E-Agriculture Analysis and Grading Disease of Leaf using Image Processing

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Abstract— E-Agriculture System is an Android based application. With the rapid progress of information technologies, may work have been dedicated to applying the technologies of pattern recognition and image processing to plant identification. The paper aims to describe, leaf identification based on shape. In this project, we describe the development of an Android application that gives user the ability to identify plant based on photographs of plant leafs. The detection of plant leaf disease is a very important factor to prevent serious outbreak. Plant diseases have turned into a difficult situation as it can cause significant reduction in both quality and quantity of agricultural products. Automatic detection of plant of plant leaf diseases is very important and challenging task. The developed processing scheme consist of four main steps, first a color transformation structure for the input RGB image is create, then the green pixels are masked and removing using specific threshold value, then the image is segmented and the texture statistic is computed. From the texture statistics, the presence of diseases on the plant leaf is evaluated.

Key words: HSI, Segmentation, Color Co-occurrence Matrix, Texture, Plant Leaf Diseases

I. INTRODUCTION

Plant plays an important role in the cycle of nature. Plant identification is very important and challenging task. The paper aims to describe, leaf identification based on shape. In this project, we describe the development of an Android Application that gives the users the ability to identify plant species based on image of the plant's leaf taken a mobile phone.

Plant diseases cause periodic outbreak of diseases which leads to large scale death and famine. The naked eye observation of experts is the main approach adopted in practice for detection and identification of plant diseases. But, this requires continuous monitoring of experts which might be prohibitively expensive in large farms. Further, in some developing countries, farmers may have to go long distances to contact experts, this makes consulting experts too expensive and time consuming and moreover farmers are unaware of non-native diseases.

Automatic detection of plant diseases in an important research topic as it may prove benefits in monitoring large fields of crops, and thus automatically detect the diseases from the symptoms that appear on the plant leaves. This enables machine vision that is to provide image based automatic inspection, process control and robot guidance. Al-Bashish, Braik and Bani Ahmed developed a fast and accurate method in which the leaf diseases are detected and classified using k-means based segmentation and neural networks based classification. Automatic classification of leaf diseases is done based on high resolution multispectral and stereo images. Sugar beet leaves are used in this approach. Segmentation is the process that is carried out to extract the diseased region and the plant diseases are graded by calculating the quotient of disease spot and leaf areas. An optimal threshold value for segmentation can be obtained using weighted Parzen-window. This reduces the computational burden and storage requirements without degrading the final segmentation results.

A. Types of Diseases

In this paper, detection and classification of leaf diseases has been proposed, this method is based on masking and removing of green pixels, applying a specific threshold to extract the infected region and computing the texture statistics to evaluate the diseases. Plant diseases may be broadly classified into three types. They are bacterial, fungal and viral diseases. Some of the diseases are shown in Figure 1.

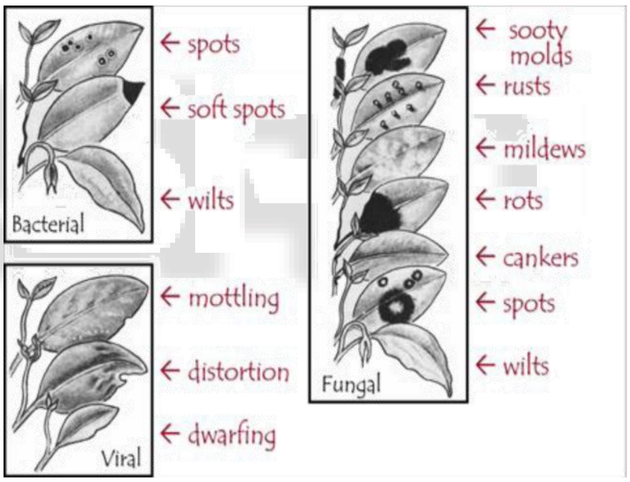


Fig. 1: Types of Diseases

II. LITERATURE REVIEW & RELATED WORK

Many research works have been published regarding the advancements of image processing for feature extraction and classification. Some researchers has suggest that a fast and accurate new method is developed based on computer image processing for grading of plant diseases. The result gives the technique for detection of plant diseases. The application of K- means clustering and neural network has been formulated for the clustering and classification of disease that affect a plant leaves. This work has been done for the five diseases. Many suggest that the citrus industry is an important constituent of Florida's overall agricultural economy. Algorithms based on image-processing techniques, for feature extraction and classification, were designed. The feature extraction process used color co-occurrence methodology, which uses both the color and texture of an image to arrive at unique features, which represent that image. Some has told during their research work that Changes in foliar color are a precious indicator of plant nutrition and health. Leaf color is measured with visual scales and inexpensive plant color guides that are easy to use. Digital color analysis now becoming an increasingly popular and cost-effective method utilized by resource managers and scientists for evaluating foliar nutrition and health in response to environmental stresses. They analyses with sugar maple leaves indicate that digital image analysis provides an accurate means of quantifying foliar color and estimating pigment concentration in multicolored leaves .Some of researcher has described their many related things on cotton. The goal of this research is to develop an automated system that can identify the pest or disease affecting a cotton leaf, boll or flower by using image analysis. This paper presents a CMYK based image cleaning technique to remove shadows, hands and other impurities from images.. The results are tested over a database consisting of 600 images. After the cleaning of the images three techniques have been applied to classify a presented image as a leaf, boll or flower.

In next paper, Cotton often suffers from various diseases that can adversely productivity to varying degrees .Proper disease control measures must be undertaken in cotton to minimize losses . They concluded that proposed feature selection approach can automatically and quickly identify independent significant feature for a pattern recognition system. Fuzzy curves can quickly isolate important and significant features subset. The process is fast and can be effectively used on system with large numbers of features and sample data. Images features extraction is very important for the grading process of flue-cured tobacco leaves. In this paper, a machine vision techniques base system is proposed for the automatic inspection of flue-cured tobacco leaves. Machine vision techniques are used in this system to solve problems of features extraction and analysis of tobacco leaves, which include features of color, size, shape and surface texture. The tobacco leaves must be careful classified by size, texture and color, all aided by a well-seasoned expert's feeling about the fine properties of the leaves. A system based on machine vision techniques is developed for automatic inspecting of flue-cured tobacco leaves.

III. ANALYSIS OF PROBLEM

The basic problems regarding with crop is on the field, a fast and accurate recognition and classification of the diseases is required by inspecting the infected leaf images also recognize the severity of the diseases. There are two main characteristics of plant-disease detection machine-learning methods that must be achieved, they are: speed and accuracy. The damage diagnosis of different crops and vegetables has traditionally been done manually. Several efforts have been made to use image processing systems to automate the process through this research work.

IV. PRESENT SYSTEM

Leaf diseases have turned into dilemma because it may cause reduction in productivity. Generally through the naked eyes the observation taken by the Experts ancient times for detection and identification of leaf diseases. But for continuous monitoring is required by the Experts and it is too expensive in large field. So in many underdeveloped countries in agricultural area, farmer needs to take lots of efforts. Simultaneously it will be so expensive and time consuming also for both experts and farmer.

V. IMAGE INTERPRETATION AND PROCESSING

This chapter examines the two main approaches that we can use to add geographical information to a fieldwork-based survey: manual interpretation and automatic feature classification. The first to be considered is the manual delineation of features using image interpretation and conventional cartographic techniques. That is followed by a brief explanation of digital image processing techniques that can use variations in the spectral response of features to produce computer-generated maps.

A. Image Interpretation:

1) Tone: variations in relative brightness or colour.
2) Texture: areas of an image with varying degrees of 'smoothness' or 'roughness'.
3) Pattern: the arrangement of different tones and textures; may indicate certain types of geology or land use.
4) Shape: distinct patterns may be due to natural landforms or human shaping of the land.
5) Size: recognition of familiar objects allows size estimation of other features; size is an important aspect of association: for instance, a 20 km-wide circular surface depression is unlikely to be a sinkhole, but might be a volcanic caldera.
6) Association: the context of features in an image, e.g. a drainage pattern.

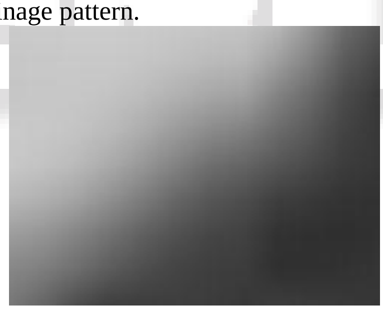


Fig. 2(a): tone

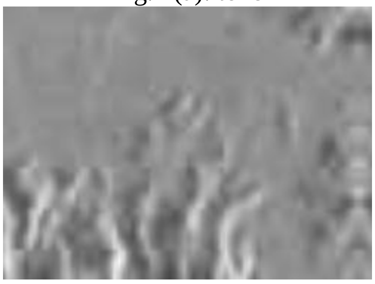


Fig. 2(b): texture

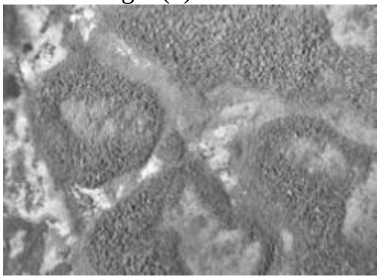


Fig. 2(c): pattern

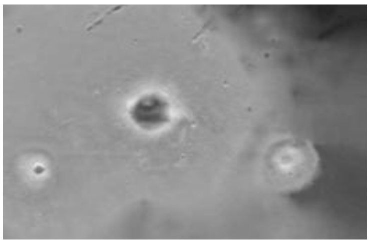


Fig. 2(d): size

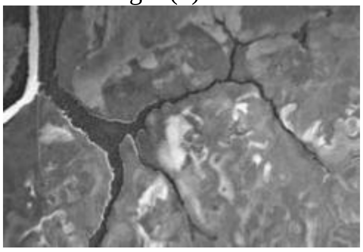


Fig. 2(e): Association

Fig. 2: Image Interpretation

Tone, texture, pattern and shape are all influenced by illumination conditions and vegetation cover: they can therefore vary with time. Subtle features, such as buried archaeological structures, are best detected with the low sun angles and long shadows found at the start and end of the day, as well as during the winter season. Conversely, when mapping rugged terrain, try to use mid-day or summer imagery to reduce the loss of detail caused by valley-side shadows. Wet season and dry season variations in vegetation cover may be linked to variations in hydrogeology. The orientation, size and density of shadows can give clues about an area's relief and degree of dissection.

VI. Proposed System

Figure 3 the basic procedure of the proposed vision-based detection algorithm in this paper. First, the images of various leaves are going to acquire using a digital camera. Then image-processing techniques are applied to the acquired images to extract useful features that are necessary for further analysis.

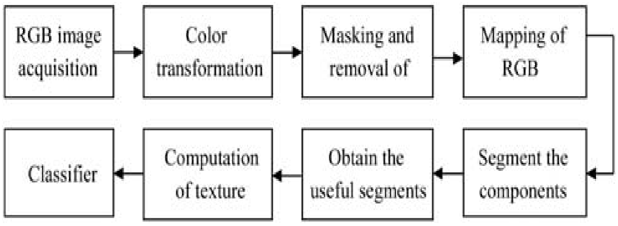


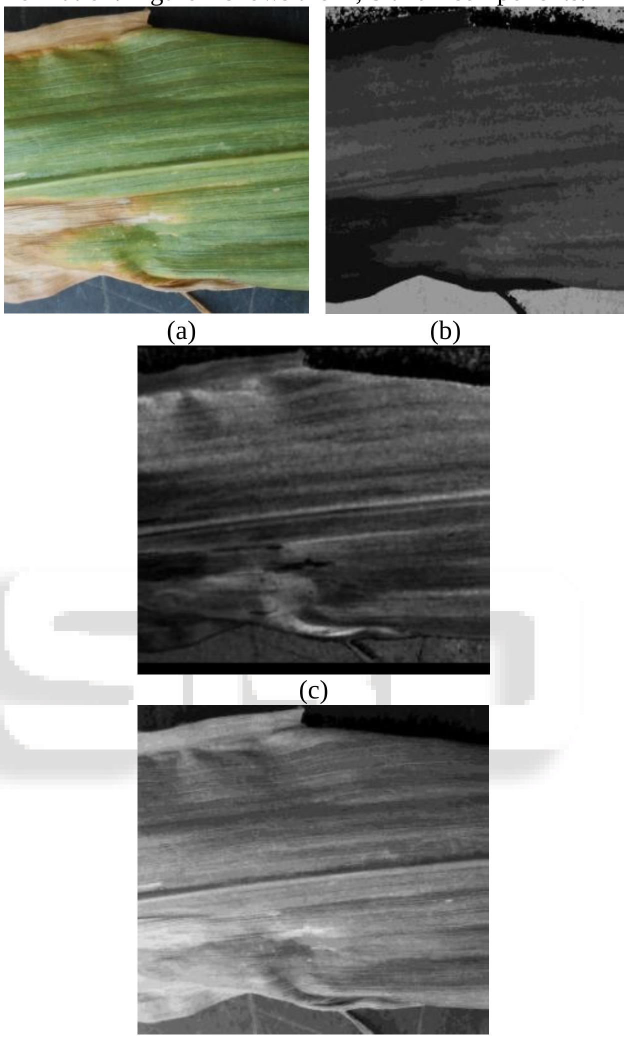
Fig. 3: Vision-based Detection Algorithm

The step-by-step procedure of the proposed system:

1) RGB image acquisition
2) Convert the input image from RGB to HSV format.
3) Masking the green-pixels
4) Removal of masked green pixels
5) Segment the components
6) Obtain the useful segments
7) Computing the features using color-co-occurrence methodology
8) Evaluation of texture statistics

VII. Implementation

The overall concept that is the framework for any vision related algorithm of image classification is almost the same. First, the can be converted from one space to another easily. After the transformation process, the. digital images are acquired from the environment using a digital camera. Then image-processing techniques are applied to the acquired images to extract useful features that are necessary for further analysis. After that, several techniques are used to classify the images according to the specific problem at hand. H component is taken into account for further analysis. S and I are dropped since it does not give extra information. Figure 4 shows the H, S and I components.



(a) (b)

(c)

(d)

Fig. 4: a) Input infected image b) Hue Component. c) Saturation component d) Intensity Component.

A. *Colour Transformation Structure:*

First, the RGB images of leaves are converted into Hue Saturation Intensity (HSI) colour space representation. The purpose of the colour space is to facilitate the specification of colours in some standard, generally accepted way. HSI (hue, saturation, intensity) colour model is a popular colour model because it is based on human perception. Hue is a colour attribute that refers to the dominant colour as perceived by an observer. Saturation refers to the relative purity or the amount of white light added to hue and intensity refers to the amplitude of the light.

B. *Masking Green Pixels:*

In this step, we identify the mostly green colored pixels. After that, based on specified threshold value that is computed for these pixels, the mostly green pixels are masked as, if the green component of the pixel intensity is less than the pre-computed threshold value, the red, green and blue components of the this pixel is assigned to a value of zero. This is done in sense that the green colored pixels mostly represent the healthy areas of the leaf and they do not add any valuable weight to disease identification and furthermore this significantly reduces the processing time.

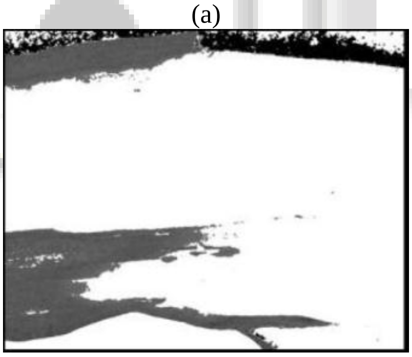
C. Removing the masked cells:

The pixels with zeros red, green, blue components were completely removed and the other remaining pixels are stored in binary image as shown in figure3.2. This is helpful as it gives more accurate disease classification and significantly reduces the processing time.

D. Matrix Generation:

The new binary image is taken into consideration which has pixels with value of 0 and 1. From this binary image we can generate the matrix which contains values of 0 and 1 and this matrix is transferred to Neural Network.

(a)



(b)

Fig. 5: a) Infected Image b) Binary Image with Infected part

E. Neural Network:

The neural networks are used in the automatic detection of leaves diseases. Neural network is chosen as a classification tool due to its well-known technique as a successful classifier for many real applications. The speed of convergence of a network can be improved by momentum backpropagation; most standard backpropagation algorithms employ a momentum term in order to speed convergence while avoiding instability.

F. Color co-occurrence Method:

The color co-occurrence texture analysis method is developed through the Spatial Gray-level Dependence Matrices (SGDM). The gray level co-occurrence methodology is a statistical way to describe shape by statistically sampling the way certain gray-levels occur in relation to other gray levels [5]. These matrices measure the probability that a pixel at one particular gray level will occur at a distinct distance and orientation from any pixel given that pixel has a second particular gray level. The SGDM's are represented by the function $P(i,j,d,\theta)$where i represent the gray level of the location (x,y), and j represents the gray level of the pixel at a distance d from location (x,y)at an orientation angle of θ. SGDM's are generated for H image.

G. Texture Features:

Texture features like Contrast, Energy, Local homogeneity, Cluster shade and Cluster prominence are computed for the Hue content of the image as given in Eqns.1 -5.

Contrast $= \sum_{i,j=0}^{N-1} (i,j)^2 C(i,j)$ (1)

Energy $= \sum_{i,j=0}^{N-1} C(i,j)^2$ (2)

Local Homogeneity $= \sum_{i,j=0}^{N-1} C(i,j)/(1+C(i-j)^2)$ (3)

Cluster Shade $= \sum_{i,j=0}^{N-1} C(i,j)\,(i-M_x + j - M_y)^3$ (4)

Cluster Prominence $= \sum_{i,j=0}^{N-1} C(i,j)(i-M_x+j-M_y)^4$ (5)

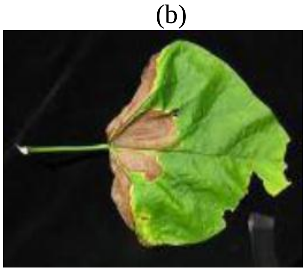
From the texture feature, the plant diseases are classified into various types.

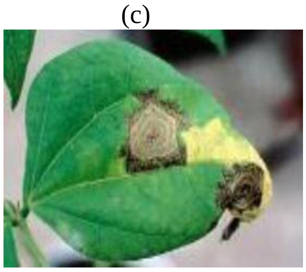
VIII. EXPERIMENTAL RESULTS AND DISCUSSION

About 500 plant leaves of 30 different native plant species of Tamil Nadu have been collected for analysis. The acquired leaf images are converted into HSI format. From the hue content, the co-occurrence features like contrast, energy, local homogeneity, shade and prominence are derived. The feature sets are used for analysis of disease type of particular species. Samples of leaves with various diseases like early scorch, yellow spots, brown spots, late scorch, bacterial and fungal diseases are shown in Fig 5

(a)

(b) (c)





(d) (e)

Fig. 5: (a) Bacterial Disease in Rose and Beans Leaf (b) Sun Burn Disease in Lemon Leaf (c) Early Scorch Disease in Banana leaf (d) Late Scorch Disease in Beans Leaf (e) Fungal Disease in Beans Leaf.

IX. MAPPED OUTPUT

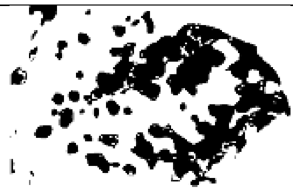
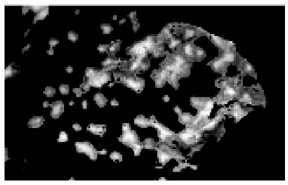
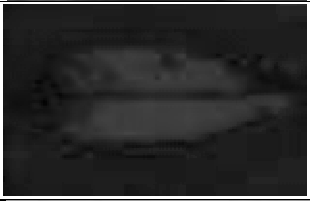
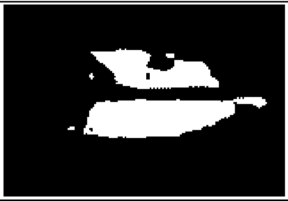
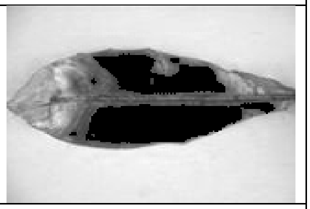
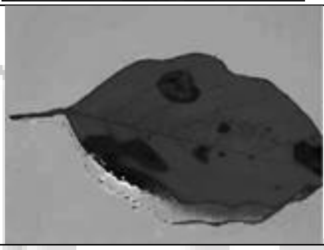
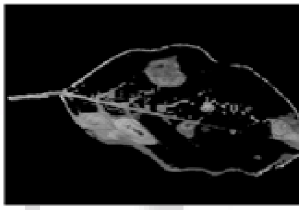
Plant species	Input image	Hue Content	Thresholded image	R, G,B Component
Beans				
lemon				
Banana				
Jackfruit				

Table 1: lists the set of leaves that are infected by various diseases and the subsequent steps that are carried out to extract the diseased region of the leaf.

X. CONCLUSION

An application of texture analysis in detecting the plant diseases has been explained in this paper. Recognizing the disease is mainly the purpose of the proposed system. Firstly by color transformation structure RGB is converted into HSV space because HSV is a good color descriptor. Masking and removing of green pixels with pre-computed threshold level. Then in the next step segmentation is performed using 32X32 patch size and obtained useful segments. These segments are used for texture analysis by color co-occurrence matrix. Finally if texture parameters are compared to texture parameters of normal leaf

XI. ACKNOWLEDGMENT

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