Diagnosis of Phyto Pathology in Pomegranate Plant Diseases using Fuzzy-C-Means Algorithm

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***Abstract*— In many states pomegranate is a fruit in the market one of the most profits gaining fruit. The plants are affected by various diseases it destroy the entire crop and it tends very less product yield. The neural network technique and an image processing to deal with the main issues of phyto- pathology. Due to the bacteria, fungus, and the climatic condition the pomegranate fruit and leaves are also infected . Due to these bacteria the Fruit root, Bacterial Blight, Leaf spot and Fruit Spot diseases would segmentation. The features are extracted by using GLCM method, and the features are given to the artificial neural network the results would be accurate and the overall accuracy is up to 90%.**

***Keywords*— disease detection and categorization; Pomegranate plant diseases; Fuzzy C means segmentation; GLCM technique; Artificial neural network.**

I. INTRODUCTION

In the horticultural sector from the past few years wide range of improvements would happened all over the world .There are varieties of fruits are exported with the cold storage facilities ,so we have to maintain the highest export quality for the inspection by the food experts ,But the process would be very expensive and for the transportation the time consuming is very high .The precision agricultural helps to the farmers to know the economical information and gives a good exposure in various fields .The main objectives for precision agriculture is profit gain, agricultural systemization and prevent the environmental damage .The pomegranate is a fruit , the tree grown in both arid and semi arid regions .In the recent years the production yield for the pomegranate will be decreased due to the fungi and bacteria the profits will decreased in high range and the production is also be decreased .The proposed work beyond fuzzy C mean clustering .The database is predefined depending on the database the infected fruits and leaves images are segmented by using fuzzy C means clustering .The GLCM method is used for feature extraction for training the neural network the back propagation algorithm is used the images are tested by using this back propagation algorithm .The accuracy is much satisfactory in this method.

II. DIFFERENT DISEASES OF POMEGRANATE PLANT

A. Bacterial Blight

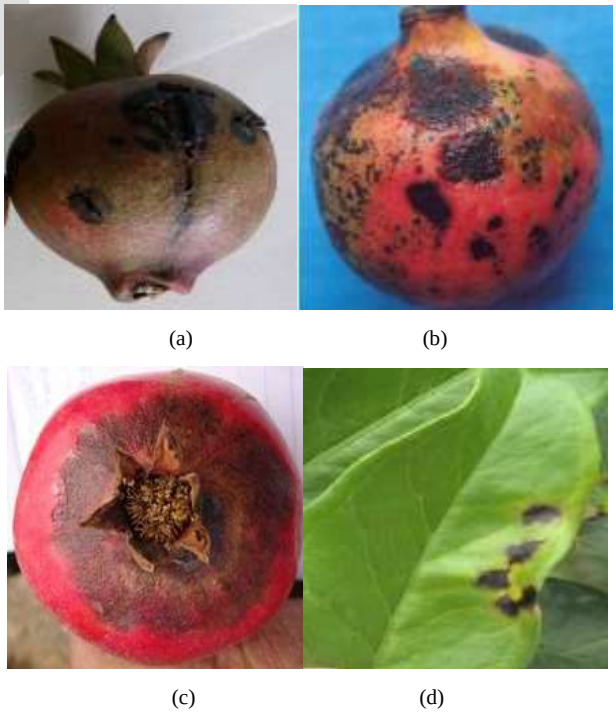
It is the most dangerous diseases of the pomegranate .the stem part was firstly effected by the Bacteria and later on it is spread to the leaves and the fruits . in this bacterial blight diseases the brown and black spots are appeared in the fruit .it is shown in figure (a).

B. Fruit Spot

The Light brown spots on fruit it may causes the plant death. And it is caused by fungus. Itshown up to 5-60%. It is favored by rainfall and water saturated soil. It is shown in figure (b).

C. Fruit Rot

This disease occurs to the calyx part of the fruit, it will damage the flower and it prevents the fruit to be set. The fruits are drop prematurely. The seeds of the fruit is also be effected. Rainy season is favor for this disease and it shows 13-14% sensitivity on the field.



(a) (b)

(c) (d)

Fig.1: Different Sample Images of the Pomegranate Plant Diseases

D. Leaf Spot

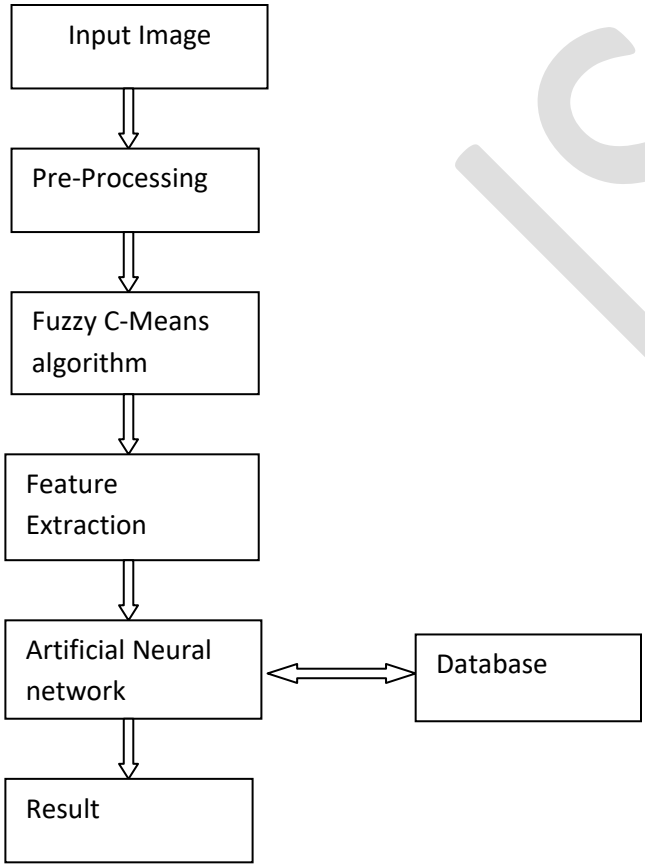
It is appeared on the leaves, the sensitivity is up to 8-60%.the water saturated oil and the rain fall is the favorable conditions for this diseases. This diseases look like black elliptical shape and it would be appeared to the leaves. it shown in figure (d).

III. METHODOLOGY

The image, preprocessing, k-mean clustering, feature extraction, artificial neural network, data base are the blocks of the block diagram in the given proposed system. For the feature extraction GLCM technique is used and in the neural network some images for test the neural network and some images are for training neural network.

A. *Creation of Database and Image pre-processing*

The images are directly taken from the farms. These images consists both infected and healthy pomegranate fruit images also, but in the preprocessing of digital images have some noises these are like Gaussian noise , pepper noise , white noise and salt noise for removing these type of noises we are using filters .



Block Diagram

B. Segmentation

for the segmentation purpose of an image we are using fuzzy c-mean clustering which is used to segment the images to different regions of different objects

Fuzzy C – means Clustering Method (FCM)

Fuzzy C – means method proposed by Y. Yang [97] is an iterative clustering method for color image segmentation. In this method pixel can belong to more than one cluster and set of membership level is associated with each pixel. FCM requires cluster center along with objective function. FCM generates fuzzy partition matrix.

Objective function for FCM is

$$J_{FCM} - \sum_{j=1}^{r}\sum_{i=1}^{c} \left(u_{ij}\right)^{q} \; d^2(p_j, u_i)$$

where $p = \{p_1, p_2, \ldots p_n\} \in R$

n- Number of data points

c – Number of clusters, $2 \leq c \leq n$

U_{Ij} - degree of membership of p_j in I^{th} cluster

U_I - prototype center of cluster 'I '

Q - weighting exponent of fuzzy member

$D^2(p_j, u_i)$- distance between the object p_j and cluster u_i

C. Feature Extraction

The energy , co-variance some entropy, difference entropy inverse difference information measure of co relation contrast are some statistical features so, for extracting these statistical features we are using gray level co-occurrence matrix(GLCM).The first second and higher order statistical features are categorized by number of intensity points in each combination.

- $G_{Ij} = (I, j)^{th}$ entry in GLCM
- $N_g =$ number of distinct gray levels
- $G_x(I) = i^{th}$ entry in marginal probability matrix obtained by summing rows of

$$g_{ij} = \sum_{j=1}^{N_g} g(i,j)$$

Energy

It Measures the textural uniformity. It reaches a maximum value when the gray level distribution has a same form.

$$E = \sum_{i=1}^{N_g}\sum_{j=1}^{N_g} g_{ij}^2$$

Covariance

It is a measure of heterogeneity. It increases when the gray level values vary with their mean.

$$cov = \sum_{i=1}^{N_g}\sum_{j=1}^{N_g}(i-\mu)^2 g_v$$

Sum entropy

It is the sum of the entropy values and it is a second order statistics feature.

$$se = -\sum_{i=2}^{2N_g} g_{x+y}(i)\log(g_{x+y}(i))$$

Difference entropy

It is the difference of the entropy values and it is a second order statistics feature.

$$de = -\sum_{i=1}^{N_g-1} g_{x-y}(i)\log(g_{x-y}(i))$$

Entropy

It Measures the disorder or complexity in image. It is large when image is not texturally uniform and GLCM features have very small values.

$$e = -\sum_{i=1}^{N_g}\sum_{j=1}^{N_g} g_{ij}\ \log_2(g_{ij})$$

Inverse Difference

It measures image homogeneity as it assumes larger values for smaller gray tone differences. For same pixels in an image, it shows the maximum value.

$$id = \sum_{i=1}^{N_g}\sum_{j=1}^{N_g}\frac{1}{1+(i-j)^2} g_{ij}$$

Information Measure of Correlation

It is a measure of gray tone dependencies in the image.

$$inf2h = \sqrt{(1-\exp[HXY2-HXY])}$$

$$HXY = -\sum_{i=1}^{N_g}\sum_{j=1}^{N_g} g_{ij}\quad \log_2(g_{ij})$$

$$HXY2 - \sum_{i=1}^{N_g}\sum_{j=1}^{N_g} g_x^{(i)} g_y^{(j)}\quad \log_2(g_i(i)g_y(j))$$

Contrast

It measures spatial frequency. It is the difference between the highest and lowest values of adjacent set of pixels

$$c = \sum_{i=1}^{N_g}\sum_{j-1}^{N_g}(i-j)^2 g_{ij}$$

A. Neural Network

Neural networks uses multilayer perceptrons (MLP) and it provide parallel processing. The Multilayer Perceptrons (MLP) are used to solve some problems. It uses technique with an algorithm .this technique based on error-correction learning rule and this rule will be called as back propagation rule.

Back-propagation algorithm

Back-propagation algorithm (BPA) is based on widrow-hoff rule. There are three phases in the back-propagation rule the first one is training phase , it is about the inputs and the targets .the second phase is recall phase, it is recall the process and check the accuracy of the process. The third one is generalization phase, in this the network is check the accuracy of the process. The back propagation trains the neural network for given input with the known classification of it. The input sample is given to the network and it generate the output of that input sample, the output of that input sample is compared with the desired output if it matches the output is generated. If not the error is generated. the error output of input sample is feedback to the hidden layer using back propagation depending on that error connection weights are adjusted. These weights are adjusted to the mean square output response to the given input sample. Repeat the process for input sample until error become minimum. W is the weight of the error, x is the input sample.

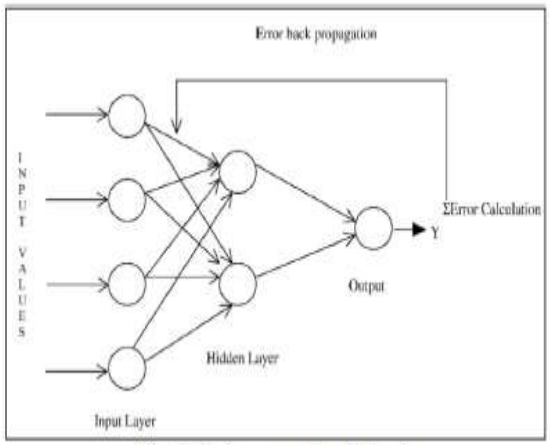


Fig. 3: Back-propagation Network

$$\Delta w_{i,j}(n) = (\eta)(\delta_j(n)(y_i(n)))$$

Where , ΔW i j (n) is the weight correction, n is the learning rate parameter, ∂j (n) is the local gradient y i(n) is the input signal of neuron .

IV. RESULTS

The database of 500 images is created for the experimental work. Fuzzy c means segments the image into 4 clusters. Here, k=4.because it is a proper cluster. From the GLCM method is for feature extraction. From these features, neural network is trained by different images so it helps to compare the different diseases of images, namely Good Fruit, Fruit Spot, Bacterial Blight, Fruit Rot, Good Leaf and Leaf Spot.

Five sample images, the Table I shows sample of the different pomegranate plant diseases classification of different pomegranate plant disease samples. All the samples of good fruit and good leaf categories are giving proper result. But for fruit spot bacterial blight, fruit rot and leaf spot categories, one sample each shows the improper result. the accuracy of the proposed method comes to be around 90%.

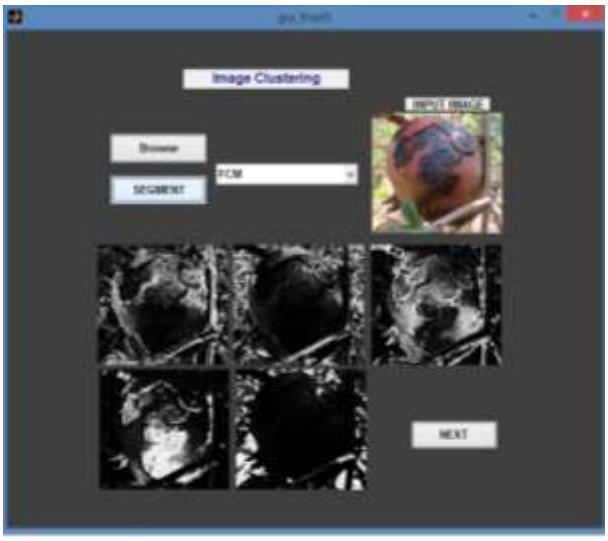


TABLE I: Classification of Different Pomegranate Plant Diseases

samples	Good Fruit	Fruit Spot	Bacterial Blight	Fruit Rot	Good Leaf	Leaf Spot	Out Casted
5 Test images (Good Fruit)	Yes	-	-	-	-	-	-
6 Test images (Fruit Spot)	-	Yes	-	-	-	-	Yes
7 Test images (Bacterial Blight)	-	-	Yes	-	-	-	Yes
7 Test images (Fruit Rot)	Yes	-	-	Yes	-	-	-
5 Test images (Good Leaf)	-	-	-	-	Yes	-	-
8 Test images (Leaf Spot)	-	-	-	-	Yes	Yes	-

VI. CONCLUSION

The Bacterial Blight, Fruit Spot, Fruit Rot and Leaf Spot are classified and detected by using digital image processing and neural network. The good fruit and good leaf gives 100% result, leaf spot gives 87.50%, bacterial blight gives 85.71% while fruit spot fruit rot gives 83.33% result. The proposed work satisfactory results and gives90%accuracy.

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