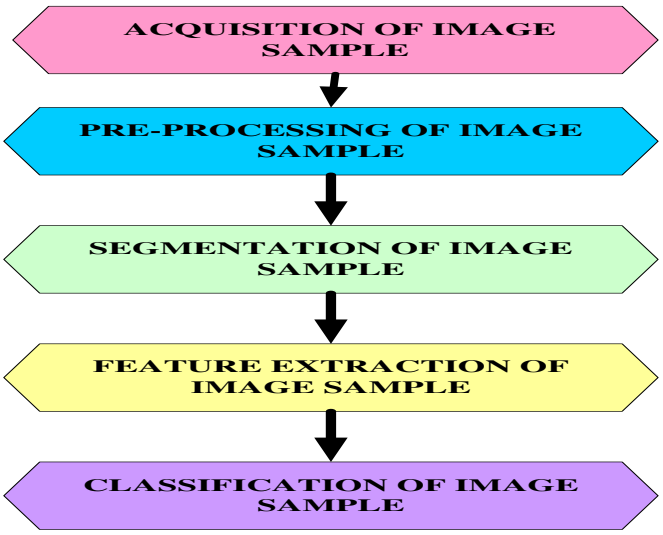

Fig. 1: ***Basic block diagram of Image Processing***

The proposed approach of the image segmentation such as thresholding algorithm, K- means cluster algorithm and classification technique based on ANN (feed forward back propagation) algorithms are illustrated below.
The RGB image of infected leaves was picked up. Figure 2 shows the sample of infected leaves. Figure 2 shows the different types of diseases in plant leaves such as Early Blight in potato leaf, Anthracnose in Custard apple leaf and Shoot blight in Mango leaf.

A. Acquisition of sample image
Image of contaminated plant leaves are collected using a camera. These images are in the form of RGB (Red, Green, and Blue).

B. Pre-processing of sample image
Per-processing is a progress of the image data that overcome non essential distortions or enhances some image feature necessary for another processing. Image cropping is done to get the interested region. Image enrichment is done for increasing the contrast of the image. Colour conversion of RGB to Gray image is done using following equation:

$$f(x) = r*0.2989 + g*0.5870 + b*0.114$$

After that histogram comparison is done which allots the intensities of image is activated on the image to improve the infected leaf image.

C. Segmentation of sample image
Partition of image into different parts of same features is called segmentation. The segmentation can be done using Thresholding, K-mean cluster, Otsu's method, converting RGB to HIS model etc.
a)Thresholding technique:
Image thresholding is an effortless and efficient way of distribute an image into a foreground and background.

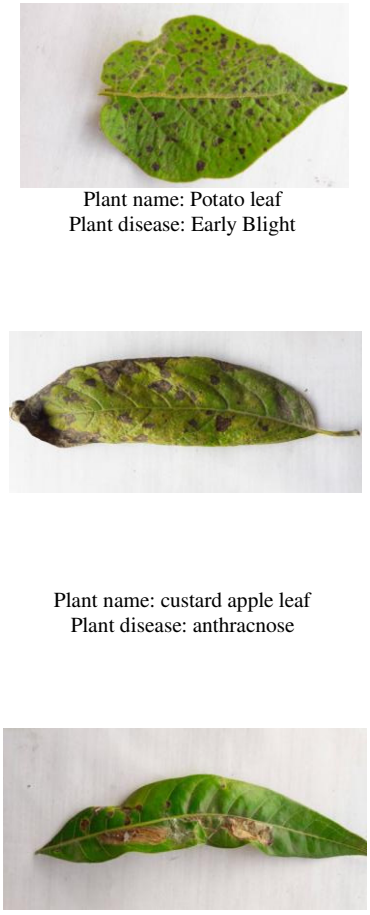

Fig. 2: ***Sample images of Infected Leaves***

This is a type of image segmentation technique that segregates objects by transforming grayscale images into binary images. This is most efficient in images with high levels of variation. Choice of threshold value is the key parameter in the thresholding process.

The procedure for Thresholding Algorithm is given below:
Step 1: Initial estimation of threshold value (T).
Step 2: Segmentation using threshold value (T):
a.) A1, if pixels are brighter than threshold value (T).
b.) A2, if pixels are darker or equal than threshold value (T).
Step 3: Calculation of m_1 and m_2 of A1 and A2 which are the average intensities.
Step 4: $T_{new} = (m_1 + m_2)/2$; where, T_{new} is new threshold value.

Step 5: If difference of threshold value and new threshold value is greater than ΔT then go back to step 2 or else stop the iteration.

$$|T - T_{new}| > \Delta T$$

Where, T = Threshold value

T_{new} = New threshold value

b) K means cluster technique:

In this analysis, for the distance measure, Standard Euclidean distance is used. Mathematically, given a dataset $(x_1, x_2, ..., x_N)$ where, N= number of elements, the K means clustering algorithm assemble the data into K clusters. Analysis of the Euclidean distance has been done as the distance measure; it is then given as:

$$d = (\sum_{j=1}^{N} \sum_{i=C_j} (x_i - z_j)^2)^{1/2} \quad (1)$$

Where, $C_j = jth$ cluster

z_j = centroids of the cluster

C_j and x_i = input pattern.

The procedure for K-Means Clustering Algorithm is given below:

Step 1: Put K points into the space represented by the elements $(x_1, x_2, ..., x_N)$ that are being clustered. These positions signify initial cluster centroids $(z_1, z_2, ..., z_K)$

Step 2:

IF $|x_i - z_p| > |x_i - z_j|$

$j \neq p$ and $p = 1,2,\ldots,K$

then appoint each element $(x_i, i = 1,2,..., N)$ to the group that has the closest centroids to cluster $C_j, j \in (1,2,..., K)$ can found.

Step 3: When all elements have been appointed, again calculate the positions of the K centroids.

As follows:

$$z_i^* = (1/N_i) \sum_{j=1}^{C_i} x_i \qquad i = 1,2,\ldots,K$$

z_i^* indicates new centroids, for N_i no. of elements belongs to C_i cluster.

Step 4: If $z_i^* = z_i, \qquad i = 1,2,..., K$

then stop or else continues from step 2 until the centroids will not move. This produces a partition of the elements into cluster from which the metric to be minimized can be calculated.

D. Feature Extraction

For identification of an object feature extraction plays an important role. Feature extraction is used in many applications. To detect plant disease colour, texture, edges and morphology can be used.

E. Classification

a) Artificial neural network:

After completing feature extraction technique, then neural network is used to classify learning database image. Neurons in ANN are feature vectors. The weighted sum of the inputs is the output of the neuron in the function.

b) Back propagation:

To train the artificial neural network back propagation is the one of the method which is combined with gradient descent optimization technique. This method analyzes the gradient of a loss function with respects to all the weights in the network. In a recurrent network Back propagation algorithm artificial neural network is used. Once it trained, the neural network weights are fixed and it can be used to calculate output values for new test images which are not present in the learning dataset.

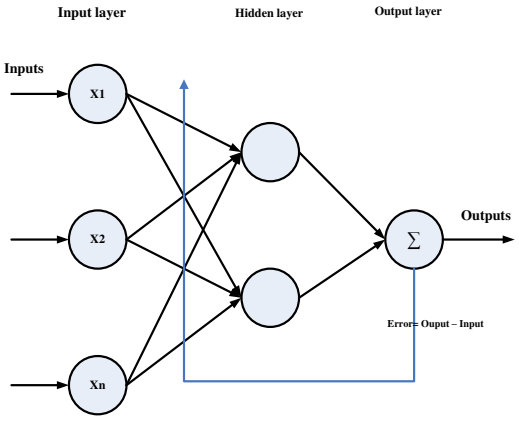

Fig. 3: ***Basic diagram of Back propagation neural network***

IV. RESULT

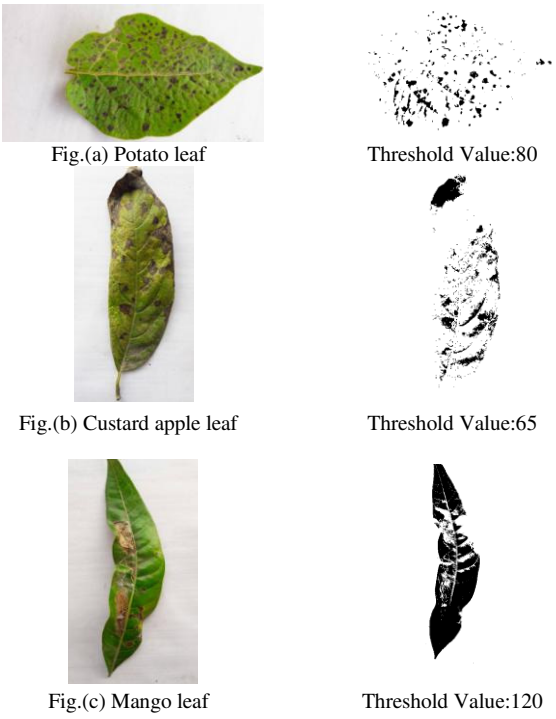

Fig.(a) Potato leaf — Threshold Value:80

Fig.(b) Custard apple leaf — Threshold Value:65

Fig.(c) Mango leaf — Threshold Value:120

Fig. 4. ***Output of Thresholding method***

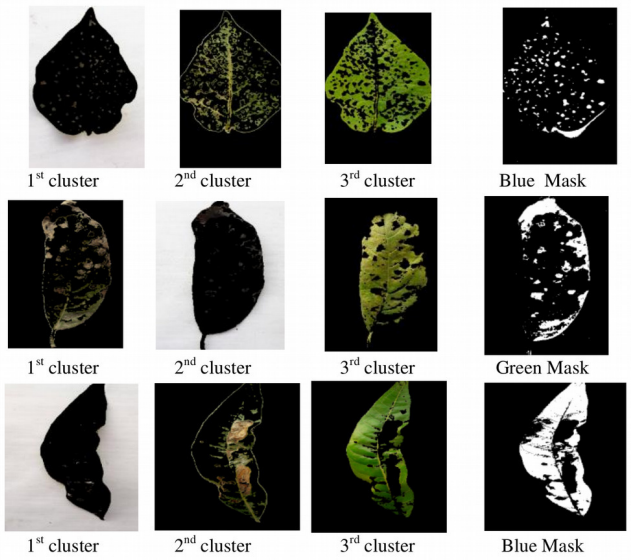

Fig. 5: ***Output for K-Mean cluster algorithm***

TABLE 2: PERFORMANCE ESTIMATION OF K-MEANS CLUSTER USING EUCLIDEAN DISTANCE METRIC

Dataset	Recognition speed (%)				
	Number of clusters				
	3	**6**	**10**	**14**	**20**
Potato	33.33	36.66	41	44.28	46
Custard apple	70	78.33	82	89.28	89.50
Mango	50	58.33	65	67.85	68

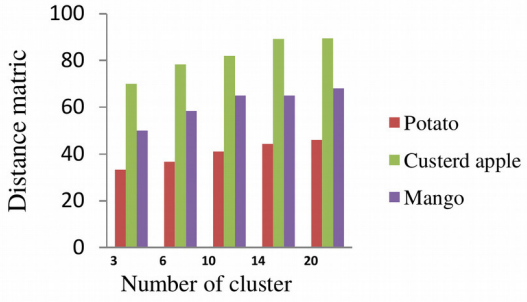

Fig. 6: ***Distance metric of infected plant sample***

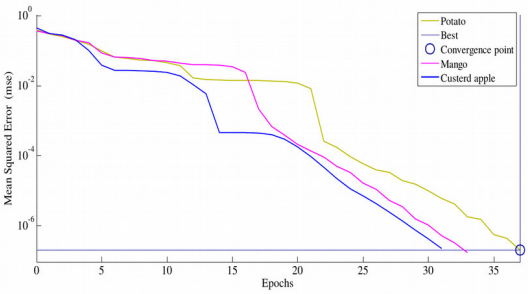

Fig 7: ***Mean square error (MSE) plot***

V. CONCLUSION

Paper presenting identification of the disease is main the purpose of proposed work. Different segmentation technique has been used for identification of plant leaf disease. Clustering and classification of plant leaf diseases have been formulated by the applications of image thresholding, K-means clustering and Neural Networks (NN). The different algorithm was tested on different diseases influence on the plants. With the experimental results which significantly support an accurate result in less computing time is neural network which give best accurate result compared to others.

VI. REFERENCE

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