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Agricultural plant leaf disease detection and diagnosis using watershed segmentation and gray level co-occurrence matrix (GLCM)

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Abstract-- Nowadays many of the farmers and agro help center use the different new technology to enhance the agriculture production. Plants have become important source of energy. There are several diseases that affect plants with the potential to cause economic and social losses. Many of disease are most popular where disease spots occur on the sugar cane plant leaves. If the disease are not detected at first stage than it is more harm full to production. To find out particular disease using Digital image processing helps to find disease and provide prevention for particular disease which types pesticide need to prevent disease. Firstly take Input image in RGB form then the green pixels are removed then the image is segmented useful segment used for extraction finally texture statistics is completed and according to analysis disease prevention is provided. The results suggested that, leaf width, length, perimeter and area related features can be used as factors for prediction, and that machine vision systems lead to successful prediction of targets when fed with appropriate information.

Keywords-Leaf images; leaf disease identification

1. INTRODUCTION

Image processing is a method to perform operations on an image, in order to get an enhanced image or to extract useful information from it. It is a type of signal processing in which input is an image and output may be image or characteristics/features associated with that image.

Image processing basically includes the following three steps:

- Importing the image via image acquisition tools;
- Analyzing and manipulating the image;
- Output in which result can be an altered image or a report that is based on image analysis.

India is an agriculture based country. In this context agriculture plays vital role in Indian economy. 58 percent of rural people depend on agriculture as their principle means of livelihood. It is an important source of raw materials for many agro-based industries. There are many causes for plant diseases which affect the yield and hence the economic condition of both farmers and in turn the entire nation as whole. Plant diseases can be infectious or noninfectious. Noninfectious diseases are usually referred to as disorder caused by various causes such as nutrient deficiency, by waterlogged or polluted soil, and by polluted air from industry or excessive use of herbicides and pesticides. Infectious plant diseases (usually not visible to the naked eye) are caused by pathogens, living microorganisms that infect a plant and deprive it of nutrients [1].

The common approach used by the farmers to identify the plant diseases is by consulting the experts which is a very tedious, consumes more time and money. In addition there are some diseases which cannot be identified by the naked eyes. Hence in this context, a fast, reliable and automatic method is required to accurately identify the plant diseases. This paper provides the review of image processing techniques applied for identifying plant diseases detection. The figure 1 represents the general image processing steps adopted for plant disease detection using image processing. a. Image Acquisition: The digital images are acquired using a digital mobile camera

or digital camera and given as input to the identification system. This is the image in which the leaf disease has to be identified by the system b.

2. LITERATURE REVIEW

Agriculture is the backbone of India because 70% of the population depends on agriculture and crop production. So crop needed to be protected at early stage. Farmers have wide range of diversity to select suitable crop. Diversity in crops causes various diseases which restrict the growth, quality, quantity and productivity of the plants. In order to obtain more good products, a product quality control is basically mandatory. Diseases in plants caused by infectious organisms, can damage the normal state of plants leaves. Therefore, the early stage diagnosis of plant disease is an important task. To better understand plant leaf disease detection, it is useful to review and examine the existing systems.

Hence, recent Approaches and methodologies in the area of plant leaf disease detection have been discussed. Color space model and Watershed transformation algorithm for segmentation, Histogram of Oriented Gradients (HOG) for feature extraction.

They described the variety of plant leaf diseases from 19 plant spices. It manipulates the histograms of the H (from HSV color space) and a (from the L*a*b* color space) color channels. Further the histograms of oriented gradient (HOG) descriptors were applied for feature extraction to extract the gradient values. Finally the results are tested, which showed that HOG descriptors significantly outperform the local-invariant features (SIFT and SURF).

Then color and texture (Global Color Histogram, Color Coherence Vector, Local Binary Pattern, and Complete Local Binary Pattern) features are extracted from the segmented image. For classification Multiclass Support Vector Machine (MSVM) is used.

Leaf images using Linear Discriminate Analysis (LDA) and Principal Component Analysis (PCA). The Histogram Oriented Gradients (HOG) are used for the representation of leaf shape with different orientation and edges.

3. PROPOSED ALGORITHM

Firstly capture image from digital camera (mobile camera). Most probably the camera with some limitations and criteria will be considered. The captured image will be considered for further feature extraction, using one of the above algorithms. There are many features of images that are to be extracted, but we in our proposed system are going to consider some of them. The below system architecture shows the actual work flow of the concept that we are working on. The main focus of this proposed work is to help the farmers, suffering from loss due to incomplete knowledge of various diseases. The concept should be more user-friendly so, we are focusing on language translation too.

Working flow of proposed approach includes following steps:

1. Take RGB image
2. Image Color transformation of RGB to Gray scale
3. Image segmentation
4. Feature extractions
5. Statistical analyses
6. According to analysis matching of feature extraction are done.

Proposed work flow:

Preprocessing:

1. Weiner Filter or Gaussian filter

Segmentation:

1. Watershed based Segmentation

Feature Extraction:

1. Gray-Level Co-Occurrence Matrix (**GLCM**)
2. Histogram of Gradient (HOG) Features

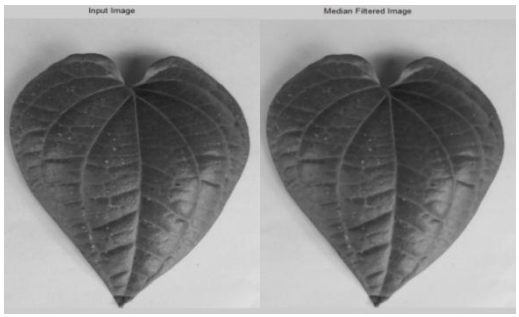
Classifier:

Minimum Distance Classifier.

1. Image Preprocessing

Image pre-processing is the term for operations on images at the lowest level of abstraction. These operations do not increase image information content but they decrease it if entropy is an information measure. The aim of pre-processing is an improvement of the image data that suppresses undesired distortions or enhances some relevant image features for further processing and analysis task. The enhancement includes filtering which

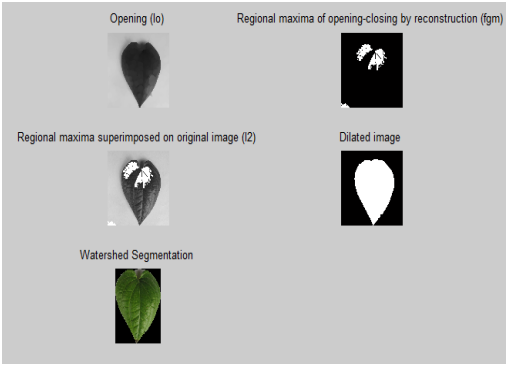
removes the noise and process the image efficiently. The filtering is done by using median filter. The median filter is operated by sorting all the pixel values from the window into numerical order, and then replacing by middle pixel value. The original image, median filtered image is shown in fig a) and fig b) respectively.



a) Original image b) Median filtered image

2. Image Segmentation

Watershed means line that divides areas drained by different river systems. The watershed separates the image region by determined boundaries. Color transformed image is given as input to the segmentation. Edge detection is done by using sable operator. The gradient magnitude of edge detected image is calculated. Then the regional maxima of opening-closing by morphological reconstruction are determined. Finally watershed transformation is done to obtain the segmented betel leaf image. Image segmentation process is in three stages. The first is image pre-processing, in this stage remove useless information from the image. The second stage is initial object discrimination, where objects are grossly separated into groups with similar attributes. Third stage is object boundary clean up, where object boundaries are reduced to single-pixel widths. In recent years several popular methods have been developed for image segmentation.



Extracted betel leaf after watershed segmentation

The flow of watershed segmentation is shown in Fig 2.1

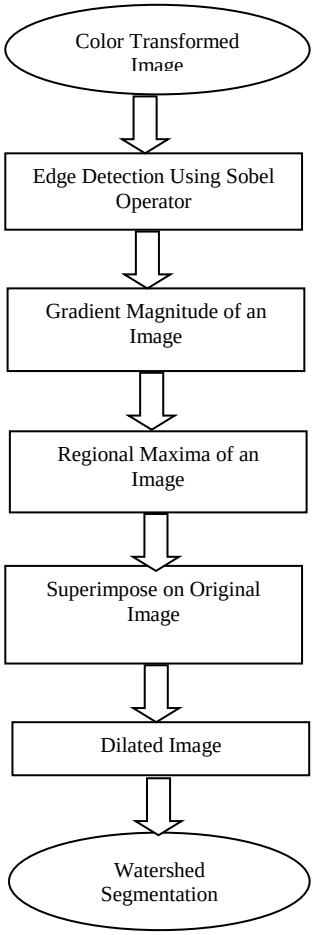


Fig 2.1Flow of Watershed Segmentation

3. Feature Extraction

Feature extraction is used to extract relevant features from the plant leaf. To arrive at the decision and identification, the results from feature extraction are classified. Using Histogram of Oriented Gradients (HOG) technique the gradient and magnitude values are extracted from the betel leaf. The Histogram of Oriented Gradient (HOG) is a feature descriptor used in computer vision and image processing for the purpose of object detection. The procedure includes events of angle introduction confined bits of a picture. HOG

counts occurrences of gradient orientation in part of an image hence it is an appearance descriptor.

HOG divides the input image into small square cells (here used 9×9) and then computes the histogram of gradient directions or edge directions based on the central differences.

Gradient Computation

$$m = \sqrt{dy^2 + dx^2}$$

$$\theta = \arctan(\frac{dy}{dx})$$

Orientation Binning

- Creating the cell histograms.
- The cells themselves can either be rectangular or horizontal.

Descriptor Blocks

The blocks are divided into two types,

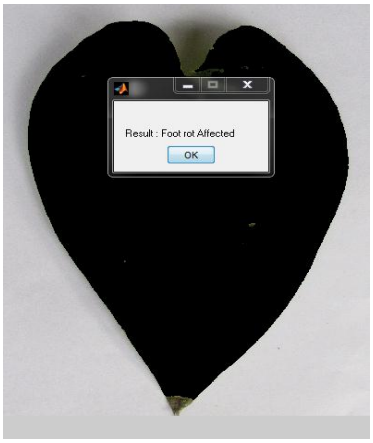
- R-HOG
- C-HOG

Block Normalization

$$\boldsymbol{V} = \frac{\boldsymbol{V_k}}{||\boldsymbol{V_k}|| + \epsilon}$$

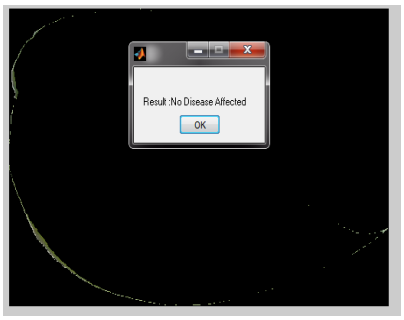
4. Image Classification

Another type of segmentation method is based on pixel classification. Pixels in an image can be represented in feature space using pixel attributes that may consist of gray level, local texture, and color components for each pixel in the image. In the case of single channel (or single frame) image, pixel classification is typically based on gray level and image segmentation can be performed in a one dimensional feature space. For multichannel (multiple frame) images or multispectral (multimodality) images the segmentation can be performed in multidimensional feature space.



Classifier Output for Foot Rot Diseases

Classifier Output for Leaf Rot Diseases



Classifier Output forHealthy leaves

4. CONCLUSIONS

The proposed method is to classify the leaf rot, foot rot and powdery mildew diseases affected in the betel vine plantation. The color transformed images are sharply segmented using Watershed transformation algorithm. After that, A channel is extracted from l*a*b color transformed images (RGB to l*a*b). The gradient feature value of betel leaf images are obtained using HOG technique based on the shapes of the betel leaf. Multiclass SVM classifier classifies the betel vine diseases

using gradient feature values of the leaf images. The watershed segmentation and Multiclass SVM classifier are the recent techniques involved in this research. From the performance evaluation of the accuracy values it is concluded that the watershed transformation algorithm could detect betel leaf diseases efficiently at the accuracy rate of about 95.85 %. Through the performance and evaluation, it is concluded that the proposed solution is feasible and is capable to reach much better classification result than the existing.

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