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Image processing for disease diagnosis in plant leaves- developing an intelligent system for diagnosis of diseases of various plants leaves using image processing

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Abstract
Agriculture is a key source of livelihood. Agriculture provides employment opportunities for village people on large scale in developing country like India. India's agriculture is composed of many crops and according to survey nearly 70% population is depends on agriculture. Most of Indian farmers are adopting manual cultivation due to lagging of technical knowledge. Farmers are unaware of what kind of crops that grows well on their land. When plants are affected by heterogeneous diseases through their leaves that will effects on production of agriculture and profitable loss. Also reduction in both quality and amount of agricultural production. Leaves are important for fast growing of plant and to increase production of crops. Identifying diseases in plants leave is challenging for farmers also for researchers. Currently farmers are spraying pesticides to the plants but it effects human directly or indirectly by health or also economically. To diagnose these plant diseases many fast techniques need to be adopt. In current days the image processing models are suitable, efficient and reliable field for diseases diagnosis with the help of plant leaf images.

Keywords: leaves- developing, disease diagnosis

Introduction
India is an agricultural country and Indian economy is dependent on agricultural productivity wherein about 70% of the population depends on agriculture. Agriculture endows near about 20% to the total GDP recent study by Economic survey 2020-21 [1] and provides employment to over 60% of the population of this country. Therefore diagnosis of plant diseases plays an important role in the area of agriculture. Farmers have wide range of diversity to select suitable fruits and vegetable crops like rice wheat, potato and oilseeds etc and non-food items like cotton, rubber etc. Plant diseases have turned into dilemma as it can cause significant reduction in both quality and quantity of agricultural products [2]. All these crops grow based on the strength of leaves, roots and there are various things that lead to different diseases for the plant leaves, which spoiled crops and finally it will effect on economy of the country. Various types of diseases can kill plants leaves. These big losses can be avoided by early identification of plant diseases. In current days the image processing models are suitable, efficient and reliable field for diseases diagnosis with the help of plant leaf images. The image processing can be used in agricultural applications for following purposes:

1. To diagnose diseased leaf, stem etc.
2. To quantify affected areas.
3. To determine the shape and color of affected areas.

Automatic and intelligent diagnosis of plant diseases is an essential research topic as it may prove benefits in monitoring large fields of crops, and thus automatically diagnose the symptoms of diseases as soon as they appear on plant leaves. Therefore looking for fast, intelligent, automatic, less expensive and accurate method to diagnose plant disease can save time and economy of the country.

Background and justification
Many researches had done research on various pants and their diseases also they give some techniques to identify that disease. Below are the various plant disease studies of the techniques used by the researches in meeting the endeavor.

Different types of plant diseases
- Leaf rot: It is caused in coconut tree. It is caused by fungi or bacteria. Leaf spot vary in size, shape and color [3].
- Leaf curl: Disease is characterized by leaf curl. It can cause by fungus, genus Taphrina or virus [4].
- Kole Raga: It is a major disease of arecanut. The pathogen is a fungus phytophthora palmivora [5].
- Blast (leaf and collar): Blast is caused by the fungus *Magnaporthe oryzae*. It can affect all above ground parts of a rice plant: leaf, collar, node, neck, parts of panicle, and sometimes leaf sheath [6].

- Brown sport: Brown spot is a fungal disease that infects the coleoptiles, leaves, leaf sheath, panicle branches, glumes, and spikelet's [7].

Gittaly Dhingra [8] describes application of agriculture using computer vision technology to recognize and classify diseases of plant leafs. The paper deals with correlation between disease symptoms and impact on product yield. It also deals with increase the number of training data and testing to accomplish better results.
Mohammed Brahimi [9] proposed deep learning method to create classifier for diagnosis of disease. Also proposed the occlusion concept to localize the disease regions & help to understand the disease. Author uses datasets which is published in good fellow, Bengio etc, further research is need to reduce the computation & size of deep models for small machine like mobiles.
Santanu &Jaya described a software prototype system in paper [10] for disease diagnosis based on the infected images of various rice plants. They used image growing, image segmentation techniques to diagnose infected parts of the plants. Zooming algorithm is used to extract features of the images. Self Organize Map (SOM) neural network is used for classifying diseased rise images.
Amar Kumar Dey [11] used image processing algorithm for betel vine to diagnose leaf rot disease. They proposed vision based method to diagnose and observe peripheral disease features. Based on color feature of rotted leaf area disease are identifying.
Shanwen Zhang [12] proposed method for recognizing disease for cucumber leaves. Due to irregular shapes, complexity, shadows existing classifiers are not suitable for diagnosis. From image of leaf, Author proposed a method using combined shape and color features. Author performed region segmentation from diseased image using K-means clustering algorithm. First system can collect images from data set. Image are converting from Red, Green, Blue space to Luminance*a*b* color model. Then classify color using k- means clustering. Here each image is processed using techniques of smoothing, enhancing, diagnosing, alignment and segmented by k-means clustering techniques.

Methodology
Proposed method works to give more importance to image processing of plant leaves. Database for the procedure is managed with already collected featured leaf images of various plants. Thus after first matching step, framework again does the image acquisition for testing and then matching procedure is performed. The proposed method includes the following steps:

- Image acquisition
- Image pre-processing
- Segmentation
- Feature extraction
- Classification

Algorithms used in feature extraction are:

a. Image Acquisition
b. Image Sharpening
c. Edge Diagnosis
d. Greyscale Image
e. Adaptive Histogram Equalization
f. Shape, Color and Texture Features
g. Support Vector Machine (SVM)

Image acquisition
In this step Images of plant leaf to be tested for disease is fed to our software. In this step the images as shown in Fig.1, are converted to grayscale images as it becomes easier to perform classification process on black and white image which is2-Dimage. In this step the system will access the snapshot of the plant and load the image into the system. Steps that follow the image acquisition are. Input: image (JPG format) Finer standard resolutions will be utilized for image analysis and JPEG is the format in which these images are usually saved.

RGB Grey

Fig 1: Conversion from RGB to Gray

Image Preprocessing
A simple sharpening operator is the unsharp filter which has obtained its name from the reality that it actually strengthens edges (and additional peak frequency parts in an image) through a procedure in which the original image will be let free of unsharp, or smoothed, version of an image by eliminating them.

Segmentation
The procedure of dividing a digital image into various fragments (set of pixels, are additionally called as super pixels) is known as Image Segmentation. The outcome of image segmentation is a set of fragments that jointly shield the entire image or a set of outline obtained from the image. Every pixel in a zone is close regarding to some distinctive or determined attributes like color, shape and texture.

Feature Extraction
Shape feature extraction
Solidity, extent, minor axis length and eccentricity are the shape features used in this paper. These features are taken in order to extract the diseased region in the leaf considered.

Texture feature extraction
Contrast, correlation and energy are the texture features used in the paper. These features are taken in order to extract the diseased region in the leaf considered. Finally the variation of pixels and its adjacent pixels will be calculated.

Color feature extraction
In concern with translation, scaling and rotation the color feature extraction has a unique way of showing image representation. The features used for color are mean, skewness, and kurtosis. Here, we transform RGB to LAB

Classification
In classification involves in separating data into two genre training sets and testing sets. The training set contains one target value and several attributes for each instance or data. Here the major part is to locate the separating hyperplane which will divide these points into two different classes as the positives classes as "+1" and the negative classes as "-1".

Conclusion
The above paper states that the importance of disease diagnosis to both plants and mankind. There is a scope for working on development of innovative, efficient & fast interpreting algorithms which will help plant scientist in diagnosing disease. It also signifies the importance of image processing in agricultural field and considering the type of disease for further research work. The scope in doing research in this field is as follow:

1. There are two main characteristics of plant disease diagnosis using machine-learning methods that must be achieved, they are: speed and accuracy. Hence there is a scope for working on development of innovative, efficient & fast interpreting algorithms which will help plant scientist in diagnosing disease.
2. Work can be done for automatically estimating the severity of the diagnosed disease.

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