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General Framework for Leaf disease detection approach of Betel Leaf using Image Processing Techniques

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Abstract: Betel leaves are the most useful leaf for health as well as for regional purpose. As the demand of betel leaves increase the farmers are moved towards the farming of Betel Leaves. But as these leaves are too sensitive, the leaf diseases disturb the farmer's financial income. This paper tries to suggest the general framework for betel leaf disease detection technique. The overall process is divided into multiple sub-processes. By implementing some or all of these sub-processes the leaf disease detection can be possible. Also, different techniques are also suggested using which each separate sub-process can be fulfilled differently.

Keywords: Betel Leaf, Leaf disease, Leaf Detection technique, Segmentation, Feature extraction, Classification

Introduction:

Betel leaves are casually consumed as "paan" whose role is as a mouth freshener. These Betel leaves are great source of nutrition. In tradition also, these betel leaves are used for "Pooja". Potential use of Betel leaves are for headache, cancer, fungal infection, gastric ulcers, diabetics, allergies, healing wounds, constipation etc.[1]. Day by day the demand of these leaves is increased. These leaves are too sensitive. They can easily suffer from diseases. Diseases on betel leaf degrades the quality of leaf. Once betel leaf suffers from disease, there is no use of this leaf. Two types of betel leaf diseases are there named Leaf rot means Anthracnose and Foot rot means Fungul Disease [2]. Fig-1 demonstrates these leaves.

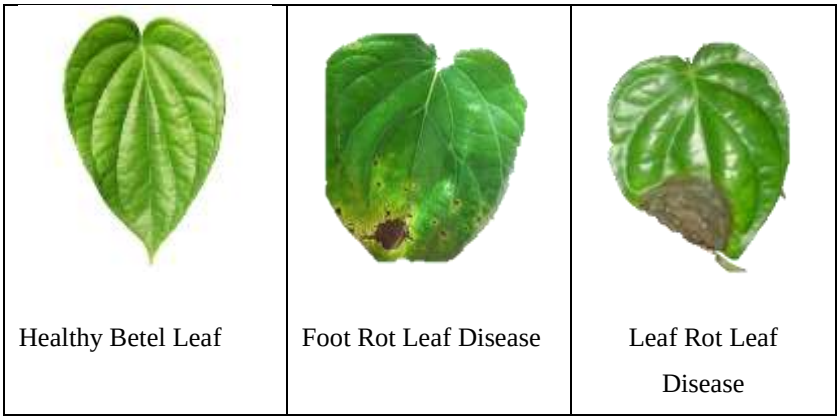

Fig-1 Original Betel Leaf with disease

There is a need to identify the disease of betel leaf which may help farmer in advance to take proper action at right time to overcome this problem in such a way that the same disease is not spread in large area of betel leaves. The author tries to detect the disease of leaf which may help farmer.

Literature Review:

Hridoy et. al. [2] had worked under the issue of betel leaf disease detection. Authors had prepared dataset and then implemented advanced CNN and achieved upto 96.02% accuracy. Basavaiah et. al.[3] had worked with same issue for tomato leaf. Fusion of multiple features named color histogram, Hu-moments and Haralick are used to train model. Random forest as well as decision tree classification algorithms implemented for classification. Accuracy is achieved up to 94%. Pranjali B. Padol et.al. [4] had worked for grapes leaf disease detection. Authors internally divided the processes as data collection, pre-processing, segmentation, feature extraction and classification. Thresholding and gaussian filter were used as a part of pre-processing. Segmentation is done using K-mean algorithm. Features are extracted by converting RGB image to HSV and then mean was calculated. For classification, Linear SVM technique was used. Upto 88.89% accuracy was achieved. Ümit Atila et.al. [5] had worked with leaf disease detection using deep learning and achieved upto 98.42% accuracy with original dataset. Iqbaldeep Kaur et.al. [6] had worked for leaf disease detection. The image dataset is prepared. Image contrast is boosted using Histogram Equalization, segmentation is done using k-mean clustering algorithm, features are extracted using gray level occurrence matrices and for classification-SVM and ant colony optimization technique is applied for optimization. Accuracy level is achieved up to 98.42%. Pooja Pawar et.al. [7] worked for Cucumber leaf disease identification. The dataset was prepared, smoothing filter is applied as a part of pre-processing for noise removal, texture features are used for training purpose using mean, standard deviation, kurtosis and skewness, and gray level co-occurrence matrix features and classification was done using ANN. Accuracy was achieved up to 80.45%. Ahmed, Kawcher et.al. [8] also worked for rice leaf disease detection. The classification was done using NN and classified the image with leaf smut, bacterial leaf blight and brown spot diseases. K-Nearest neighbour, decision tree, naïve bay and logistic regression algorithms were implemented for classification. Accuracy was achieved up to 97%.

General Framework for leaf detection technique:

As per above mentioned study, the overall detection process is internally divided into multiple sub-processes which are discussed here. Some or all of the mentioned steps are followed by the researchers to fulfil the purpose. The diagrammatically, the framework is presented in Fig-2.

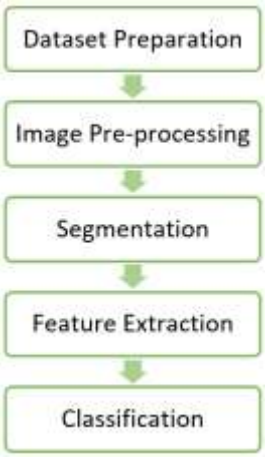

Fig-2: Framework for leaf detection technique

1. **Dataset Preparation:**

   A dataset of betel leaf is created using Digital camera These include images of healthy betel leaf, foot rot leaf, leaf rot leaf and other diseases leaf. All these images are stored with 512x512 size.

2. **Image Pre-processing:**

   There is a need to apply pre-processing to above created dataset to prepare the image for detection process and to remove the noise. So first, the color image which includes 3 color channels named Red, Green and Blue which are not required for detection process so color images are transformed to gray-scale image which is presented as single plan with proper content. The images which may include some noise then for clearing of these noises, some filters can be applied to these gray-scale images. Noise can be removed from image using Mean filter, Median Filter, Low-pass Gaussian Filter, Wiener Filter, Adaptive Filter [9].

3. **Segmentation:**

   After implementing Pre-processing to the image, the required part from the image is only the Betel leave which is available within image. So, there is a need to extract the leaf content from the image. It means for the disease detection process, there is no need of background of the image. Using segmentation techniques, the specific object can be extracted from the image. There is a need to identify the region within image where the leaves are presented. Thresholding based, Edge based, Region based, Energy-based segmentations are possible. Edge based Gradient operator, 2^{nd} derivative operator, Optimal edge detector are the technique through which the segmentation can be possible. Region based Region growing, Region splitting & merging and clustering through segmentations are possible. Energy based Active contour, Graph normalize cut, Graph cut and Graph local cut segmentations can be applied to the image [10]. K-mean clustering technique can be used for segmenting image [4].

4. **Feature Extraction:**

   Once the leaf is extracted from the image, there is a need to extract parametric features of this leaf. The features of image can be extracted using image processing techniques like Histogram, Gradient feature, Principle Component Analysis, Singular Value Decomposition etc.. . For leaf features, histogram can be useful, for shape feature extraction Hu-moment as well as for texture feature extraction Haralick features can be extracted which can help for classification process [3].

5. **Classification:**

   The classifier is used to classify the segmented leaf means image as Healthy leaf or weak leaf with the help of extracted features. Classification can be done using supervised neural network classification algorithms like logistic regression, K-nearest neighbour, Decision tree and Naïve Bayes classifier[8] , convolution neural network[2] , deep learning[5], linear support vector machine [4][6], artificial neural network [7] etc.

Conclusion:

The general framework is suggested in this paper which includes dataset preparation, image pre-processing, segmentation, feature extraction and classification. Also, the different image processing techniques are shown for solving specific sub-process. It is concluded that when the neural network or deep learning concepts are used for classification then directly the features are extracted from the image and it is used to train the model. As per the mentioned techniques for each sub-processes, authors are planned to experiment different techniques to solve the issue.

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