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Detection and Classification of Various Plant Diseases Using Digital Image Processing In Matlab

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ABSTRACT: Agriculture is an important sector of Indian economy. It plays a crucial role in the economy of developing countries. Around half of the Indian population is engaged in the cultivation of land. Father of our nation Mahatma Gandhi said "India lives in villages and agriculture is the soul of Indian economy". Agriculture is the main source of food, income and employment to the rural populations. Plant diseases are the major challenge in the agriculture sector. The disease symptoms include change in the appearance, color, shape and functions of plant. Most plant diseases are caused by fungi, virus and bacteria. Smart agriculture mechanism provides assistance to farmers in analysing diseases. In this paper proposed a method or computer vision system for automatic detection and classification of plant diseases using image processing technique. Image processing technique can be used to quickly and accurately detect plant diseases on images of leaves. The main steps in this process are image acquisition, image pre-processing, image segmentation, feature extraction and classification. The collected information can be circulated to other people who are at remote locations quickly and in expensively.

KEYWORDS: Plant diseases, image processing, K-means clustering, GLCM feature extraction, Artificial neural network (ANN)

I. INTRODUCTION

Agriculture is the main occupation of our country. It is the oldest and largest occupation. There are 3 sectors driving the Indian economy service sector, manufacturing sector and agriculture sector. The prosperity of the country depends upon the prosperity of agriculture. Agriculture provides largest employment, share in national income, supply of food to the expanding population, market for industrial products, sources of capital formation, sources of revenue for the government and developing of tertiary sector. Through the direct contribution of agricultural taxes to the central and state government they get a significant part of their total revenue in the terms of land revenue. Agriculture contributes development of trade, banking and transport etc. According to latest economic survey 2021, in India share of agriculture and allied sectors has increased to 19.9%. Agriculture is important for industrial development and it supplies raw material to industries. India faced a shortage of food grains during the 1960's. The green revolution, which made the country self-sufficient in food grains by the year 2010.Losses due to plant diseases have a dramatic impact on economy and livelihood of farmers. Symptoms give an initial indication for the type and cause of plant disease. Most of the symptoms are restricted by our visual capabilities.so in this project developing the modern approach of plant disease control depends on the digital image processing. Image processing technology, detect the plant diseases by processing the images of plant. MATLAB image processing starts with image acquisition. In image acquisition RGB images of all leaf samples are picked. Color transformation structure is created and RGB color values are converted in to HSI color structure, in the pre-processing step. In the image segmentation K-means clustering are applied and the green pixels are masked. The masked cells removed inside the boundaries of infected cluster. GLCM function is used to calculate the features and these features are arranged in a feature vector. This feature vector is given to the ANN for identifying the diseases. The neural network trains the input and classifies the output correspondingly.

II. LITERATURE SURVEY

In paper [1] rice leaf blast and brown spot are considered. Self-organising map neural network introduced for classification of images. For feature extraction boundary and spot detection methods are used. In paper [2] explains image pre-processing

stage, image segmentation using K-means clustering technology, feature extraction and classification of diseases]. They are the four stages to detect plant diseases. Automatic illness detection using image processing technology is support the famers for the identification of disease at initial stage and reduce the agriculture losses [3]. According to paper [4] digital cameras used for capture the healthy and diseased pictures of leaf. Segmentation is based on the K-means clustering algorithm. Feature extraction analysis is based on the gray level co-occurrence matrix GLCM. It calculates how often different combinations of gray level co-occur in the image [5][6]. According to paper [7] Artificial neural network (ANN)is used for the detection and classification of plant diseases. Artificial neural network is a machine level algorithm [5] The captured RGB images are converted in to HSI (Hue, Saturation, Intensity) images.HSI image help to separate chroma information (color information) from luma information (intensity information). CCM used for feature extraction.

PLANT DISEASE BASICS

Most of the plant diseases are caused by bacteria, fungi and viruses. **Fungal** diseases are plant infections caused by fungi. Fungi are heterotrophic micro or macro-organisms. They constitute the large number of plant pathogens and damage plants by killing cells. They are characterized by spots, blights, tumours, cancers, wilts and, rots. Some of the fungal diseases are:

- Anthracnose
- Ergot
- Downy mildew
- Powdery mildew
- Verticillium wilt
- Smut
- Snow mold
- Sooty mold
- Smut
- Scab
- Alternaria alternata
- Cercospora leaf spot

Virus particles are extremely small. Viruses can produce different kinds of symptoms on different plants. Depending on the particular combination of virus and host and on environmental conditions, a plant's response to infection may range from a symptomless condition to plant death. Typical leaf infection of viral disease includes mosaic patterns, yellowing, curling, leaf rolling, chlorotic or necrotic lesions and vein banding. Viral diseases are:

- spotted wilt
- Necrosis
- Curly top
- Leaf curl
- psorosis
- Mosaic
- Tobacco mosaic virus
- Tomato spotted wilt virus
- Tomato yellow leaf curl virus
- Barley yellow dwarf
- Lettuce mosaic virus

Bacteria are microscopic and single celled organisms. They multiply rapidly by cell division like binary fission. Individual bacterial cells cannot be seen without the use of a microscope. The symptoms that they cause, which may include necrosis, soft rot, vascular wilt, overgrowth and leaf spot. Bacterial diseases of plants are

- Bacterial blight
- Rot
- Canker
- Scab
- Bacterial spot
- Bacterial wilt
- Bacterial speck
- Bacterial pith necrosis
- Halo blight
- Black leg
- Aster yellows
- Fire blight

III. PROPOSED METHODOLOGY

This is the block diagram of proposed work. First step in image acquisition is to capture the leaves using digital camera. These stored images of the leaves from the database are load by specifying the path. In pre-processing quality of image increased and remove the unwanted distortion. Image segmentation used to segment the pre-processed image into sub images, using K-means clustering technology. GLCM is used for feature extraction, to convert the raw data into useful information. Artificial neural network (ANN)is used for detection and classification.

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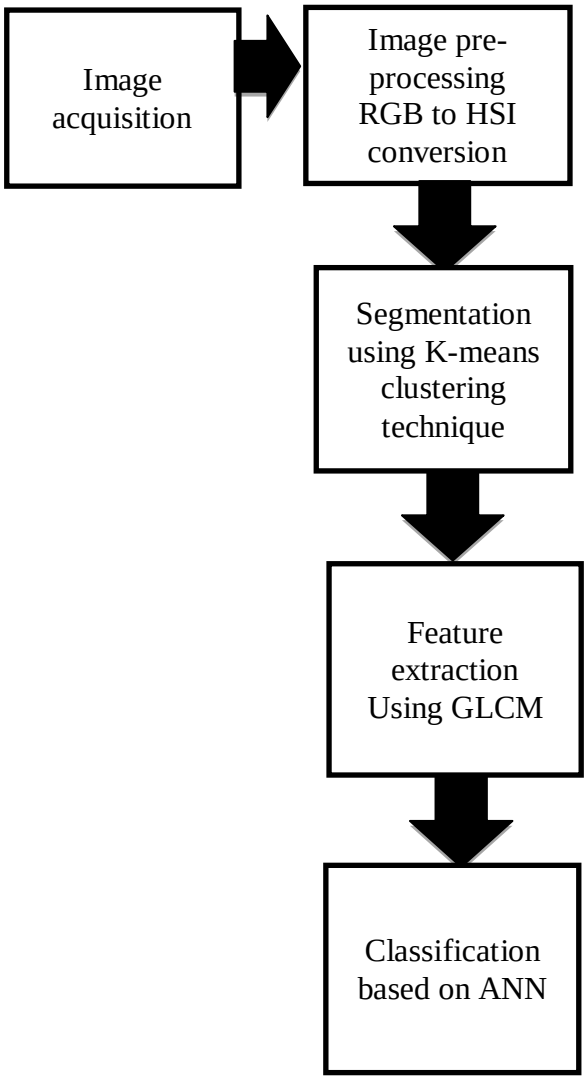

Fig 1:Block diagram

A. IMAGE ACQUISITION

Image acquisition is the process in which we acquire the images by using different sensors. Here digital camera is used to capture the healthy and unhealthy leaf images. These images are stored for further operations. Digital camera is based on the CCD sensor array. CCD array convert the light energy into electrical energy. This electrical energy or output voltage waveform is converted into digital form by using sampling and quantization. It is the ability of digital camera to digitize the signal produced by sensor.

Fig 2: Diseased leaf image(antracnose)

B. IMAGE PREPROCESSING

The aim of pre-processing is an improvement of the image data that suppresses unwanted distortions. Or it is used to enhance some captured image features important for further processing.eg: rotation, scaling, and translation. There are two types of image enhancement they are qualitative and quantitative enhancement. In this project MATLAB codes used to enhance the contrast, change the size and RGB to HSI conversion.HSI model help to separate chroma information (color information) from luma information (intensity information). HSI model represents every color with 3 components: hue (describe pure color), saturation (amount of white color mixed with hue) and intensity(brightness).it is more suitable for human interpretation.

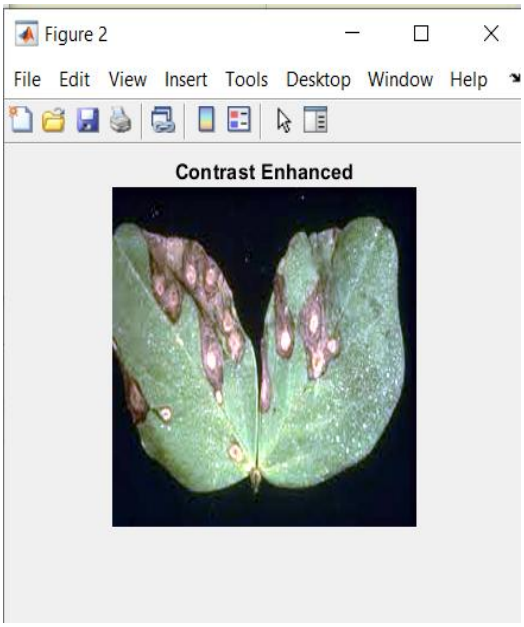

Fig 3: contrast enhanced image

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C. IMAGE SEGMENTATION

Segmentation as the name suggests, subdivides an image into its, constituent regions or objects. The main purpose of subdiving an image into its constituent parts or objects is that we can further analyse each of the constituents or each of the objects, present in the image once they are identified.so each of these constituents can be analyse to extract some information. That information useful for high level machine vision applications. Image segmentation is typically used to locate objects and boundaries (lines, curves etc). In this project K-means clustering algorithm is used for segmentation.

C.1 ALGORITHM

1. Initialize the clusters and centroid value
2. Select the next object and find Euclidean distance from two clusters
3. Assign object to the cluster which having lesser Euclidean distance
4. Update centroid value
5. Repeat the process until all the objects are included
6. For next round repeat same process

After segmentation any one of the clusters contain the major part of unhealthy leaf. That particular cluster use for next step, feature extraction step.

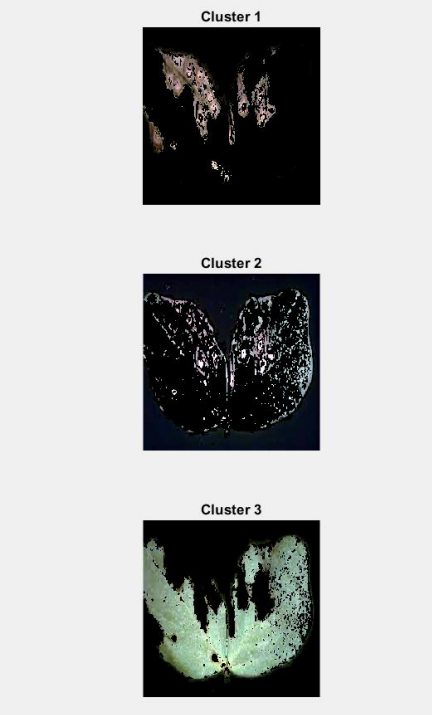

Fig 4: clusters of infected leaf image

D. FEATURE EXTRACTION

After image segmentation, the features of segment or cluster extracted by GLCM (Gray level co-occurrence matrix). The texture, color, and intensity characteristics are extracted. It is the second order statistical method for texture analysis. An image is composed of pixels, each with an intensity value at particular location.so GLCM help to calculate how often different combination of gray level co-occur in an image.

GLCM tells us about what is the frequency of finding a pair of pixels or pair of gray levels in a particular orientation in overall in an image. In this project 13 features are extracted. They are contrast, energy, correlation, homogeneity, mean, standard deviation, entropy, RMS value, variance, smoothness, skewness, IDM and kurtosis. All these extracted features are arranged in a feature vector. This feature vector applied to ANN as the input.

E. CLASSIFICATION

Artificial neural network (ANN)is used for classification. ANN is a machine learning approach that models human brain and consists of a number of artificial neurons. Each neuron in ANN receives a number of inputs, which means the feature vectors from the feature extraction step.

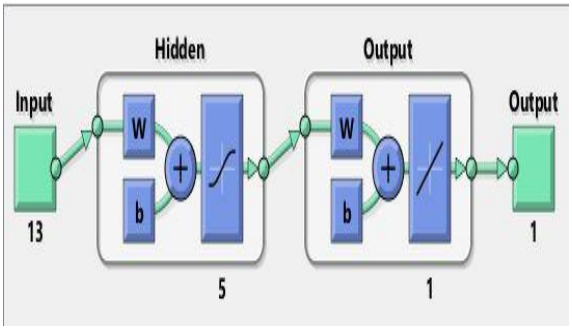

Fig 5: Artificial neural network

Figure 5 shows the artificial neural network used in this project. It is used to predict the output values for given input parameters from their training values.13 features of each disease is arranged in a feature vector and each feature vector labelled with a number. The complete table of features load in to the ANN and train it.when the particular 13 features of each disease formed the corresponding number of disease predict.

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IV. RESULTS

ANTHRACNOSE

Anthracnose disease is caused by the fugus Colletotrichum lagenarium. The term anthracnose actually refers a group of diseases that effect on the host plants in similar ways. Anthracnose generally looks like irregularly shaped lesions on the leaves of infected plants. Younger leaves are more vulnerable to anthracnose development.

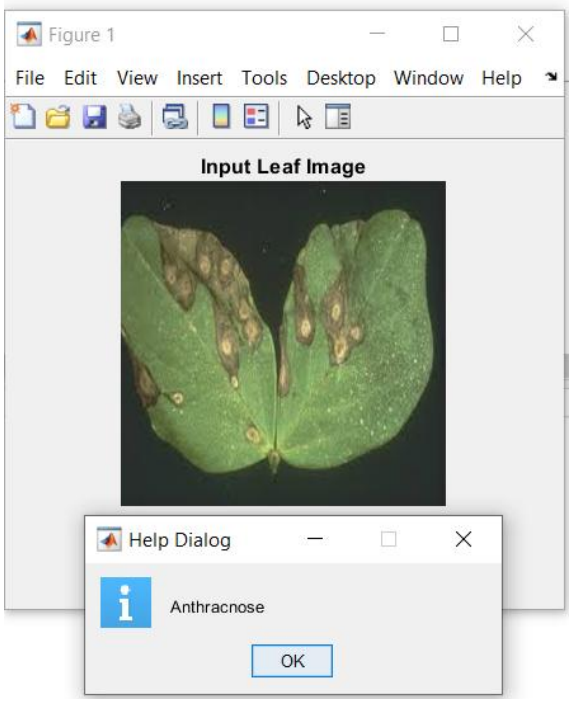

Fig 6: Anthracnose infected leaf and output

B. ALTERNARIA ALTERNATA

Alternaria alternata caused by the Deuteromycetes fungi. They are the small spots develop on the surface of leaves. The lesions are circular or oval in shape, later lesions are appeared as black spot. High humidity and moderate to warm temperature favour Alternaria leaf spot.

The main sources of alternaria alternata-soil,infected plants,decaying vegitation etc.Alternaria grows fast in colonies.They are effect over 380 host spices of plant.Important host plants are

- Apples
- Carrots
- Tomatoes
- Cauliflower
- Citrus
- Broccoli
- Soyabean
- Groundnut

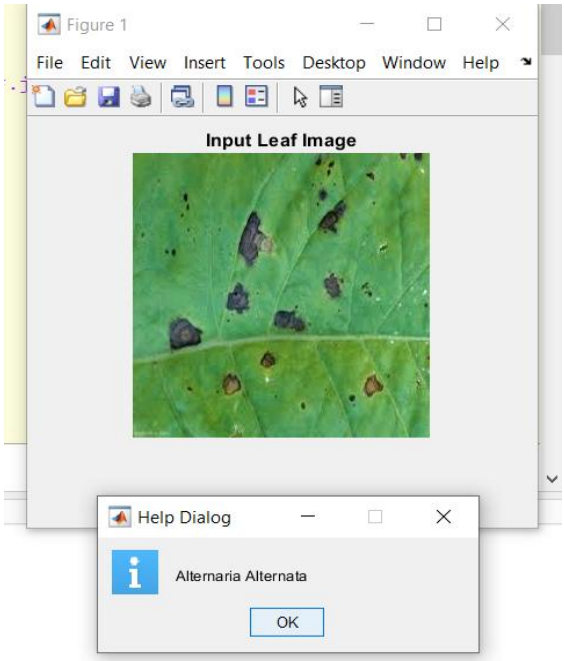

Fig7: Alternaria infected leaf and output

A. BACTERIAL BLIGHT

Bacterial blight caused by Pseudomonas syringae pv. glycinea. Symptoms of bacterial blight pale green spots, streaks, Water-soaked appearance, spotting. Lesions are triangle or rectangle in shape. Later they appeared as the dead dry spot. Bacterial blight severe in cool and wet weather.

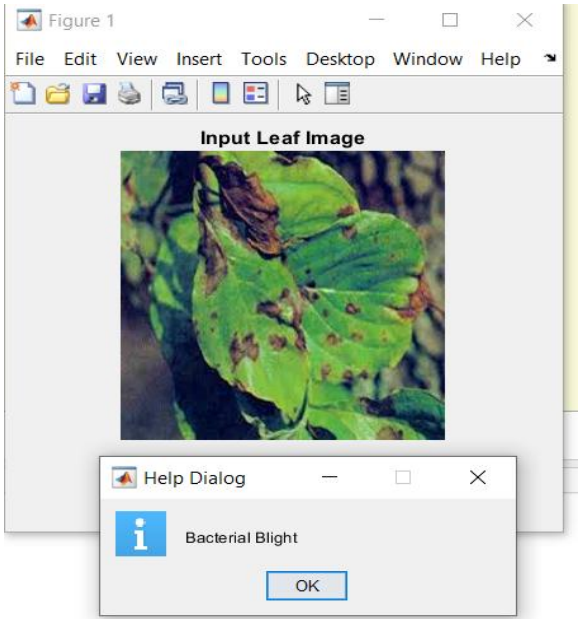

Fig 8: bacterial blight infected leaf and output

Sample No.	Disease Classified	Affected Area (%)
1	Alternaria alternata	15.85
2	Alternaria alternata	18.689
3	Anthracnose	35.4453
4	Anthracnose	18.4676
5	Bacterial blight	19.6053
6	Bacterial blight	15.0142

Table1: Classification of disease and Affected area

V. CONCLUSION

This work deals with efficient detection and classification of plant disease using digital image processing in MATLAB. Image acquisition, image pre-processing, image segmentation using K-means clustering algorithm, feature extraction using GLCM and image classification based on the ANN are the different steps involved. This project helps the famers to detect the disease from the initial stage. Also, to take the remedial action according to the collected data. This study is deals with Alternaria alternata, anthracnose and bacterial blight. In future work, we can modify the structure in accordance with large data set for achieving better accuracy.

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