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Crop Diseases Detection with Preventive Measures Using Image Processing

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Abstract—
The prime need of this world is the best farming which decides the development of each country as the survival of human being is completely dependent on farming and its best production. The problem observed in various region of farming is the early crop diseases Occurring and making the crop production at low level. To avoid this many researchers have been developed the different techniques to detect early crop diseases and to apply the preventive measures for it. In this paper a literature survey is given for the various techniques of crop detection method using image processing. The image processing using Matlab is being observed as a very important tool for it.
Keywords—Neural network; WMSN; Machine Learning; CTB.

I. INTRODUCTION

First arrival of crop disease can observed at very first stage from its leaf pattern. The infected plant shows some colored spots on leaf generated due to different types of infection [1]. Manual observation of the plant leaf with manual conclusion of crop disease is a difficult one, also there may chance of wrong conclusion with wrong preventive action.

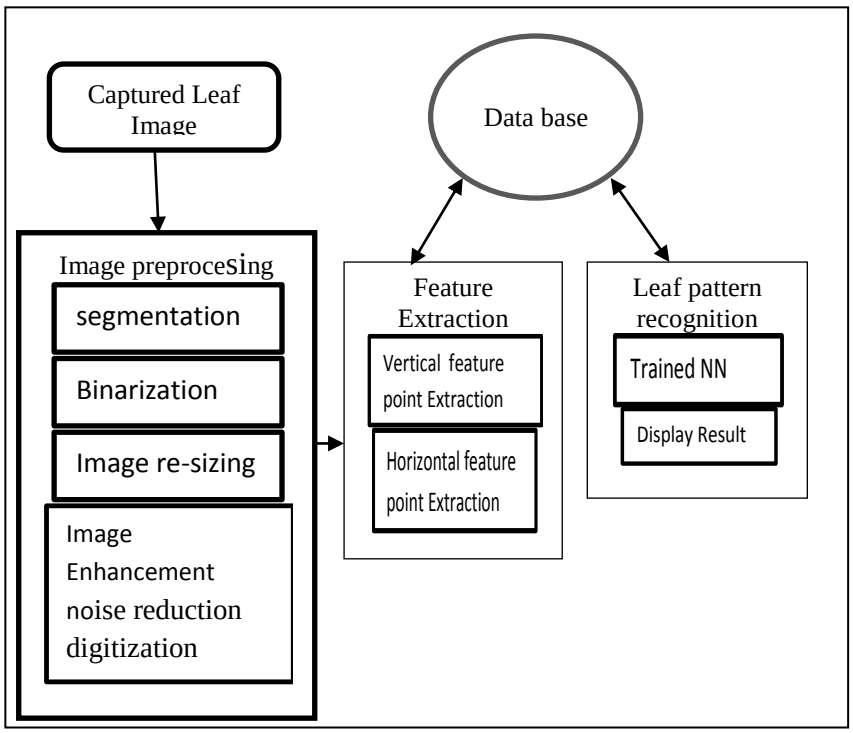
Image processing has shown its wide application with more relevant and correct output for achieving this early crop disease detection. The leaf image can be processed in different extent to observe the various spots and comparing it with the stored data sets to provide the exact disease occurred on crop [2].

This paper represents different techniques introduced by many researchers for this early crop detection. In first section the methodology of crop detection is mentioned. Leaf Recognition using neural network is explained in second section. Color Transformed based, wireless multimedia sensor network (WMSN) and machine learning technique recognition is explained in further sections.

II. Methodology:

The methodology for disease recognition in fig.1 starts with capturing of images of plant leaf using digital cameras. These images are preprocessed into different steps for improving its qualities using image enhancement, noise reduction, background subtraction, normalization and digitization [3]. Features are extracted for given leaf and get applied as an input to the image processing toolbox. Overall method is contributed using following steps.

Fig1. Overall method



A. Input Leaf Image:

The very first step in the proposed approach is to capture the leaf image with uniform background from the digital camera and after process of pre-processing, extract the feature points of leaf image [4]. The leaf image captured from digital camera and the feature points are extracted from the leaf image and extracted feature points store in the database. The recognition rate mainly depends on the image quality.

B. Leaf image Database:

The next step in the work is the formation of the leaf image database. These leaf images from database are used for training the artificial neural network as well as for testing of input leaf image. The formation of leaf image database is clearly dependent on the application. The leaf images are capture in specific manner. The background use for the leaf images is of uniformed colored this propose work uses the white colored background. The leaf image database in the propose work consisting of 200 leaves images.

C. Image Pre-processing:

The use of leaf image data for leaf database requires several preprocessing procedure. These procedures include; reading, displaying and resizing of the image, segmentation, binarization and fast Fourier transform (FFT), and image enhancement, noise reduction, digitization which improves the leaf image quality. The techniques used in this process may vary. These image preprocessing techniques doesn't affect the leaf image content. The goal of digital image preprocessing is to increase both the accuracy and the interpretability

III. Leaf Recognition using Neural Network:

Neural Network recognition is achieved using two types of classification i.e.

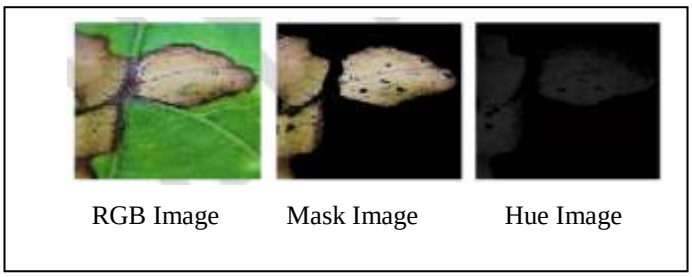
A. Supervised classification
B. Unsupervised classification

In supervised classification, a priori knowledge of the images to be classified is known. Hence, the classification is simply a process of testing whether the computed classification agrees with the prior knowledge.

In unsupervised classification, there is not any prior knowledge on the images to be classified. Hence, the classification is a little bit more tedious since we have no prior knowledge of the various data classes involved.

An input image of leaf is first converted to gray scale image representing all black and white spots on the image. This leaf image gets split vertically and horizontally to obtain the features points. A feedforward back propogation neural network is used for training purpose for all leaf images used in database [5]. Leaf image to be recognized also undergoes same process and final comparison of all feature points is carried out. The result as displaying recognize leaf image, name of leaf image and the disease detected is mentioned in fig.2

Fig. 2 Result of leaf recognition using Neural Network

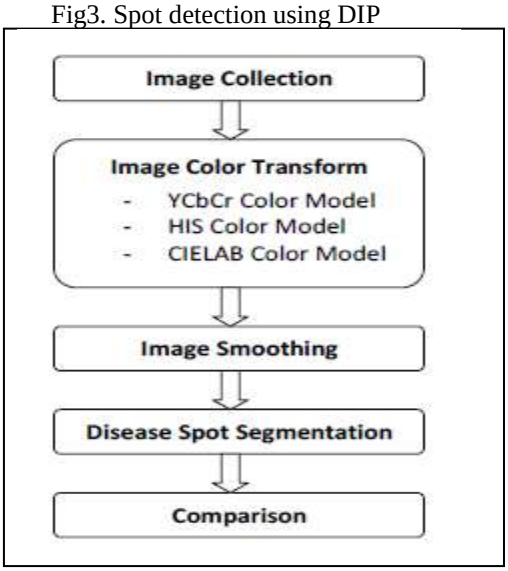


IV. Color Transformed Based (CTB) Approach:

The methodology of automatic detection and classification of plant diseases with diseases spots are different in color but not in intensity so color transformation can be used for better segmentation of diseases spots. Median filtering is used for smoothing the image and OTSU method are for detecting the diseases spots on leaf [6].

The detection of spots is achieved by means of some techniques such as image acquisition, image preprocessing and OTSU method. OTSU method is used for threshold and median filter is used for removal of unnecessary spots on the leaf. Thresholding converts the filtered image into binary one carried with edge detection for recognizing the spot diseases on leaf [7]. The overall process is as shown in fig.3

Fig3. Spot detection using DIP



Method 1: disease spots are segmented by applying Otsu threshold on RGB image.

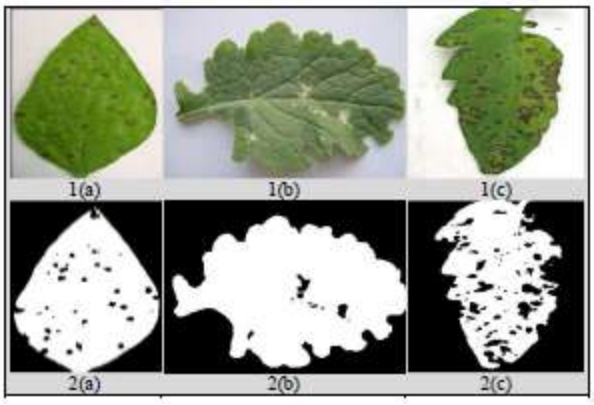
Method 2: in second method RGB image is first converted into YCbCr color space using color transform formula. Then median filter is used for image smoothing. Disease spots are detected by applying Otsu threshold on 'Cr' component of filtered YCbCr color space.

Method 3: this is similar to method 2. Only difference is that in place of YCbCr color space RGB image is transformed into HSI color space and disease spots are detected by applying Otsu threshold on 'H' component of filtered HSI color space.

Method 4: again same process is repeated using CIELAB color space. Disease spots are segmented by applying Otsu threshold on 'A' component of filtered LAB color space.

The RGB image of frog eye leaf spot lesion on soybean leaf results with white spot on mustard leaf and grey spot on tomato leaf with respective result of diseases spot detection is shown in fig4.

Fig4. Result with different colored disease spots

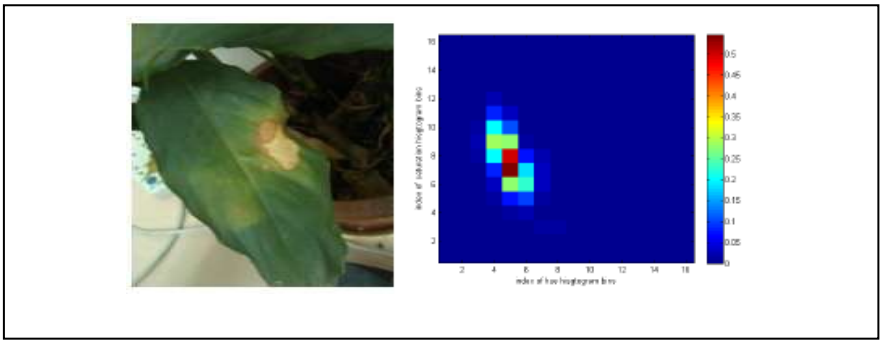


V. Wireless Multimedia Sensor Network Recognition:

Every time capturing the image individually and training it consumes the man power and time both. Hence a new support is provided by Rapid development of wireless multimedia sensor network (WMSN) which reduces the workload to a great extent. A CCD camera equipped with WMSN captures and sends back the images of provided location. Once the images reached to the desired location, the inspector only needs to distinguish crop images on the computer to obtain the information on crop growth [8].

The complete method includes image segmentation based on both color and shape, and also uses 2D histogram as the feature for classification. The overall work is carried out using ARM 11 core on the integrated Raspberry Pi board as its main processing power. An input image with its 2D histogram as a result is shown in figure 5.

Fig5.An input image with 2D histogram of positive training dataset.



VI. Machine Learning Technique Recognition:

Different Machine Learning techniques for learning classifier have been investigated in this paper. These techniques are selected due to the reason that these classifiers have performed well in many real applications [9].

A. K- Nearest Neighbor (KNN)

The K Nearest Neighbor is a kind of lazy learner which means that this classifier train and test at the same time. KNN classifier is instance based classifier that performs classification of unknown instances by

relating unknown to known by using distance or similarity function. It takes K nearest points and then assigns class of majority to the unknown instance [10].

B. Naïve Bayes Classifier

Naive Bayesian Classification is commonly known as a statistical classifier. Its foundation is on Bayes' Theorem, and uses probabilistic analysis for classification. Naïve Bayesian Classifier give more accurate results in less computation time when applied to the large data sets. [11]

C. Support Vector Machine (SVM)

Support Vector Machine is machine learning technique which is basically used for classification. It is a kernel based classifier; initially it was developed for linear separation which was able to classify data into two classes only. SVM has been used for different realistic problems such as face recognition [12], cancer diagnosis voice identification and glaucoma diagnosis.

D. Decision Tree

Decision Tree Classifiers (DTC's) are being successfully used in many areas including medical diagnosis, speech recognition, character recognition etc. Decision tree classifiers have ability to convert the complex decision into easy and understandable decisions. [13]

E. Recurrent Neural Networks

Recurrent Neural Networks (RNN) includes feedback connections. In contrast to feed-forward networks, the dynamical properties are more significant. Neural Network has evolvement within a constant state and the activation values of any units do not change anymore. But in some cases, according to required scenario it is important to change the activation value of the output neurons. [6]

It is clear that on the average, Decision Tree is the best classifier, followed at a close distance by KNN and SVM. Decision Tree gives its best performance on DCT features followed by DWT. KNN gives its best performance on DWT followed by Texture and SVM gives its best performance on Texture features followed by DWT. The best performing features on the average accuracy is Discrete Wavelet Transform (DWT) feature.

Table1: Comparison of performance for various methods

Features	DCT	DWT	Texture	Average
KNN	75%	91.85%	75.45%	80.77%
Decision Tree	91.95%	83%	75%	83.31%
Naïve Bayes	68%	75%	50%	63.67%
RNN	66.25%	75%	83%	74.45%
SVM	75%	83.67%	90.45%	83.04%
Average	74.84%	81.70%	74.87%	

VII. Conclusion and future work:

The digital image processing is observed to be an effective tool for crop disease recognition. In this paper few techniques of detection is given with various input images of crops and results. It is observed that the last method of recognition using machine learning technique shows better and more efficient results than others.

If this machine learning technique is equipped with wireless sensor network will provide much efficient result than expectation.

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