COMPUTER VISION BASED APPROACH IDENTIFYING THE AGRICULTURAL DISEASES USING IMAGE PROCESSING AND SOFT COMPUTING TECHNIQUES

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ABSTRACT

Agriculture is the backbone of Indian economy and livelihood of Indians relies on Agriculture. In recent days, farmers face many issues because of the diseases that affect the crops. Due to the affected n, yearly productivity of farmers is lower. Manual monitoring of plant disease tends to require enormous amount of work and also require excessive processing time. As it is observed that the banana production is plagued by numerous disease conditions and inflicting large loss to the poor farmers. By using modern technology of image processing and soft computing techniques, these may be known at the sooner stage and appropriate precautions may be taken to avoid more injury and thus increase in healthy production. In this project used identified the banana diseases in sooner stage. Through the pre-processing technique, image is input to urge standardization and soft coring filter is completed to get rid of the noise. Then colour, shape and texture feature are completed for feature extraction, followed by classification techniques. During these classification techniques, two algorithms are used, that's the Adaptive Neuro-Fuzzy Inference System and case-based reasoning. Then fuzzy logic is used for making the decision. The proposed system analysis was done using the Receiver Operating Characteristics (ROC) curve. The analysis shows Adaptive Neuro-Fuzzy Inference System is best than the case-based reasoning algorithm. Finally, the performance is analyzed by combining all feature extractions with existing classification methods such as MDC, KNN, SVM, ANFIS and CBR. Based on the performance of classification techniques, it is observed that the detection failures are reduced, such that overall accuracy for CBR is 92% and it is 97% in ANFIS. Results of evaluation of the

proposed algorithm show that the majority of plants diseases are correctly detected with desired accuracy, even in occluded conditions.

Keywords: Adaptive Neuro-Fuzzy Inference System · Case-based reasoning · Fuzzy logic · Soft coring filter

I INTRODUCTION

Agriculture is the process of cultivating soil to generate crops and raise livestock with its origin dating back to thousands of years ago. Humans gathered wild grains before 1,05,000 years and the fledgling farmers started to cultivate them before 11,500 years. The domestication of animals like Pigs, sheep and cows dated back to 10,000 years. Crops had its origin from eleven regions across the world. The surplus production of agriculture crops led to sedentary civilization of human beings and also increased the production of food, fiber and feed. Increased population and requirement of increased agricultural products paved way for modern agriculture which enabled the use of latest technologies and chemical fertilizers.

Evolution of Modern Science, plant breeding technologies, utilisation of agrochemicals like fertilizers and pesticides and technological developments have sharply inflated the agricultural yield, however, it has disturbed the ecology and. Genetic modification, selective breeding and recent fashionable practices in animal husbandry have equally increased the meat output which on the other side has led to issues concerning animal welfare, environmental harmness, depletion of aquifers, presence of growth hormones and antibiotic resistance in industrially grown meat. In this day and age, the number of people employed in agriculture has steadily fallen due to environmental changes and industrial revolution.

As per the statistics, India ranks second in agricultural production irrespective of the environmental changes or barricades. According to the International Monetary Fund (IMF) and Central Intelligence Agency (CIA), world factbook has listed the countries with large agricultural production. In the world, China ranks first in the highest agricultural yield followed by India, European Union, United States, Brazil and Indonesia. Food and Agriculture Organisation (FAO) lists the most valuable crops and livestock products, its type, its global value and global production and the country producing highest yield.

As per 2010 Food and Agriculture Organization world agriculture statistics, India is the world's largest producer of fresh fruits like banana, mango, guava, papaya and lemon and vegetables like chickpea, okra, chilli pepper, ginger, jute, millets, and aperients seed. India is the second-largest producer of wheat and rice and India is renowned as the world's major food.

India is presently the world's second largest producer of several dry fruits, agriculture-based textile raw materials, roots and tubers, pulses, farmed fish, eggs, coconut, sugarcane and numerous vegetables. In 2010, India was at the top level hierarchy in the production of various agricultural products as well as various cash crops such as coffee and cotton comparing other countries across the world. India was one of the world's. fifth largest

producers of Eutherian mammal and poultry meat, being one among the producers with quickest growth rates, as of 2011.

The principle food crops are rice, maize, jowar (cholam), bajra (cumbu), ragi and pulses (Bengalgram, Redgram, Greengram Blackgram and Horsegram). The principle cash crops are cotton, sugarcane, oilseeds, coffee, tea, rubber, coconut, gingelly and chillies. Tamilnadu is the largest producer of bananas, flowers, tapioca and sugarcane, and the second-largest producer of mangoes, natural rubber, coconut and groundnut and also the third-largest producer of rice, sapota and tea. Tamilnadu owns its pride in producing highest sugarcane yield per square measure in Asia. The state has involved feather palm cultivation in 17,000 hectares of the land, the second-highest in Asia. The major staple food of the state is Paddy and three varieties of paddy are grown in different time frame. The primary one is 'Kuruvai' (the short-term crop) grows in a period of three to four months and as per the Gregorian calendar month it is from July to November. The second variety is 'Thaladi' and requires five to six months to develop and it is grown from November to March as per Gregorian calendar. The third variety is 'Samba', and it incorporates a period of about six months and as per Gregorian calendar it is grown from August to January

II LITERATURE REVIEW

In the modern digital world of computer vision and machine learning, the image processing tools are used to analyze the agricultural crops in the fields whereas images and machine learning methods are used to predict the diseases. Nowadays, farmers expect software tools to analyze the yield of crops in different environmental factors. The main problem the farmers are facing is difficulties in identifying agricultural diseases at an earlier stage. In this modern era, technological advancements and software development play a vital role in the modern agricultural system.

This work is a genuine attempt that aspires to improve the existing image processing and soft computing methods to diagnose agricultural diseases. Image processing methods are used to get multiple sources of information from high-resolution cameras, image sensors and hyper spectral cameras. Pre-processing and feature extraction methods were used to retrieve useful information from the image. Soft computing method was used to classify and cluster the information and make a suitable decision accordingly. In line with the survey, a number of research works have been introduced in recent years. Knowledge in the literature survey, the pros and cons of the existing agricultural disease detection methods in the past can be used in the proposed work for further development.

On the client-side, the user can upload the image using a high-resolution camera and it has been considered as the input image. On the server-side, they can store 20 different images for 32 different plant species. In the next step, image pre-processing techniques such as rotation, gray scaling, thresholding, opening operations, inverse threshold, edge extraction and edge filtering were used to remove noise and unwanted information of the input image. The next step is feature extraction which is to extract the relevant information from the pre-processed output image using the following techniques such as convex hull information, morphological information, distance maps (vertical maps, horizontal maps and centroid radial maps) and color histogram to classify the different plant species using KNN classifier based on the Euclidean distance and centroid map

values. The accuracy value of the proposed system was 83%.

An developed a web tool for identifying the infected and non-infected pomegranate based on image processing methods as shown in Figure 3.2. In this method, user can upload the input image and it has been considered as the testing image and then resize technique is applied to avoid unwanted information from the testing image, resized size was 300 x 300 (Height, Width) pixel to extract the essential features using color, morphology and Colour Coherence Vector (CCV) feature and to group the similar features into same clusters using K-means algorithm. To classify the infected and healthy pomegranate fruit using the Support Vector Machine algorithm and to increase the accuracy of the proposed system based on the margin value of the linear separating hyper plane, 610 images were used as the training dataset. The overall system accuracy was 82%.

Vijai Singh in his paper, he explained about an automatic detection and classification of plant leaf diseases using image segmentation methods, classification techniques and genetic algorithm. The proposed method is as shown in Figure 3.4. In the image acquisition method digital camera was used to capture the input image. In the Pre-processing technique, the smoothening filter was used to remove the noise and increase the contrast of the input image. The masking process was used only to mask the green color pixel value using the threshold method. Clustering methodology was used to remove the green color pixels. The segmentation method was used to classify the diseased area and normal area in a leaf using a genetic algorithm and extracting the feature using color co-occurrence method based on contrast, energy, and local homogeneity and entropy values and classifying the leaf diseases using Support Vector Machine classifier. The proposed system accuracy was always above 90% compared to other methods such as MDC with K-mean algorithm. The proposed system was used to detect various leaf diseases for different species of plants like banana, lemon, beans, mango, jack fruit, sapota, tomato and potato.

Aaron Partick, in this work, conveyed that the multispectral image was captured using a quad copter, based on Several Vegetation Indices (SVI). To extract the feature from the SVI processed multispectral image threshold segmentation method was used and to detect the tomato spot wilt disease the correlation method was used as shown in Figure 3.6. This method provides the relationship between diseased areas and the healthy area. The correlation values were manually ranked to find the relative resistance value. The accuracy of the proposed system was above 90%.

The ARM processor was interfaced with an image sensor to capture the wheat leaf, which is transformed into an RGB color model image. In the next step, sober operator and vertical edge detection were used to convert the RGB model image into a gray scale image and to eliminate the background information. Flood filling algorithm was used to identify the diseased area and the healthy area. The wheat leaf rust disease was diagnosed based on the ratio of disease spotted on the image. The accuracy of the proposed system was 92.3%. This proposed system was used in various application fields such as classification of crop disease, detection, diagnosis and identification.

III EXISTING SYSTEM

The existing methodologies are used to identify only few crop diseases based on colour or texture or shape with its restriction to particular crops but not applicable to all the crops. The proposed methodology is to identify the diseases affecting three major crops of Tamilnadu

i.e. Rice, Sugarcane and Banana based on the features such as colour, texture and shape.Banana cigar end tip root is a recently emerging disease where the roots get affected by verticilliumtheobromae, inturn affects the fruit fingers and color changes to ash grey resulting in fruit wastage. Hence, fruits with less market value they are rejected in the market thus leading to a loss to the farmers. From the pie chart, the banana Cigar end tip root disease majorly affects crop in four major districts namely Sivangangai, Virudunagar, Theni and Dindugal. Nearly 12 % of the banana crops are affected by this disease. In other districts, 7% to 9% of banana crops are affected by this disease. Further, from the field survey it is observed that the banana Cigar end tip root disease occurs mostly during autumn season and it spreads fast through air medium.

In banana crown rot disease, the crown of the fruit gets infected initially leading to blackening of the skin eventually infecting the pulp resulting in rotten fruit. Due to this, the quality of fruit is degraded and it loses its market value. Banana Virus Disease leads to streaking of the leaves in yellow and even black in some cases due to necrosis. The disease occurs due to bugs, infected materials and saccharicoccussacchari and even shoot tip culture cannot resist this attack.

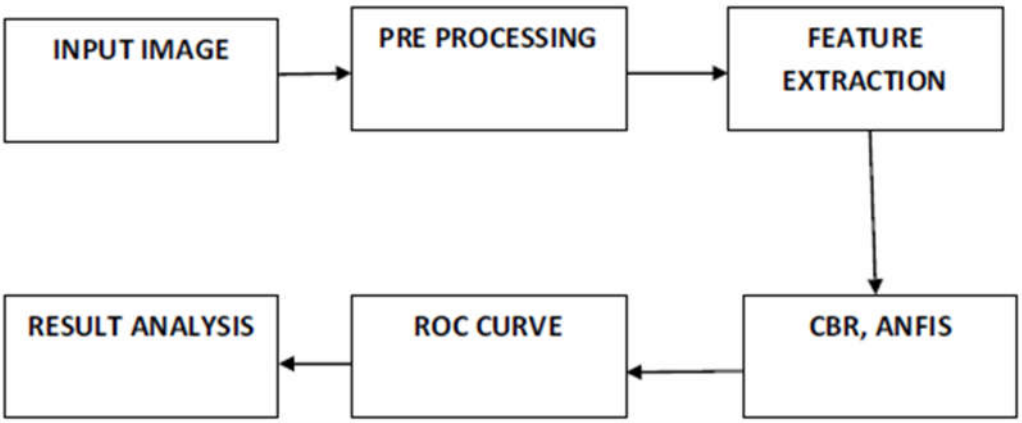
As the name suggest, mosaic appearance is observed on the leaves. Banana plants are observed to be dwarf in growth and have mottled and distorted leaves. The first symptom observed from the above three is mottled appearance with streaks and bands on the leaves. This disease is transmitted due to aphis gossypii.

IV DISADVANTAGES

Banana bract mosaic virus disease has similar symptoms as seen in mosaic virus but the bands and the mottling is observed over the entire area of young leaves. The most affected part is vein in the leaves where the vein is thickened abnormally due to the bunch development in the plant.

Banana virus disease also affects the leaf, stem, flower and fruit. The blackening of the stem and leaves are affected by the banana streak virus. Young leaves of vein are affected by the banana bract mosaic virus. The flowers of banana are affected by Cucumber Mosaic Virus.

V BLOCK DIAGRAM



Images are represented in a two dimensional array form with each element of the array representing one point of the image called as pixel. The pixel is represented by the mathematical function f (x,y) where 'x' and 'y' represent x and y coordinates respectively an example of the digital image displayed on computer screen, but in fact, this picture is nothing but a two-dimensional array of numbers ranging from 0 to 255. For image formation, a CCD array of sensors is used in the digital camera.

CCD, a charging-coupled device, is an image sensor and senses the values like other sensors and converts them into electrical signal. This CCD possesses an array or a rectangular grid form and it resembles a matrix that includes a sensor which detects the photon intensity within each cell of the matrix. Each CCD array sensor's value refers to each pixel value.

Pre-processing is one of the important stages in the DIP. It involves elimination of low-frequency background noise, normalization of brightness of individual images of objects and extraction or improvement of information in the images before digital processing. There are many techniques for pre-processing the image which are used for reducing noise, improving contrast and equalizing lighting (Kurniawati et al. 2009). In pre processing, different filters like median filter, wiener filter, Gaussian filter, etc., are used to remove background noise and contrast stretching is used to enhance and illuminate contrast.

Feature Extraction is the final stage of Digital Image Processing. Detection of image processing and image features in computer vision involves methods for computing image information's abstractions and deriving local decisions. Subsets of the image domain will be the resulting feature often in the form of isolated points, continuous curves or connected regions. Though the features selection is primarily carried out to choose appropriate and informative features, it also include other reasons like General data reduction to reduce storage requirements and increase the speed of algorithm Performance improvement to achieve predictive accuracy.

VI PROPOSED METHODOLOGY

In this research work, diagnosis of diseases affecting rice, banana and sugarcane crops is done using image processing, pre-processing, feature extraction, Case Based Reasoning (CBR) and Adaptive Neuro Fuzzy Inference System (ANFIS). Input images were collected from the agricultural field, pre processing technique was used remove the noise (Wijekoon et al. 2008). Feature extraction was used to extract the diseased area from the pre processed output image.

The CBR and ANFIS were used to diagnosis the diseases affecting rice, banana and sugarcane crops. Receiver Operating Characteristic (ROC) curve was used to evaluate the proposed system performance.

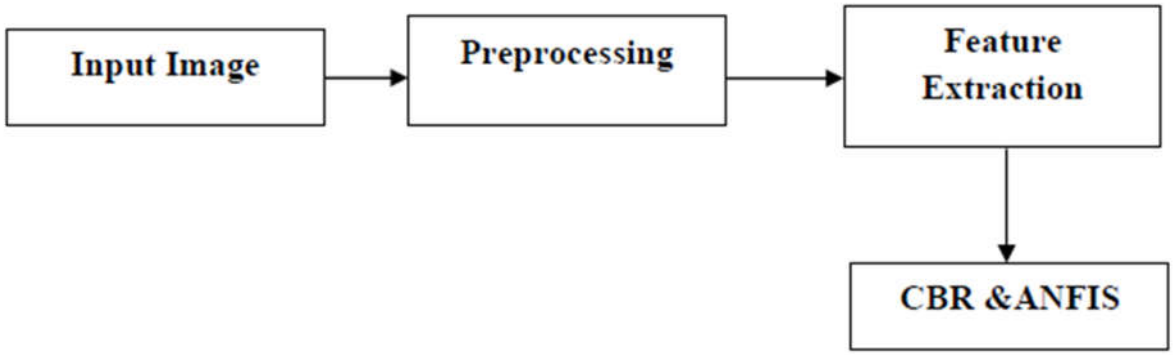


Figure Block diagram for Computer Aided Diagnosis of agricultural diseases of proposed system

In this project work the following modules were used and it is shown in Figure

1. Input image
2. Preprocessing
3. Feature extraction
4. CBR, ANFIS

INPUT IMAGE

In general, image is stored in matrix format and each matrix element is called as a pixel (Story et al. 2010). The input image captured with the help of digital camera is classified into two types:

1. Testing image
2. Training image

Training images were collected from Tamilnadu Agriculture Universities located in coimbatore, Madurai and also from various Agricultural Research Institutes in India. Testing images were collected from the rice, banana and sugarcane agriculture fields. In this research work, we used 16,000 images as input image where 11,200 images were used for training data set and 4,800 images were used for testing data. Input images for rice, banana and sugarcane diseases.

Pre-processing is a method used to remove the noise from the input image. In this research work, normalization method and soft coring filter were used. Normalization method was used to convert the RGB image into grey scale image The soft coring filtering is a non linear method that is used to remove the unwanted information from normalized image. Gaussian high pass filter is used to represent visually based on kernel function that can be performed in the frequency domain. Gaussian high pass filter performs a fast Fourier transform in two dimensional convolutions with sliding windowing technique. The normalized output image was passed to the high pass filter and output was added with soft coring function α.

Gaussian high pass filter was used to remove the noise from the input image. Soft coring kernel function was used to obtain the line and edge information of the input image. Soft coring filtering method was used for two dimensional images and data loss was very less when compared to median filtering technique. Two step pre-processing method contributes to the quality of the

image to be enhanced, reduction of processing time, compensation of illumination, reduction of the shaded background, maintenance of the image contrast and brightness.

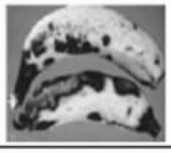
Disease Name	Input Image	Pre- processing Image
Panama Wilt		
Leafspot		
Crown Rot		
Anthracnose		
Tip Rot		
Virus Disease		

Table: Pre processing output of Banana disease

FEATURE EXTRACTION

Image stores pixel values and each pixel values indicate some features. Some general features of images are colour, texture and shape .

These features are further divided into three types

1.Pixel level features: These image features are calculated based on colour and location of each pixel values.

2.Local features: This image features are calculated using image segmentation and edge detection techniques.

3.Global features: This image features are calculated for entire image

VII ADVANTAGES

One of the major problems faced by the farmers is the identification of the crop diseases in the earlier stage. Different methods are available to identify agricultural diseases in an advanced stage like Visual inspection by the human eye, Chemical tests, Genetic analysis, Bio-chemical method We have some drawbacks in these methods as the diseases could be diagnosed only at the advanced stage but not in the earlier stage. Some methods consume time and also they are cost expensive where it cannot be employed by the farmers effectively. To overcome all these problems, an efficient and productive novel method to identify agricultural diseases at an early stage should be explored comparing other existing methods.

VIII APPLICATION

1.Image sharpening and restoration
2.Medical field
3.Remote sensing
4.Transmission and encoding
5.Machine/Robot vision
6.Color processing
7.Pattern recognition
8.Video processing
9.Microscopic Imaging

IX RESULTS AND CONCLUSION

The aim of this proposed work was to develop an algorithm for detection and diagnosis of various agriculture diseases. The unwanted noise was reduced in images by using different filtering methods like median filter and soft coring filter (Aaron Patrick *et al.* 2017). Based on the performance of the filters, it was observed that the soft coring filter resulted in better filtering of noise hence this filtering technique was used for further process.

After filtering, the essential features were extracted using feature extraction techniques. Based on the performance of feature extraction techniques, color feature extraction was observed to provide better result for Blast, Brown spot, Bacterial leaf Blight, Leaf Scald, Leaf spot, yellow leaf disease and Eye spot; shape feature extraction was observed to provide better result for Anthracnose, Cigar end tip root and Stem Rot; texture feature extraction was observed to provide better result for Panama wilt, Virus disease and Pokkahboeng.

After feature extraction, the diagnosis of agricultural diseases was done using classification techniques like MDC, KNN, SVM, CBR and ANFIS. Based on the performance of classification techniques, it was observed that the ANFIS resulted in better diagnosis of agricultural diseases.

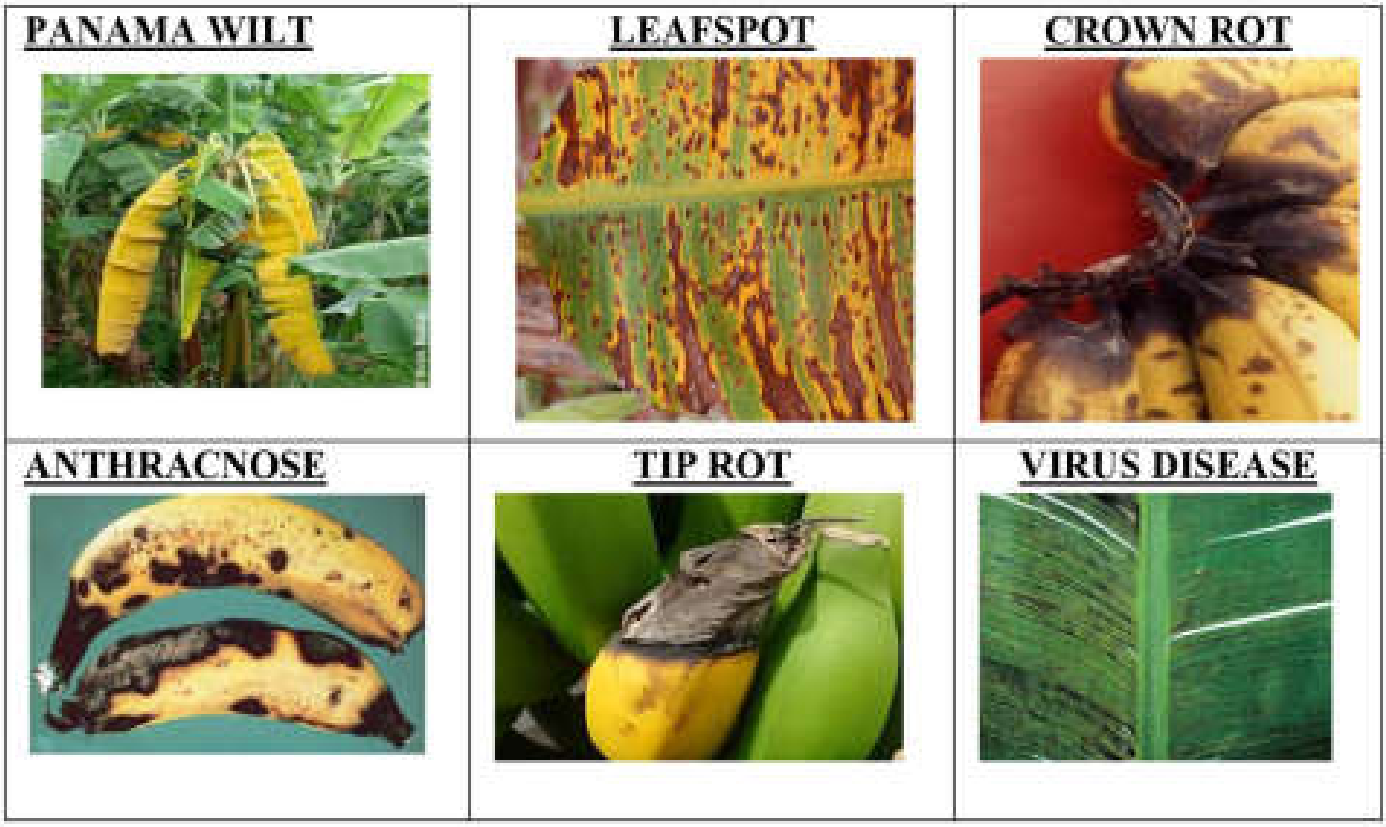


Figure: Input images of banana diseases

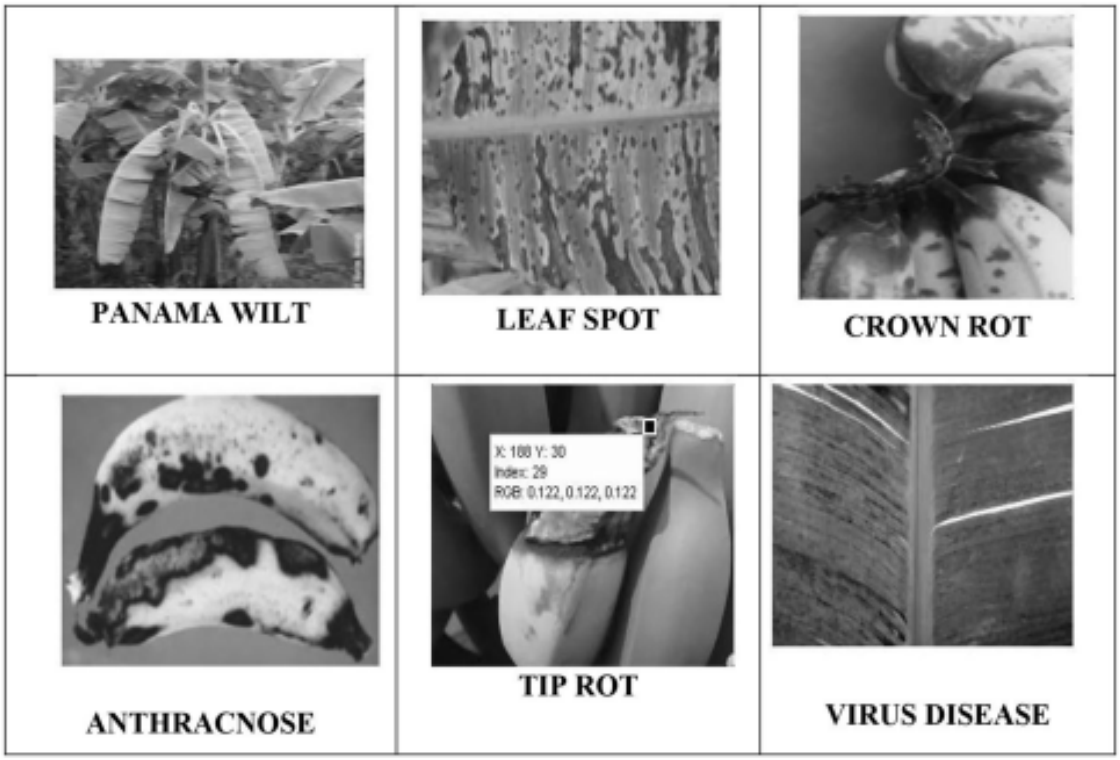


Figure: Preprocessing output of banana disease

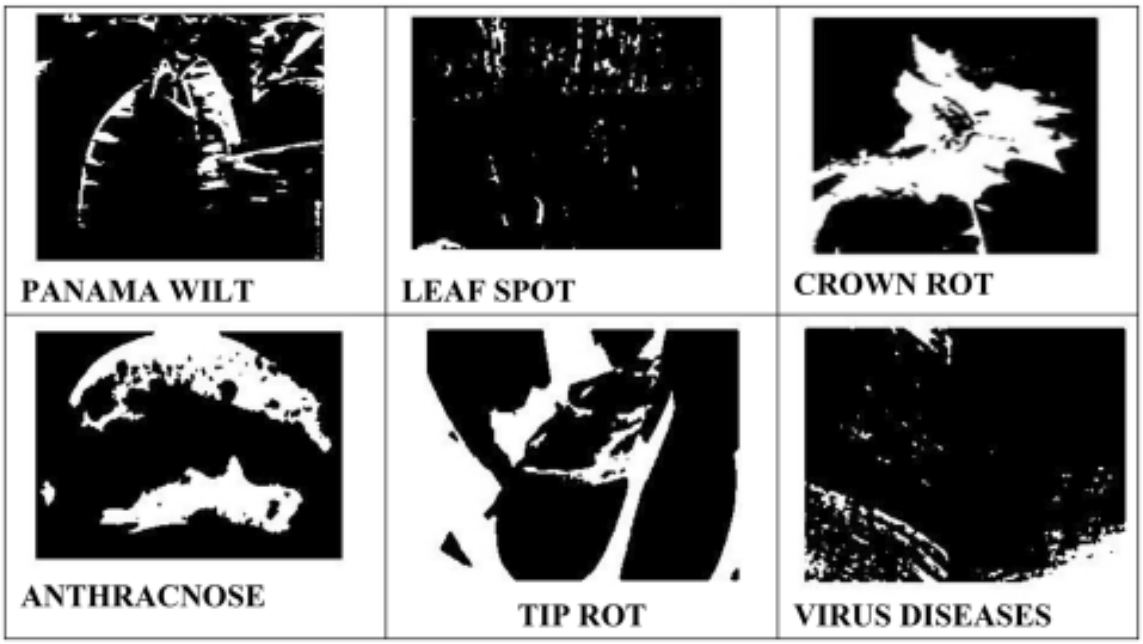


Figure: Colour feature extraction output of banana diseases

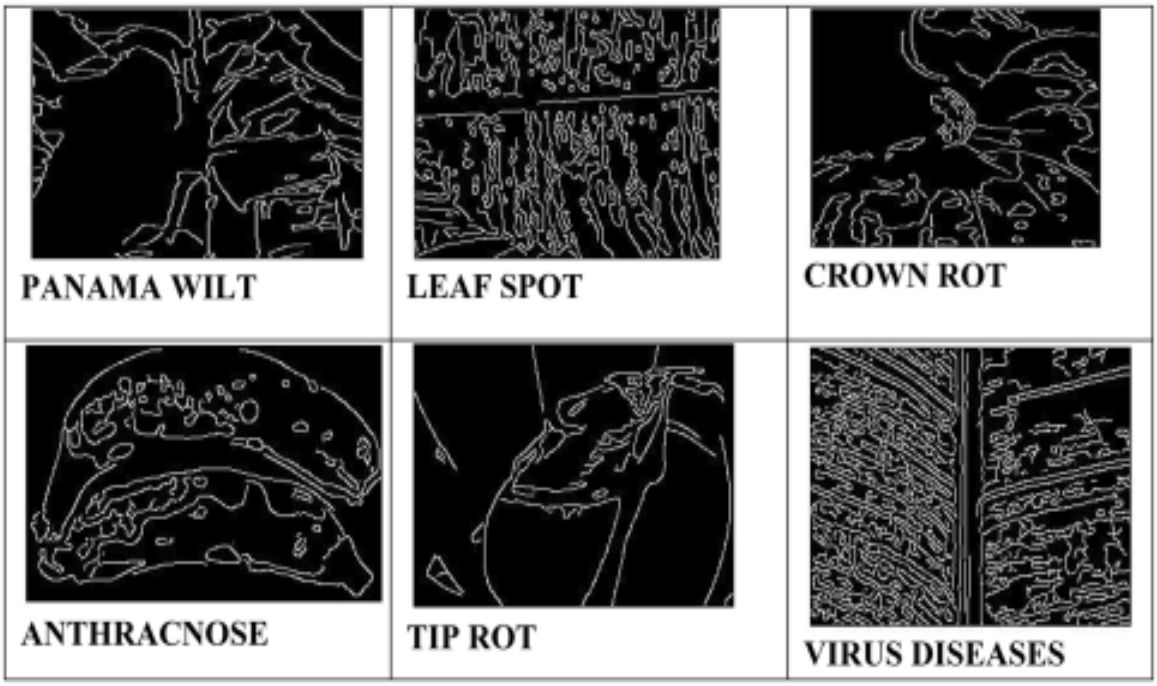


Figure: Shape feature extraction output of banana diseases

X FUTURE SCOPE

banana plant diseases are diagnosed. Images from the paddy field were gathered input and the noise was removed using the technique of smooth coring filtering. Computerassisted detection using segmentation is performed using threshold technique to locate the preprocessed image's diseased place. Computer-aided diagnosis utilizes ANFIS to classify the diseased cells as original, very tiny, tiny, medium, high and very high classes. Based on the above classification value, the Fuzzy logic technique was used to create the choice. The ROC curve was used to assess the efficiency of the scheme. The system's suggested accuracy is 97.5%.

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