Image based Feature Extraction and Segmentation using k-means for Disease Diagnosis in Agricultural Plants

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***Abstract* - This paper is intended to perform an analysis on various segmentation methods applied on an image, acquired from a crop field for effective detection of the object (leaf/ disease spot). Traditionally disease diagnosis in agricultural plants is based on naked eye observations, which may vary depending on the individual experts experience and their visual perception. Thus traditional method is time consuming and is expensive. These problems faced can be resolved by developing automated or semi-automated systems to detect and classify diseases based on the symptoms found. Automated and semi-automated systems utilizes various steps in digital image processing namely image acquisition, preprocessing, segmentation, feature extraction and finally using an appropriate machine learning algorithm for classification. For effective classification, unique feature or a combination of features needs to be identified, which mainly rely on an effective segmentation algorithm, for extracting or clustering the similar pixels forming the target object (foreground) from the background. Analysis of various segmentation algorithms are performed highlighting its role in diagnosis and classification of any type of disease found in agricultural plants.**

***Index Terms* – Image Preprocessing, Image Segmentation, Feature Exatraction, Image Classification**

I.INTRODUCTION

A. Role of Agriculture in India

As of June 2017 record updates, India ranks second largest in producing various crops namely rice, wheat, fruits, vegetables, cotton, sugarcane and oilseeds on 157.35 hectares of agricultural land in the whole world. In India, the highest producer of rice is West Bengal and Tamil Nadu is one of the major producer of rice. In the same way for sugarcane, the highest producer state is Uttar Pradesh, whereas Tamil Nadu is one of the major producer states upon which the yield per hectare is high. Similarly for different crops, different states can be recognized as the highest producer state and major producer states, based on the land area allotted, climate, soil, etc. hence agriculture is the main livelihood for the majority of population in India and also played a vital role in Indian economy by exporting various high quality agricultural products.

Crops can be classified into different types based on different season's viz. kharif, rabi and zaid. Kharif crops comprise of rice, maize etc.; tomato, potato, etc; belongs to rabi crops; and finally zaid crops include cucumber, bitter gourd etc. Crops can also be classified as food crops, cash crops, plantain crops and horticulture crops based on their usage. Rice, wheat, maize etc. are food crops; cotton, sugarcane etc. are cash crops; plantain crops are coconut, rubber etc. and lastly fruits and vegetables are treated as horticulture crops.

Different steps followed by farmers in managing a field includes the following:

- Crop selection
- Land selection
- Seed selection
- Seed sowing
- Irrigation
- Plant growth
- Harvesting

Though India has occupied the second place in having the largest agricultural land and producers of various crops throughout the world, farmers struggle for their living, facing many challenges starting from the crop selection stage to the harvesting stage. Traditionally, farmers rely on the following sources of information obtained from,

- Agricultural department
- Fellow farmers and other agricultural experts

- Media – TV, Radio, Newspaper
- Agents selling fertilizers, pesticides and seeds
- Some of the challenges faced by the farmers using traditional methods of information flow are:
- Costly and time consuming activity
- Information gathered from different persons may vary
- Lack of education and knowledge to access media
- Late detection of infection
- Accuracy not guaranteed

After foreseeing the challenges, current generation is less attracted towards farming. Therefore several tools are developed by the researchers along with the extension workers and farmers, utilizing Information and Communication Technology (ICT) to improve the yield of crop. Hence challenges are resolved in a simplified way, within limited time. One of the ICT initiative in Tamil Nadu is TNAU AGRITECH, is a web portal for agro-advisory services. Several other automated systems are developed and practiced, overcoming the drawbacks of various traditional methods for different applications like,

- Predicting the current market price for the product
- Climate prediction
- Selection of appropriate crop in appropriate period of time
- Disease detection and diagnosis
- Quality grading of the food product, etc.

B. Impact of Disease in Agriculture

Diseases in plants may vary depending on the type of crop, soil, climate etc. resulting in devastating loss, both in quality and quantity of the agricultural products. Disease can be biotic or abiotic caused by some agents like fungi, bacteria and virus which are collectively called as pathogens.

Symptoms of various diseases can be found on different parts of the plant – leaf, stem, root, flower or fruit, which can be either visible or invisible during its early stages. In some cases symptoms are visible during its last stage. In such cases recovery is difficult. Due to its vastness, the paper is restricted to disease diagnosis in plant leafs, as majority of the symptoms for any disease is visible on leaves. Diseases found in rice caused by the different pathogens and its target occurrence namely leaf blast, panicle blast, collar blast and node blast.

TABLE I. DISEASES CAUSED BY VARIOUS PATHOGENS AND ITS TARGET OCCURRENCE OF SYMPTOMS IN RICE

Pathogens	Diseases	Target occurrence
Fungal	Rice Blast	Leaf, panicle, collar, node
	Sheath Blight	Leaf sheath, leaf blade
	Brown Spot	Leaf, grains
	Leaf Scald	Leaf – margin, tip, edge
	Stem rot	Outer leaf sheath
	Sheath rot	Inner leaf sheath and grains
	Bakanae	Elongation of plant
	False smut	Rice grains
Bacterial	Bacterial blight	Leaf
	Bacterial leaf streak	Leaf
Viral	Tungro	Leaf
	Grassy stunt	Leaf

Initial stage of disease infection starts with water soaked, tiny pale green spots for both fungal and bacterial infection. Later the spot is enlarged and turns to a dry dead spot, in case of bacterial infection; and for fungal infection, the spot darkens to brown or yellow color and later to white patches appearing on both sides of the leafs. Viral infection are difficult to diagnosis, in which wrinkling and curling up of leafs are observed resulting into stunting of growth.

C. Role of image processing methods in disease diagnosis of agricultural plants

Earlier disease diagnosis is done using traditional methods, manually monitored by the farmers using naked eye and preventive measures are adopted accordingly observing the symptoms found on the leaves. Now-a-days research is done to incorporate ICT in agricultural field. Therefore automated systems are developed for disease diagnosis highlighting the following advantages,

- Timely and appropriate disease control using the specific type and quantity of pesticide
- Increased yield and quality
- Less cost
- Increased sustainability

The severity and spread of infection depends on the type of the disease and its susceptibility, period of infection and other favorable environmental parameters like air, temperature, rainfall, relative humidity, soil temperature, soil fertility, soil type, soil pH, soil moisture. Microscopes, sensors, etc. helps in identifying such symptoms that are not visible but requires attention. Therefore image processing methods together with computer vision and machine learning techniques can be merged to develop and automated system to detect and classify the disease found on the plants.

Paper is organized as follows. Section II presents a survey on existing image processing and machine learning algorithms used in various applications of disease diagnosis in agricultural plants. Section III performs a discussion on the analysis of each algorithm, highlighting its performance and accuracy from the literature for disease diagnosis. Section V describes the major Paddy crop diseases and their early symptoms in the leaves. Section VI overlays the model of disease diagnosis system in paddy crops. Conclusions and challenges to be faced are given in section VII.

II.DISEASE DIAGNOSIS OF AGRICULTURAL PLANTS – A SURVEY

A. Digital Image Processing based methods

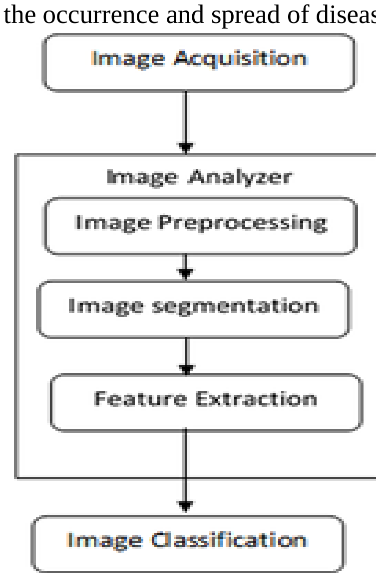
Image analysis is to extract useful information from the images, which can be later used for various applications. Different image processing related applications in the field of agriculture include the following:

- Weed detection
- Detection and classification of diseases
- Extract the region of interest from the background, where the region of interest can be either the leaf or the diseased spot separated from the background environment or the leaf respectively.
- Classification of different types of leaves to identify the medicinal plants.
- To predict the chlorophyll level in plants, etc.
- Different steps to analyze a digital image comprise of image acquisition, image preprocessing, image segmentation, feature extraction and lastly classification based on the features extracted. Fig. 1, shows the different fundamental steps in image processing which leads to disease diagnosis.

1) Image Acquisition: Images can be defined as a two dimensional function, f(x,y), indicating the intensity or gray level value of the image, generated by the combination of illumination or any form of light absorbed or reflected by an object. Hence digital image is composed of finite number of elements, where each element has a particular location and value. The processing of digital image by a digital computer is called digital image processing [1].

Many sophisticated instruments are developed and used to capture and process the images. Real time images or video are captured manually, from the field using the digital camera ([2], [3], [4]) or with the aid of various sensors mounted in a robot or any other electronic device ([5], [6]).

Several types of sensors exist for acquiring real time images namely, spectroscopic and imaging sensors. Images can be extracted from the video as frames to monitor the occurrence and spread of disease [7].



Fundamental steps in Image Processing

1) *Image Preprocessing:* Image is preprocessed to improve its appearance and obtain useful information which is suitable for specific applications. Different steps in preprocessing include image enhancement and image resizing.

Image Resizing: upsampling or downsampling the image to a specified resolution. This reduces the storage space, computational cost and increases the bandwidth ([4], [8], [9]).

Image Enhancement: can be categorised into spatial domain and frequency domain techniques. Spatial domain methods are procedures that operate directly on the pixels, denoted by the expression

$$g(x,y) = T\left[f(x,y)\right] \quad (1)$$

In frequency domain methods Fourier transform is computed for the image, multiply the result obtained by a filter and inverse transform is taken to obtain the enhanced image.

Some other existing methods for image enhancement includes – filtering with morphological operators – erosion and dilation, histogram equalization, noise removal and smoothing using various filters like wiener filter, median filtering, Gaussian filtering etc.

Color space is a defined range of colors used in image processing. Enhancing color increases the saturation without altering the brightness or hue. Hence device dependent or device independent color transformation is done before or after preprocessing. RGB and CMY(k) are device dependent color space models whereas CIELab, CIELuv, HSI, HSV, HSL, etc are device independent color spaces. Color transformation from RGB to HSI ([3], [11], [12]) or HSV ([9], [13], [14], [15]), or L*a*b* ([8], [9], [16], [19]).

Information from the image can be obtained by enhancing the contrast and removing the noise if any found in the image using various filtering techniques. Contrast of the image is enhanced by normalizing the color space ([11], [17]). Binary filter, median filter, Gaussian filter, etc. are used for region growing, smoothing and removal of noise through enhancement ([4], [13], [18]). Among these, Gaussian filter is the best filter for removal of noise and smoothing the image. Noise can be any form blurr or spots formed due to segmentation. These type of noises can be removed by morphological open and close operations ([11]).

Histogram constructed for red, green and blue channels for any RGB image. Green pixels forming the G channel are masked choosing a threshold value. This identifies the healthy and diseased region found in leaf. Diseased spot is separated for further analysis ([3], [9], [10]).

2) Image Segmentation: Segments an image to distinct regions or object of interest based on the application. This mainly depends on 2 properties of intensity viz. discontinuity and similarity. Discontinuity helps in partitioning the image based on edge. Similarity partitions an image into regions [1].

Various types of segmentation methods are applied for segmenting the region of interest from the captured and enhanced image. These methods are thresholding based like Otsu method([11], [5], [17], [18]) and histogram method ([13]), clustering based includes kmeans ([2], [4], [9], [16], [19]) and fuzzy c-means algorithms ([8], [12]), and morphological based watershed segmentation [11].

An alternate method in which cropping along the edge contour to form a mask is called polygon cropping. This helps in segmenting or cropping the region of interest from the background ([8], [9]).

3) Feature Extraction: Segmented region can be represented using the external or internal characteristics. External characteristics include the boundary or shape of the region whereas internal characteristics are the pixel properties such as color and texture, forming the region [1]. These charcteristics are termed as feature set.

Extracting unique feature or feature set for further analysis reduces the image data. Features extracted may vary based on the application. Features extracted comprise of number of occurrences of zero or the number of connected components in the image, color and shape [13], color, texture and entropy [4], median, mode, variance, standard deviation, histogram peaks count and the density of green pixels occurred [12].

Texture features are extracted from statistical models called Color Co-occurrence Matrix (CCM) or Gray Level Co-occurrence Matrix (GLCM) [2]. Features are identified through computation of inertia, energy, homogeneity and correlation ([14], [2]) for each color space models.

4) Image Classification: Various classification methods include Principal Component Analysis (PCA), Neural Network (NN) and Support Vector Machines (SVM), Fuzzy Logic, Genetic Algorithm, Decision trees and so on.SVM is one of the best classification method with mean percent error, less than 2.25% [5], and hence can also be used for forecasting plant diseases. PCA classification is based on RGB channels where the severity of the disease is predicted based on the ratio of diseased pixels ([18], [19]).When multi-layeredfeed forward back propagation network are used to detect Rust disease in wheat leaves, the detection rate is 97%, and the overall performance success rate is 84.8% [12]. Fuzzy Logic is used for both classification and grading. A Fuzzy Inference System (FIS) is developed using 3 input variable – energy, entropy and saturation, and a single output variable – a leaf sample. It also has a triangular membership functions to define 7 fuzzy inference rules. Disease grading is based on the disease scoring scale referred from plant pathology [4].

Performance Analysis of Various Algorithms

From the existing literature taken for study it was found that the main task which needs attention is in the selection of the threshold for segmenting the region of interest, feature extraction and classification. Various methods are adopted to perform each task. Each has its own advantages and drawbacks. Among the different methods implemented the best algorithm is chosen based on its simplicity, sensitivity, specificity and the accuracy in the performance. These are measured using various metrics depending on the task.

Image acquisition can be done on a mobile camera placing a white paper behind thereby avoiding the complexity of leaf extraction from the background. Threshold based segmentation is found simple to use for segmenting the maximum region of interest. This is an important step prior to feature extraction for further processing.

SVM is one of the best machine learning technique for training machines efficiently in kernel induced feature spaces. Some of the general kernels are listed below:

Pth degree polynomial:

$$K(x_i, x_j) = (x_i . x_j + 1)^p$$

Radial Basis Function (RBF):

$$K(x_i, x_j) = e^{-\left\|\frac{x_i - x_j^2}{2\sigma^2}\right\|}$$

Multi-layers Perceptron (MLP) :

$$K(x_i, x_j) = \tanh(\beta x_i . x_j + \delta)$$

It that can be employed for forecasting disease in agricultural plants by processing the extracted features. Feature vectors can be represented either as graphs, sequences or as a relational data. It can also be used for predicting the severity of the disease occurred as benign and malignant after proper training of the sample images uploaded or captured. SVM is applied to feature vectors.

Advantages of SVM include:

- Robustness – maps data to high dimensional space.
- Absence of local minima
- Flexible
- Solutions are sparse

Table II lists the performance analysis of various algorithms, which is used for different steps in image processing mentioning their role in disease diagnosis in agricultural plants. Table III lists the performance analysis of machine learning algorithms used for classification and prediction in disease diagnosis of agricultural plants.

Table II Performance Analysis of Algorithms

Method	Accuracy	Application
To choose threshold for segmenting Region of Interest		
Maximum entropy	80%	Disease detection in orchid leaf
Valley Emphasis	75.2%	Detect defects in rail, steel plate images
Neighborhood Emphasis	92.2%	Detect defects in rail, steel plate images
Otsu	48%	Threshold for Leaf extraction
Improved Otsu (WOV)	94%	Threshold to detect defects from rail images
Marked watershed Segmentation	99%	Leaf extraction
Feature Extraction & classification		
Color co-occurrence matrix with SVM classification	95.71%	Texture features extraction and classification
Spatial Gray Level Dependency Matrix with NN	93%	Texture features extraction and classification
Run-length Matrix with NN	85%	Texture Features extraction and classification

TABLE III. MACHINE LEARNING ALGORITHMS FOR CLASSIFICATION AND PREDICTION

Algorithm	Accuracy	Application
SVM	98%	Pest Detection Classification
PCA	95.2%	Powdery Mildew in greenhouse bell peppers
PCA	90%	Tomato Spotted Wilt Virus in greenhouse peppers
PCA	92%	Classify plant as weed or crop
ANN	97%	Detection of disease in wheat leaves
ANN	85%	Identification of disease Severity
Multi Feedforward Back-propagation NN (BPNN)	84.8%	Classification to a disease type in wheat leaves
Minimum Distance Criterion K-means clustering	93.63%	Disease detection and classification in beans leaf

IV.MAJOR PADDY CROP DISEASES

Rice is one of the most important food crops in the world. Farmers face economic losses, incurred due to some pathogens namely – fungi, bacteria and viruses. These losses can be overcome, if the disease symptoms are identified early and appropriate actions or remedial measures are taken accordingly.

Some of the major paddy crop diseases found and requires attention are viz., Rice Blast, Rice Bacterial sheath blight, Rice Sheath blight. Initially it appears as spots around the infected areas. So detecting and predicting severity of the disease rely mainly on the spots and the total area in which the leaf is affected. Spots can be varied in their size and shape. More than one disease can show the symptom of similar spots which increases the complexity in identification. In such cases, additional factors like the rice variety and the local environmental conditions are also considered for prediction.

At present, farmers mainly rely on their experience. If any misidentification occurs, it leads to application of wrong control measures. Therefore a model for disease diagnosis system to detect Rice Blast disease is proposed. This is intended mainly for the farmers to take decisions on the application of control measures or any pesticides based on the severity of its occurrence, without the intervention of any expert person's knowledge or presence. The model can be executed with the help of a mobile phone, which is currently available in common.

V.THE MODEL FOR DISEASE DIAGNOSIS SYSTEM

From the above literature review, it is agreed that to improve the diagnosis process, there is a great necessity in developing an automatic and reliable method for the early detection of diseases in agricultural plants. This detection can be done by the agricultural experts or robots which is time consuming and expensive.

Hence, the importance of early detection of disease to improve diagnosis and production within less time and cost, prompted the research interest in quantifying the severity of the disease, detected independently by the farmers, and applying the appropriate remedial measures suggested, with the aid of an Android phone and without the intervention of the agricultural experts.

Currently, there are no such methods widely accepted and practiced on field by the farmers. Hence, the objectives of the research are the following:

- To build a database that stores the paddy infected /uninfected images as samples.
- Build a database containing disease symptoms and severity mapped with appropriate treatment measures.
- Using Android mobile phone camera capture the image of a plant leaf.
- Develop an algorithm to enhance and the extract features of the captured image using OpenCV for real time processing and compare it with the stored features of the image samples.
- Find out the severity of the affected disease based on the threshold computed.
- Based on the severity of the particular disease, treatment measures are displayed.

Figure2. shows the overall architecture of Rice Blast disease diagnosis system, in which the farmer captures an image of crop leaf to predict its healthiness and its severity, so that appropriate remedial measures are taken. Figure3. shows the different steps in mobile based rice blast disease diagnosis system where the captured image is processed to obtain the desired output. Figure 4-6 shows the method chosen in this disease diagnosis system model from the list available methods based on their efficiency analyzed from the literature.

Figure 7. shows the detailed framework of the Rice Blast Disease Diagnosis System. This explains the different steps to be performed on the captured image for disease diagnosis. Image can be captured using a mobile phone, keeping a white paper behind, to overcome the task of extracting the leaf from the complex background. Later the diseased spot is extracted from the leaf using K-means clustering based segmentation. To perform this the captured image is resized to 256x256 pixel resolution.

Color transformation is applied to obtain useful information from the image. From the R, G, B components of a color image H, S, I components can be obtained by the following equations:

$$\text{Intensity(I)} = \frac{R+G+B}{3} \quad (1)$$

$$\text{Saturation(S)} = 1 - \frac{3\min(R, G, B)}{R+G+B} \quad (2)$$

$$\mathrm{Hue(H)} = \begin{cases} \theta & \text{if } B \le G \\ 360 - \theta & \text{if } B > G \end{cases} \quad (3)$$

$$\theta = \cos^{-1}\left\{ \frac{\frac{1}{2}[(R-G)+(R-B)]}{\sqrt{(R-G)^2+(R-B)(G-B)}} \right\} \quad (4)$$

Result obtained can be compared with the HSV model by converting the RGB image to HSV. Therefore the RGB image is transformed to HSV to check the accuracy in segmenting the regions. Conversion from RGB to HSV can be done by using the following equations. First R, G, B values are divided by 255 to change the range from 0:255 to 0:1

$$R' = R/255 \quad (5)$$

$$G' = G/255 \quad (6)$$

$$B' = B/255 \quad (7)$$

$$C\max = \max(R', G', B') \quad (8)$$

$$C\min = \min(R', G', B') \quad (9)$$

$$\Delta = C\max - C\min \quad (10)$$

$$H = \begin{cases} 0, \ \Delta = 0 \\ 60\, x\left(\frac{G'-B'}{\Delta} \bmod 6\right), C\max = R' \\ 60\, x\left(\frac{B'-R'}{\Delta} + 2\right), C\max = G' \\ 60\, x\left(\frac{G'-B'}{\Delta} + 4\right), C\max = B' \end{cases} \quad (11)$$

$$S = \begin{cases} 0, C\max = 0 \\ \frac{\Delta}{C\max}, C\max \ne 0 \end{cases} \quad (12)$$

$$V = C\max \quad (13)$$

Later morphological filtering is applied to remove noise or blur if any. Clustering results in 3 or 4 segmented regions from which a region of interest is selected. Features are segmented using the Gabor filter and classification is done using Support Vector Machines.

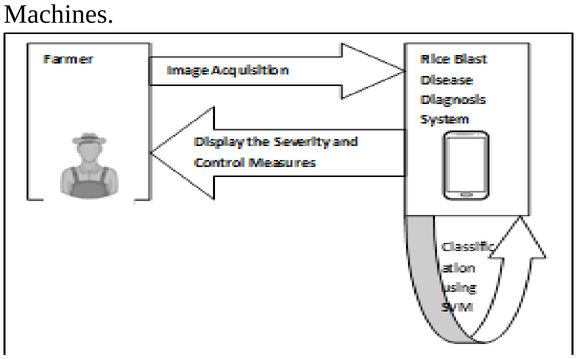


Fig. 2. Overall architecture of Rice Blast Disease Diagnosis System

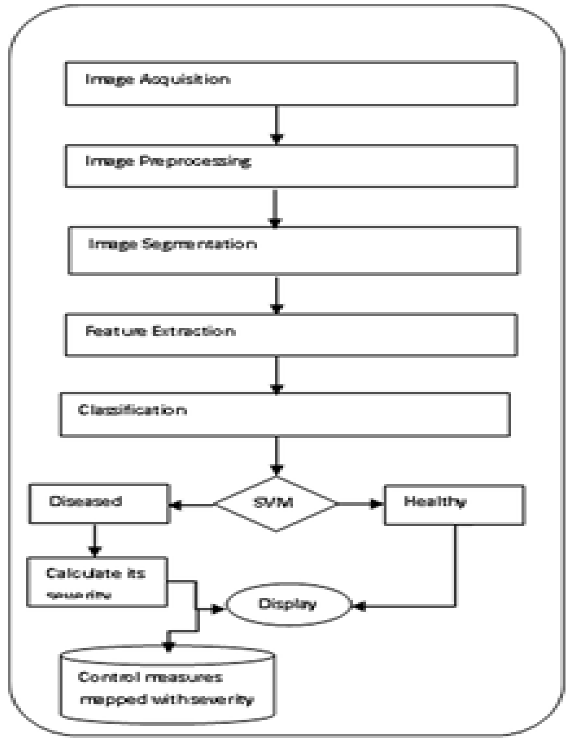


Fig. 3. Different steps in mobile based Rice Blast disease diagnosis system model

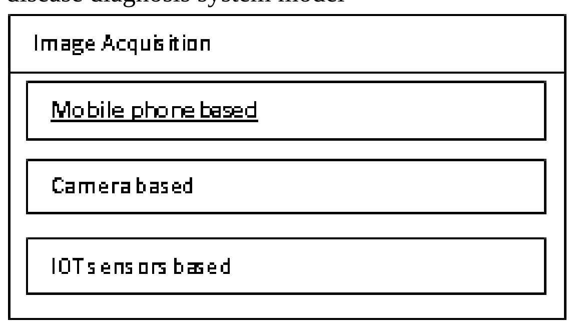


Fig. 4. Different methods in image acquisition

Dataset used for the experiments are collected based on the real images of diseased and healthy leaves of Rice Blast from the rice crop. From the dataset constructed a major number of images are used for training and the remaining can be used for testing.

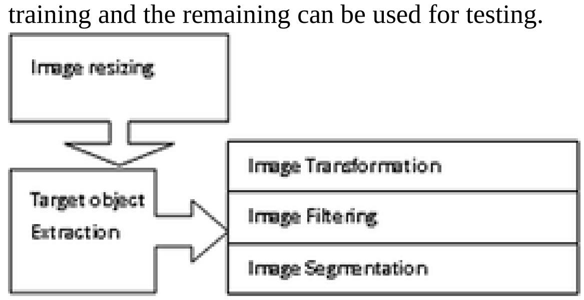


Fig. 5. Different processes in image processing

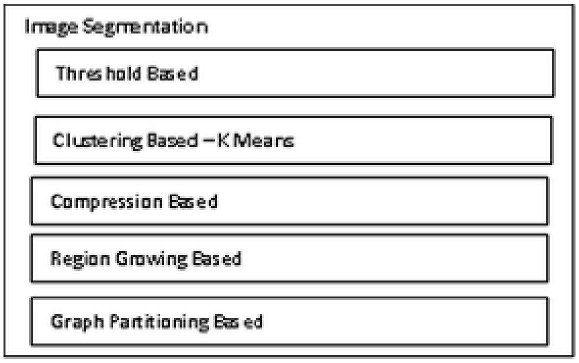


Fig. 6. Different methods in Image Segmentation

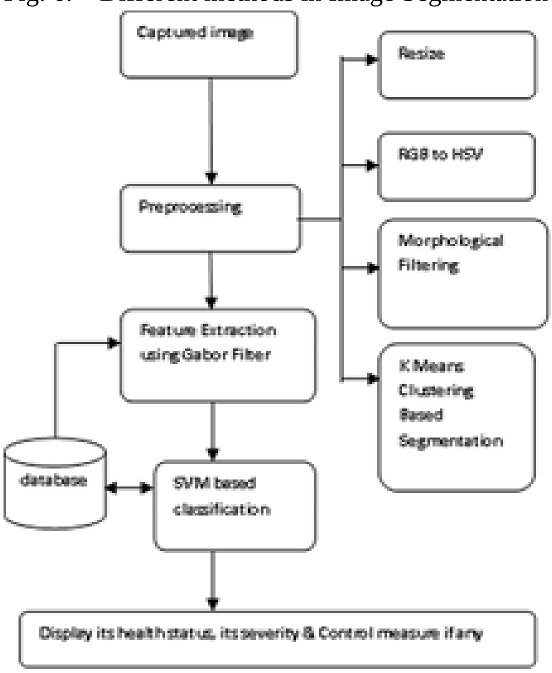


Fig. 7. Detailed framework of Rice Blast Disease Diagnosis System

VI.RESULTS AND DISCUSSIONS

The proposed system is built in Ubuntu 16.04 Operating system and is also run and tested in NVIDIA Tesla containing 2 GPU's. The final model is chosen to be deployed on an android device. The performance of the app while predicting disease is captured and displayed as shown in fig. 8. The entire program is using an open deep learning platform called Tensorflow – keras with an opencv - python package to perform various image based processing.
Similar to m-ADD, the proposed system km-ADDS also consist of 2 phases, namely – training phase and testing phase. Both phases perform some steps in common. Following are the different image processing steps performed on the digital image:

- Image acquisition
- Image preprocessing
- Segmentation
- Feature extraction
- Classification

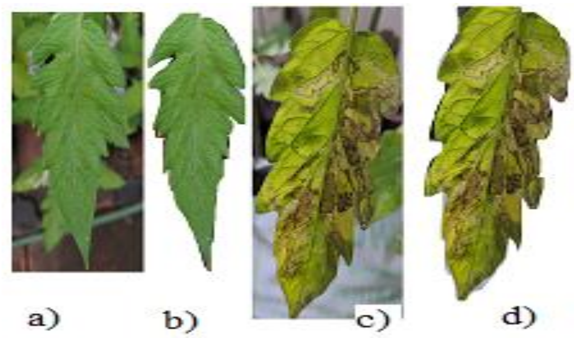


Fig.8 Sample tomato leaf images (a) Healthy-original, (b) Healthy-segmented, (c) Diseased-original and (d) Diseased- segmented

5.3.1.1 Image preprocessing

After collecting the images from various sources, they are enhanced and augmented for further analysis. The images may be of different size when captured. Therefore to accelerate the image processing - all images are resized to same size ie., 224x224 from the center of the captured image. Inorder to distinguish between the diseased and non-diseased part, contrast stretching technique is used to enhance the contrast.

5.3.1.3 Image segmentation & severity estimation

Among the different segmentation techniques, k-means clustering is chosen to separate the infected and healthy region of the preprocessed image based on k clusters. It can be able to detect the segment of interest of the image and find the similarity groups in data by minimizing the sum of the squares of the distance between the corresponding cluster and the object [8]. Therefore, after enhancement the kmeans clustering algorithm is applied to extract the diseased spots. The segmented images were divided into different classes viz. healthy, leaf blast, bacterial blight. The Image processing algorithm was developed in Python (3.7, Python Software Foundation) using the OpenCV library (4.2)
In km-ADDS, kmeans clustering is used to separate the diseased lesion, from which the affected ratio is calculated to predict the severity. Kmeans algorithm performed on km-ADDS is as follows (Bhange &

Hingoliwala 2015; Jaby *et al.* 2021; Majumdar *et al.* 2014; Pinki *et al.* 2021; Poonguzhali & Vijayabhanu 2019 and Zhang *et al.* 2017)

- Step1: Take the preprocessed image as input
- Step2: The image is converted from RGB to L*a*b color space, which consist of 2 chromaticity layers in *a and *b channels and luminosity layer in L* channel.
- Step 3: Colors are classified using k-means clustering in *a*b space and simultaneously the difference between the 2 colors is evaluated with the help of Euclidean distance metric
- Step 4: Each pixel of the image is labeled with its assigned cluster index
- Step 5: The pixels present in the input image is separated by color using pixel labels which produce different image segment based on the number of clusters

K=3 is used in the km-ADDS method. Fig. 9 shows the segmentation results. The image is segmented to 3 clusters. Fig. 10 shows the features extracted from the segmented clusters containing the region of interest for the Rice Blast infected paddy leaf image. Fig. 7 shows the steps involved in estimating the severity of the disease in each leaf. Disease severity scale for evaluation of Bacterial Leaf Blight is shown in Table IV

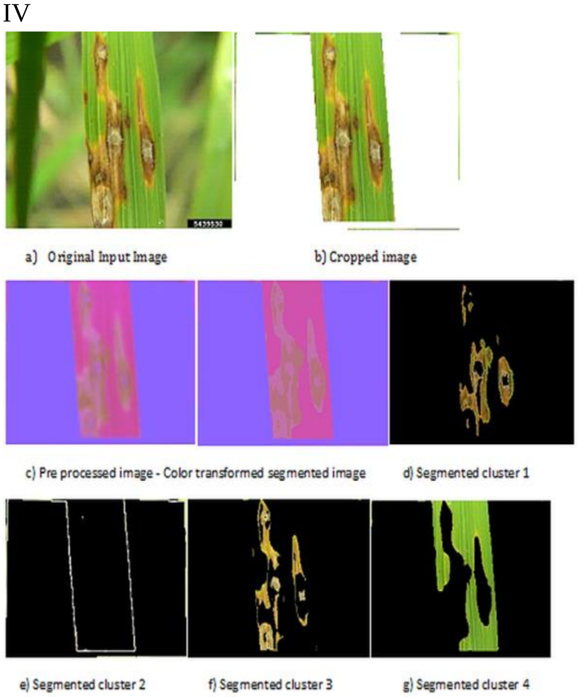


Fig. 9 Sample output ımages after segmentation using kmeans

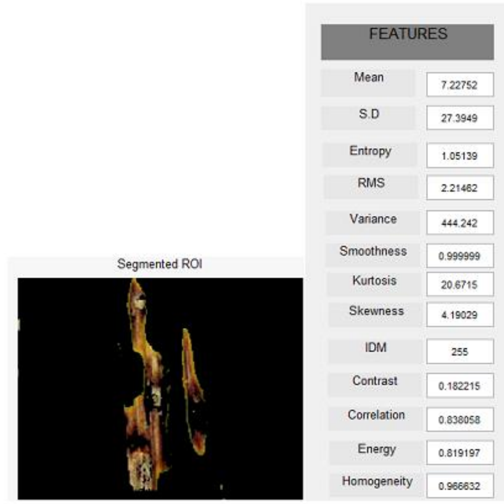


Fig. 10 Features extracted from the selected segmented clusters

Table IV Disease severity scale for Bacterial Leaf Blight (BLB)

Disease Rating	0	1	3	5	7	9
Lesion size (% of Leaf length)	0	>1-10%	> 11-30%	> 31-50%	> 51-75%	>76-100%

VII.CONCLUSION & CHALLENGES

This paper presents the existing information and communication technologies applied in agriculture. From the review it is found that there exists a gap between the systems developed and field users for diagnosing the disease in agricultural plants. To mitigate this gap, various tools like OpenCV, Android can be used to attain the objectives and overcome the existing difficulties faced by the farmers in their field. Challenges to be faced are the following:

- Difficulty in getting appropriate data
- Tool used for classification and mapping of disease should be compatible with android mobile
- Comparing the result performance based on Accuracy, Sensitivity and Specificity.

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