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# Detection of Plant Diseases by analyzing the Texture of Leaf using ANN Classifier

Dr. Gajula Ramesh[1], Dr. D. William Albert[2], Dr. Gandikota Ramu[3]
[1,3]*Associate Professor,* [2]*Professor*
[1,2,3]*Department of Computer Science and Engineering*
[1]*GRIET, Bachupally, Hyderabad-500090*
[2]*Siddharth Institute of Technology, Puttur, Andhra Pradesh*
[3]*Institute of Aeronautical Engineering, Hyderabad*

***Abstract***

*The plant disease detection and analysis are constrained by human's visual potential as it entirely depends on microscopic behavior. The computer-based image reorganization schemes are implemented in accurate classification and identification of plant diseases. Disease Detection operation is performed by k-mean clustering operation on captured real time leaf image. Once the detection has been done its features are extracted by GLCM filter. Generally, classification is done by SVM based approaches, but it is having the low accuracy towards texture features. To implement features based matching operation, an advanced artificial intelligence based Back Propagated ANN approach is adopted for classification. The proposed approach is implemented in MATLAB environment, and the accuracy of this methodology is much better that conventional approaches.*

***Keywords:*** *Segmentation, gray-level cooccurrence matrix, KNN classifier, support vector machine and artificial neural networks.*

## 1. INTRODUCTION

The making of better-worth food production and growth in harvest capitulate are demanding for the agriculturists such as agro-scientists. To meet the growing demands globally, it is necessary to do the research in image processing-based engineering sectors to analysis the crops through camera sensors from remote locations. With the implementation of image processing techniques, possibility to reducing errors and costs for achieving ecologically and economically sustainable cultivation is major consideration of the present period [1-3]. Previously utilized approaches are incompetent and mostly time-power overriding for evaluating the troubles and accomplishment of corrective metrics to analyze the accuracy of the system. Unhealthy plants and corresponding leaf's show signs of a diversity of indications similar to yellowing, wilted, stunt, reddening, falsification, blight, browning and additional irregularities all this happened due to color change due to effects of temperature and lack of water and fugal, bacterial and viral infections [2-5]. Thus, accurate diagnosis is essential for detection and classification of plant diseases to avoid the misjudgment. In anticipation of a disease syndrome is sufficiently detect, a farmer might dissipate moment in time and vigor in addition to funds to resolve a difficulty by means of an unidentified reason Once a disease is diagnosed, appropriate management practices can be selected [6-8]. To conquer this difficulty a quick and perfect development is essential; it can without human intervention notice the disease syndrome of leafs. So, Digital image processing technique is proven to be an effective method as compared to visual analysis. However, existing approaches suffered due to the lack of detection and classification accuracy. Thus, to improve the performance efficiency of disease detection and accuracy of classification, this article presented ANN-based plant leaf disease detection and classification using segmentation and texture feature extraction with image statistics. Rest of the paper is as follows: section 2 describes the brief literature work in the field of plant leaf disease detection and classification. Section 3 explains proposed back propagated ANN-based approach for detecting the affected area in the leaf and how to classify the type of disease. Section 4 describes the simulation results and discussion. Section 5 is about conclusion followed by bibliography.

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## 2. LITERATURE SURVEY

In the modern era, enhancement in the use of internet attracts the science and engineering techniques to get easy and quick solution, as, it is most efficient and effective way of communication. Therefore, Korkut UB et al. (2018) developed a web-based tool for identifying pomegranate leaf disease. In the first step, feature extraction (based on color and morphological features) was done. Thereafter, to segment the diseased part from healthy region k-mean algorithm and SVM was used. Accuracy achievement in this method was 65% [1]. Segmentation was done using genetic algorithm to distinguish diseased part and the healthy parts of the leafs. This algorithm was tested on ten species of plant i.e. Jackfruit, Banana, Mango, Sapota, Potato, Beans, Tomato, Lemon, etc. to check the accuracy of proposed algorithm. The author accomplished that the algorithm provides optimum results with less computational efforts in recognition and classification of leaf disease. Shima Ramesh A et al. (2018) proposed a machine learning technique for automatic detection and classification of Sugarcane leaf disease using image processing technique [2]. Infected leafs were captured by using digital camera. After then, the preprocessing and segmentation was done using image histogram equalization, filtering, color transformation to detect infected parts of the leafs. Finally, SVM classifier was used for classification purpose. Decimated wavelet [9], [19] redundant discrete wavelet [10-12] can also be utilized for low-level feature extraction from plant leaf and further clustering or segmentation algorithm can be employed for efficient disease detection and identification.

## 3. PROPOSED METHOD

The basic operational detail of the plant disease detection and classification is represented in figure 1. The operation is explained below


Fig. 1 Architectural diagram of proposed system

### 3.1. Image Acquisition

The impression of images is the primary and essential step to observe the state of the Groundnut leaf. The image imprisonment has been done through various tools and devices, such as, cameras, mobile phones and satellites. The proper estimation of RGB color pixels in an image is essential step towards successful completion of image capturing. The technical parameters of these simple, handheld devices such as light sensitivity of the photosensors, spatial resolution and digital focusing have improved dramatically year after year. Today, nearly every person, farmer or plant pathologist carry these modern and sophisticated devices such as digital cameras together with a mobile phone or tablet computer[13-17].

### 3.2. Image Pre-Processing

The pre-processing follows the image acquisition. The acquisition of images and creating images database, pre-processing has been done. The pre-processing of created database is a preliminary step to eliminate the undesired distortion of the image and provides enhancement in features. While considering leaf of a plant, various colors have been observed. To distinguish the color of the diseased lesion from the original color of leaf, the RGB color pixels should be converted into some other pre-processing for the better perception. The reason for unacceptability of RGB is the system dependency of such pre-processing. Therefore, the improvement in the precision of color for detection of disease, the independency of pre-processing is essentially required.

### 3.3. Image Segmentation

Segmentation of an image is the process of partitioning the object (diseased spot) from its background (leaf). Different segmentation techniques are available like clustering methods, thresholding, edge detection, ANN based methods, partial differential equation-based segmentation, etc [18]. In the present paper k-mean clustering technique for segmentation has been given the priority among all of the above stated techniques. The inherent advantages of k-mean clustering method are that, it works well with large


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data sets. The accuracy of system depends on the data sets. Therefore, this (k-mean clustering) proves to be fast, robust, easier to understand and simplest to implement. Furthermore, it may work more efficiently; if clusters are spherical (diseased spots are spherical in shape) and more in number. Increased value of the k (cluster) reduces the amount of error in the result. Current work has a value of five for k. The formations of clusters have been done based on the selection of five random points selected from the data sets. These five random points treated as centroids of each cluster. These random points attract the same intensity points (based on Euclidian distance method). This movement of the centroid happened till the same intensity cluster formed and can't move further. The ultimate end results come in the form of diseased and healthy parts of the leafs. After segmentation, one of the diseased clusters (obtained from one or more than one cluster) has been extracted and considered for calculation of the disease area of the leaf.

### 3.4. Feature Extraction

At this stage of the paper we calculate the Gray Level Co-occurrence Matrix of an image in order to extract the set of features required for further calculations. In an arithmetical and statistical texture approach, texture consistency features are calculated based on the statistical geometric allocation for intensity of pixel at a known location comparative to other pixel in the image matrix. Based on the number of dots or pixels in each arrangement, it comprises of the multi order statistic features such as primary-order statistic features, subsequent-order statistic features and superior-order statistic features. Spatial dependence-based Texture and statistic Feature extraction using gray-level cooccurrence matrix (GLCM) is the subsequent -order information, it will be utilized to analysis the picture as texture entity. GLCM is a group of the spatial frequency entities or how repeatedly a grouping of image brightens contrast standards in pixel occurrences. Altering the contribution information into the group of spatial and texture statistic features is described as feature extraction.

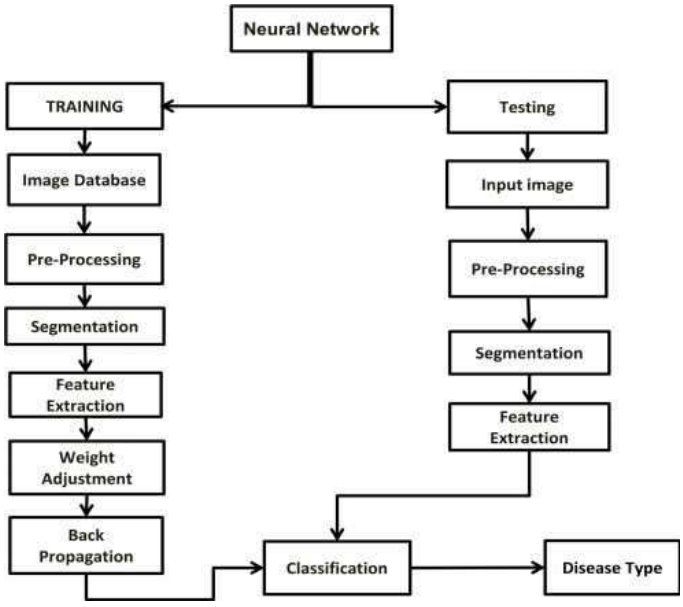


Fig. 2 Proposed plant leaf detection and classification system


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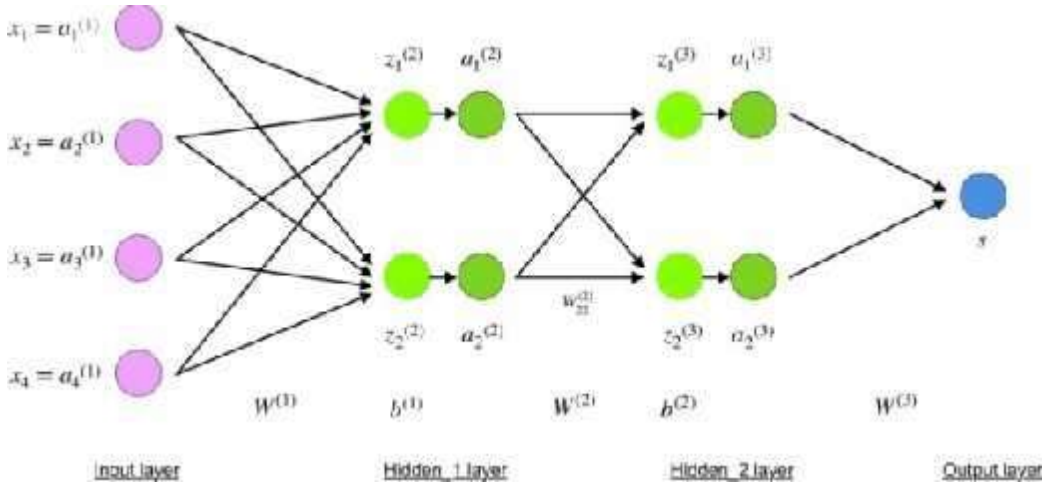
### 3.5. Classification using ANN

Figure 2 represents the detailed architecture of Training and Testing process using ANN. In the training process, on the plant image dataset consisting of more than 1000 images are performed. In this training process, initially pre-processing operation will perform for noise removal then enhancements, segmentation operation to detect the location of disease using k means clustering then detected location features are extracted using GLCM filter. Now the detected features are applied to weight adjustment process to create a sigmoid based model function for ANN back propagation model. The weights are altered based on the chronological relationship base on the multiple plant diseases. Then using these weights an artificial intelligence based back propagation model will formed. Whenever test image applied, its GLCM features are compared with the back-propagation model and classification operation will be formed. And classification results generate the type of disease with high accuracy.

### 3.6. Artificial Neural Network (ANN)

The major building block of figure 1 is the ANN, which is used for classification purpose. It is an artificial intelligence-based approach consisting of neurons as its processing elements. These neurons hold the weight maps to solve the critical issues and classify the diseases. To implement this weight




distributions, it is majorly depending on training operation on bulk amount of dataset. Thus, using this trained information, a random test objects either image or data will be applied on it. This operation is described as data classification or pattern identification. Training and Testing in image processing based digital environments; it requires the weight adjustments and its synaptic interconnections. The different combinations of weights will create the layer-based architecture as shown in Fig 3. The three major layers are Input, Hidden and Output layer.

Fig. 3 Back propagation model of ANN

**Input layer:** Every Weight map in the layer consists of predicted value. The input texture features are organized as a weight matrix here. As different types of texture features for different diseases are organized to create the weight model. Here x1, x2, x3, x4 can be treated as the different GLCM features, similar features from different diseases are grouped and fed to hidden layer.

**Hidden layer:** it is multi-layer architecture, here back propagation-based RBF kernel matrix will be created to classify the input layer information. Here a sigmoid control model will used to generate the weight matrix elements and its interconnections. Now, this weight matrix was created based on the similarity between the same categories of disease dataset of GLCM features, the similarity will be calculated by Euclidean distance criteria. Also, for different datasets of diseases relationship also identified here, in order to examine the test image features very precisely. If the test image features are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matched with the more than one classification, then sigmoid control based back propagation model gives the accurate outcomes.

**Output layer:** the output layer holds the classification outcome pattern; thus, it compares the hidden layer output pattern with the original training data set pattern, so it will identify its accuracy, sensitivity and specificity. By the parallel procedure of all layers will generate the effectual categorization outcome.

## 4. SIMULATION RESULTS

For simulation purpose four different categories of plant leaf are considered and trained using ANN through MATLAB R2018b simulation environment.

Fig. 4 Plant leaf dataset used for training the model

Figure 4 represents the training dataset with first row of images are belongs to Alternaria Alternata disease, second row of images are belongs to Anthracnose disease, third row of images are belongs to Bacterial Blight disease, fourth row of images are belongs to Cercospora Leaf Spot disease and finally fifth row of images are belongs to Healthy Leafs with no Healthy Leafs.

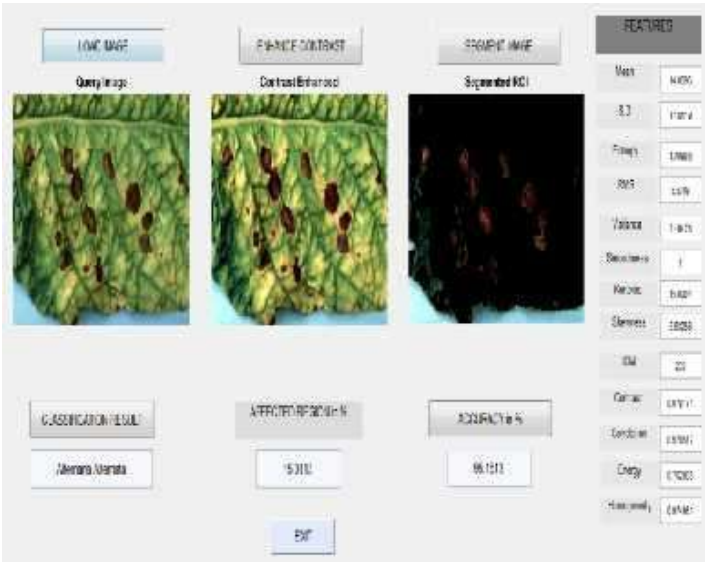

Fig. 5 Alternaria Alternata disease detection and classification


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Fig. 6 Anthracnose disease detection and classification

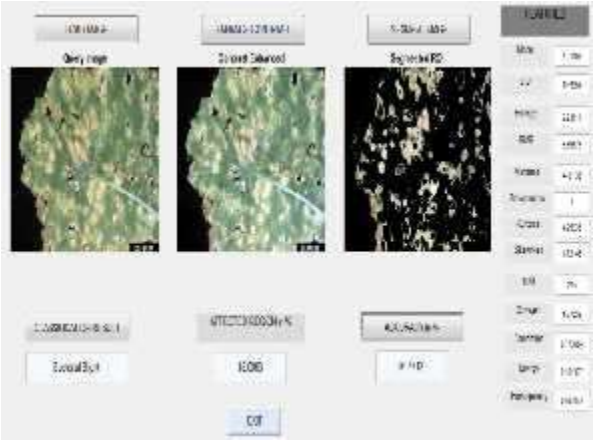

Fig. 7 Bacterial Blight disease detection and classification

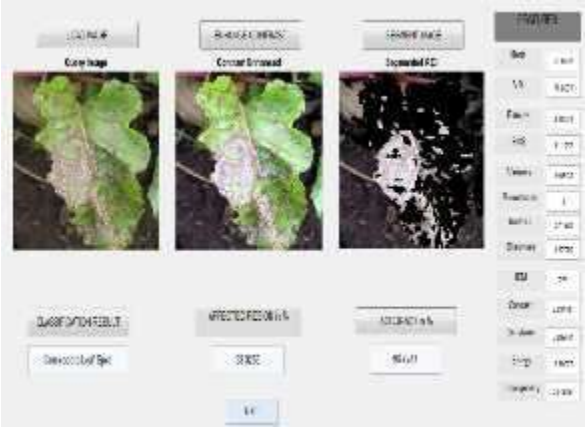

Fig.8 Cercospora Leaf Spot disease detection and classification


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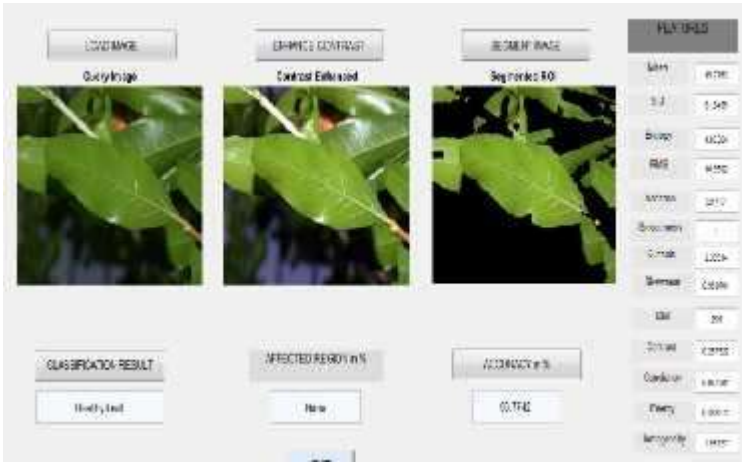

Fig. 9 Healthy Leaf detection and classification

From figure 6 to 8 represents the four types of disease detection and classification results. And Fig 9 represents the detection and classification operation on healthy leaf image. In each figure query image represents the test input image, contrast enhanced image represents the pre-processed and noise removal of input image. Then segmented ROI represents the disease detected location in original input image. Then its features such as mean, SD, Entropy, RMS, Variance, Smoothness, kurtosis, skewness, IDM, contrast, correlation, energy and homogeneity are extracted using GLCM filter are presented as column in feature window. Finally recognised disease type is shown in Classification result, with its affected region and accuracy of classification. Average of all those features and parameters are summarized in table 1. The quantitative and qualitative results show that our proposed method is performing much better in detection and classification compared to the existing SVM based classification.

Table 1:Performance comparison of statistical parameters for existing and proposed method

| **Parameter** | **SVM [1]** | **Proposed method** |
|---|---|---|
| Mean | 0.01 | 0.03 |
| Standard Deviation | 0.03 | 0.089 |
| Entropy | 2.14 | 3.17 |
| Rms Error | 1.15 | 0.089 |
| Variance | 0.2054 | 0.0080 |
| Smoothness | 0.57 | 0.920 |
| Kurtosis | 2.87 | 7.32 |
| Skewness | 0.839 | 0.469 |
| IDM | 0.024 | 0.057 |
| Contrast | 0.149 | 0.2088 |
| PSNR | 25.28 | 41.20 |
| Accuracy | 87% | 96% |

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| | | |
|---|---|---|
| Sensitivity | 67% | 83% |
| Specificity | 86% | 93% |

## 5. CONCLUSION

The paper majorly focused on deep learning method, such as Back Propagated based Artificial Neural Network Classifier for disease classification. As it is an Artificial intelligence-based approach, it has much accuracy, sensitivity and specificity compared to the conventional machine learning based SVM classifier. This paper also focuses on accurate detection of location in plant leaf's using k-means clustering and its GLCM feature extraction. Hence, it will give the better quantitative and Qualitative results than conventional approaches. This work also extends to implement the generalized disease classification for multiple diseases using deep machine learning approach.

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