DETECTION OF DISEASED PLANT LEAF USING SVM CLASSIFIER

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Abstract* – *Agriculture in now days is not just a mean to feed population, it is more than that especially in countries like India where economy is directly or indirectly affected by production. So to maintain economical status, plants should be free from disease. Thus detection of disease in plants should be of great concern. To detect disease in plants number of techniques of segmentation and classifications are applied. Proposed work in paper begins with preprocessing of input plant image. Then processed image is segmented with k-mean clustering and thresholding, after getting clusters features are extracted using GLCM. GLCM (Gray Level Concurrence Matrix) is used to extract texture related features from plat images. At last classification is performed using Support Vector Machine that shows more accurate results for identification and detection of plant leaves diseases.

Keywords- Segmentation, GLCM, SVM, plant disease detection.

I. INTRODUCTION

Agriculture is the mother of all cultures. It has assumed an important part in the improvement of human development. Today's world, land of agriculture is a feeding source. Mostly Indian economy is highly reliant on agricultural productivity. In this manner, disease identification in plants assumes as an imperative part in agriculture field. To recognize a plant sickness in extremely starting phase, use of automatic disease detection technique is advantageous. It may causes serious effects on the plants, if appropriate care is not taken in this area and due to which particular product quality, quantity or productivity is influenced.[1]

Diseases and insect pests are the major issues that threaten development of agriculture. These require careful diagnosis and convenient dealing to shield the products from heavy losses. There are some common diseases seen in plants such as are brown and yellow spots and others are fungal, viral and bacterial diseases. The plant leaf disease identification is the methodology which is utilized to recognize infected part from the plant leaf. The properties of the input image can be investigated into shading and textural features. The color properties of the image include shading powers of the commitment to terms of red, green and blue. The textural components of the picture include shading segments of the cluster of the pixels. The plant disease identification contains the three phases, in the main phase, the textural components of the information picture are analyzed. In the second phase, the segmentation method is applied which will partition similar and dissimilar parts of leaf. In the last phase, classification is applied which will characterize the image into specific classes according to their properties. The SVM is the classifier which is associated to organize the image as demonstrated by their properties into particular classes. The linear SVM just classify the information into two classes which is exceptionally wasteful and decrease precision of grouping.

In case of plant, the disease is described as any debilitation of normal physiological capacity of plants, conveying trademark reactions. A manifestation is a phenomenon running with something and is viewed as confirmation of its existence. The management of disease is a challenging task. Most of the disease symptoms are seen on the leaves or the stem of the plants.[2] Disease is caused by pathogen which is any specialist causing ailment. It is found that heavy crop losses caused by several diseases such as cordana spots, canker, late blight, early blight, root rots, apple scab, sigatoka, rust, anthracnose, powdery mildew, fungi, etc.

II. LITERATURE SURVEY AND RELATED WORK:

Several methods have already been proposed to detect the plant leaf diseases. This section gives an overview of the existing methods that suggests the various implementation ways: *Vijai Singh et al.* [1] are covered various techniques for the classification of the plant diseases and also present a classification of plant leaf diseases and an algorithm for image segmentation technique which is utilized for automatic detection. Image segmentation, which is an essential aspect for disease detection in plant leaf disease, is done by using genetic algorithm. *Jayamala K. Patil et al.* in [2] provide advances in different techniques used to examine plant diseases/traits utilizing image processing. The techniques examined are for increasing throughput & reducing subjectiveness arising from human experts in distinguishing the plant diseases. *Mrunalini R. Badnakhe et al. in* [3] suggested k-menas clustering and neural networks methods to identify and recognize various types of diseased crop patterns. K-means clustering is simple and easy way of segmentation and neural networks are used for the automatic detection of plant leaves diseases. *Anand.H.Kulkarni et al. in* [4] suggested image processing techniques and artificial neural network (ANN) for the detection of the plant diseases accurately. The proposed methodology in this paper is depends on ANN classifier for classification and Gabor filter for the extraction of the features. An ANN based classifier classifies various plant diseases and utilizes the combination of textures, color and features to detect those diseases. *Sabah Bashir et al. in* [5] are using K-mean clustering, texture and color analysis to detect the diseases in Malus domestica. To arrange and perceive distinctive horticulture, it utilizes the texture and color highlights those generally show up in typical areas. *Smita Naikwadi et al.* in [6] are identified plant diseases by using histogram matching that is based on the edge recognition methods and color feature. For the training process, layers separation strategy is utilized which incorporates the training of these samples which separate the layers of RGB image into red, green, and blue layers and edge detection technique which are used for detecting edges of the layered images. Spatial Graylevel Dependence

Matrices are used for building up the color co-occurrence texture analysis method. *K. Sasi et al.in* [7] implements the Convolutional Neural Network (CNN) algorithm for automated prediction of the plant leaf disease. An image is enhanced for the better quality of the image then CNN algorithm is applied for the classification of plant leaf image and identification of the disease information. *Piyush Chaudhary et al.in* [8] described an algorithm for disease spot segmentation in plant leaf utilizing image processing techniques. In this paper, by comparing the impact of HSI, CIELAB, and YCbCr color space disease spot detection procedure is done. Median filter is used for soothing the image. In final step, calculate the threshold value for detection of the disease spots by applying Otsu method on color component. *Arti N. Rathod et al.* in [9] are surveyed different methods for leaf disease detection using image processing techniques. The current methods are for increasing throughput and reduction subjectiveness which comes because of naked eye observation through which identification and detection of plant diseases is done. *S. Arivazhagan et al* in [10] suggested the automatic detection of diseases of plants that is a basic research point as it might demonstrate benefits in monitoring large fields of products, and subsequently automatically detect the symptoms of diseases as soon as they show up on plant leaves. The proposed framework is a software solution for automatic detection and classification of plant leaf diseases. The proposed algorithm's efficiency can effectively detect and classify the inspected diseases with an accuracy of 94%. Experimental results on a database of about 500 plant leaves affirm the robustness of the proposed approach. *Basvaraj .S. Anami et al.* [11] suggested the color and texture features are used for recognisation and classification of different agriculture/horticulture using neural network classifier. An ANN based classifier is embraced which utilizes the combination of color and texture features to recognize and classify different agriculture/horticulture produce. *Sanjay B. Patil et al.* in [12] identified symptoms of disease on the plant vary significantly under the different phases of the disease so the accuracy of the measured disease relies on the segmentation of the image. Simple threshold segmentation is used to calculate the leaf area but this technique is not appropriate to figure out the area of the lesion region because of varying characteristics of the lesion region. So, Triangle strategy of the thresholding used here to segment the lesion region. *S. Ananthi et al.* in [13] explained the texture analysis in detecting the plant diseases. The experimental results shows up the proposed approach can perceive the leaf diseases with minimal computational effort. The extension of this work will focus on creating algorithms and NN's in order to increase the recognition rate of classification process. *H. Al-Hiary et al.* in [14] are utilized K-means clustering and Neural Networks (NNs) for clustering and classification of diseases that influences plant leaves. It can significantly support an accurate detection of leaf diseases in a little computational effort. *T. Rumpf et al.* in [15] has been implemented the early detection and differentiation of sugar beet diseases based on Support Vector Machines and spectral vegetation indices. Sugar beet diseases are identified using k-means, K-nearest neighbor and SVM Classifier. SVM classifier proved to be a powerful tool for the automatic classification. *Sindhuja Sankaran et al.* in [16] has been reviewed various types of detection techniques for the plant diseases. These techniques involve spectroscopic, imaging and volatile profiling based plant disease detection methods. This paper also compares the advantages and disadvantages of these detection techniques.

III. PROPOSED METHODOLOGY:

In case of leaf, image preprocessing contains preprocessing as segmentation of leaf, extraction of color, data extraction related to leaf. Classification is a main process in image processing and in case of plant leaves classification is based on their color and their morphological features using SVM. Framework for this vision related algorithm of image classification is as follow. The processing will be done through different steps as shown in fig.1.

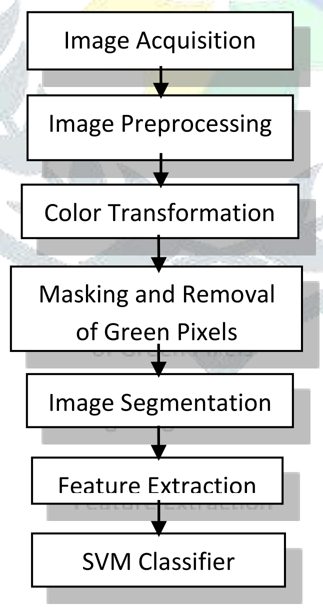


figure.1: system design of proposed methodology

1. Image Acquisition: This is the first most process for capturing the pictures of diseased plant leaves using camera and converted to desired output.

2. Image Preprocessing: It is the common name for operations with images at lowest level of abstraction. The main aim of preprocessing is an improvement of image and removing unnecessary image related data and also enhances the image features such as modifies or brighten the pixels and removal of noise. This process consists of sub processes image segmentation, enhancement and conversion of color space. Filters are used to enhance image.

3. Color transformation: First, the RGB color image is converted into the L*a*b color space model. This is also known as CIELAB color space model. The purpose of this conversion is to quantify the visual differences. This model consists of luminous layer 'l*', chrominance layer 'a' and 'b*'. Luminance refers to brightness and chrominance refers to color. Chrominance layer 'a*' indicates where color falls along red-green axis and chrominance layer 'b*' indicates where color falls along blue-yellow axis.

4. Masking and removal of green pixels: In this step, the green pixels are recognized and then particular threshold value is computed for these green pixels. After that, green pixels are masked such that the most of the green colored pixels represent the healthy areas of the leaf and furthermore removal of masked green pixels help in more accurate disease classification and significantly reduces the processing time.

5. Image Segmentation: It is used to locate the objects and boundaries such as lines and curves in images. It means assigning a label to each and every pixel in the image such that pixels with same labels share common visual characteristics. Image segmentation is analysis process to identify the objects from the image. It actually extracted the infected area from the leaf. K-mean clustering is for segmentation. In proposed work, firstly choice for number of clusters is input. Based on that choice original input image is segmented into that number of parts or clusters based on K mean clustering. Then based on the region of interest, cluster is chosen. On that cluster, thresholding technique of segmentation is applied. This process of preprocessing and segmentation is done in both training and testing phase.

6. Feature extraction: After segmenting the image based on data set features are extracted such as extraction of color, texture and shape or domain specific features. Feature Extraction is a method of capturing visual content of images for indexing & retrieval. The texture features are extracted by using GLCM such as correlation, homogeneity, energy, contrast. The gray level co-occurrence methodology is a statistical way to describe shape by statistically sampling the way certain information.

Types of texture related features are calculated in this work. Some of them are:

Contrast: contrast is also known as sum of square of variance.

$$\sum_{i,j=0}^{N-1}\left(P_{i,j}(i-j)\hat{}2\right)$$

equation 1. for calculating contrast

Energy: Energy gives the sum of squares of elements. Also energy is square of angular second moment.

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

equation 2. for calculating energy

Entropy: It is related to homogeneity. Homogenous image has high entropy whereas inhomogeneous image give low entropy.

$$\sum_{i=0}^{G-1}\sum_{j=0}^{G-1} P(i,j) * \log(P(i,j))$$

equation 3. for calculating entropy

7. Classifier: Classifiers are used to define features of image. For the classification of diseased leaf image Support vector Machine is used. SVMs are an arrangement of related supervised learning methods utilized for classification and regression. Supervised learning includes analyzing a given arrangement of labeled observations (the training set) so as to predict the labels of unlabelled future data (the test set). In particular, the objective is to learn some function that describes the relationship amongst observations and their labels. More formally, a support vector machine constructs a hyper plane or set of hyper planes in a high- or infinite-dimensional space, which can be used for classification, regression, or other tasks. Basically, a good separation is achieved by the hyper plane that has the largest distance to the nearest training data point of any class (so-called functional margin), in general the larger the functional margin the lower the generalization error of the classifier.

IV. RESULTS AND DISCUSSION:

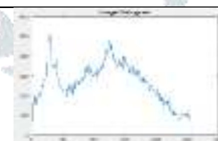
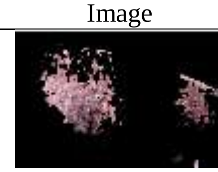
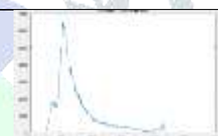
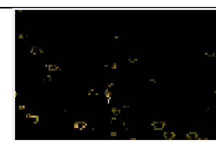
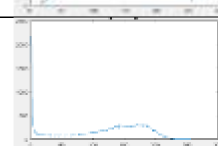
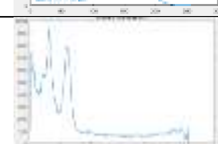
About 60 images of plant leaves from different plant species have been collected. The acquired leaf images are converted into CIELAB color space. The co-occurrence features like contrast, energy, homogeneity, entropy are derived from the co-occurrence matrix. With these set of co-occurrence features the plant diseases are detected. Samples of leaves with various diseases like early blight, early blight, rust, fruit rot, yellow spots, brown spots, bacterial and fungal diseases etc are shown as in fig.2:

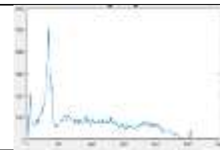
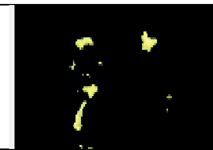
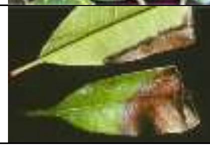
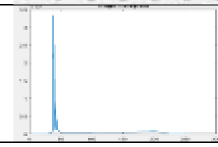
figure.2: sample of infected leaves

1. **Result Analysis:** The diseased leaf images are given as input to the algorithm. Color transformation structure on the input image is performed. Then the green pixels are masked and then removed using a specific threshold value. Then the R, G, B components are mapped to the thresholded image. The set of leaves that are affected by various diseases are shown in Table 1.

2.

table 1: detection of diseased area of leaves

Plant Species	Input Image	Thresholded Image	Histogram of Diseased leaf	Disease Detected Image
Banana				
Lemon				
Beans				
Tomato				
Potato				
Mango				
Guava				

Apple				
Sapota				

2. Experimental Results:

2.1 Accuracy: This parameter tells about the accuracy of segmentation that how accurately disease is detected and as shown in table 2. Accuracy in image segmentation is calculated as:

Accuracy (%) = (No. of test images detected/ Total no. of diseased images)*100

table 2: Results of detection of diseased leaf images

Plant Species	Category	No. of Images used for testing	Existing Accuracy	Proposed Accuracy
Banana	Sigatoka, Leaf spots	5	84.60%	92.15%
Lemon	Canker, Rots, Leaf spots, Leaf miner,	5	82.14%	90.83%
Beans	Blight, Rust, Root rots, Mosaic Virus	7	87.50%	90.02%
Tomato	Blight, Canker, Leaf spots, Rots, Anthracnose	11	82.15%	92.29%
Potato	Blight, Rots, Powdery mildew	5	96.43%	97.53%
Mango	Powdery mildew, Blight, Rust, Canker	7	83.33%	92.45%
Guava	Rots, Canker, Leaf Spots, Anthracnose	5	92.86%	92.95%
Apple	Apple scab, Canker, Rots, Blight	7	90%	92.97%
Sapota	Sooty moulds, Leaf spots, Blight, Rots,	8	80%	92.24%

Overall Accuracy = (Total calculated accuracy of all images/ total no. of images)*100
= (833.43/9)*100
= 92.60%

2.2 Accuracy Performance: The detection accuracy performance of the implemented method is evaluated in terms of accuracy as shown in figure. 1.27. Each of the input images is evaluated using GLCM features and these features are compared for every type of image in the data set. Comparative results of existing accuracy and proposed accuracy using SVM classifier are shown in fig. 3.

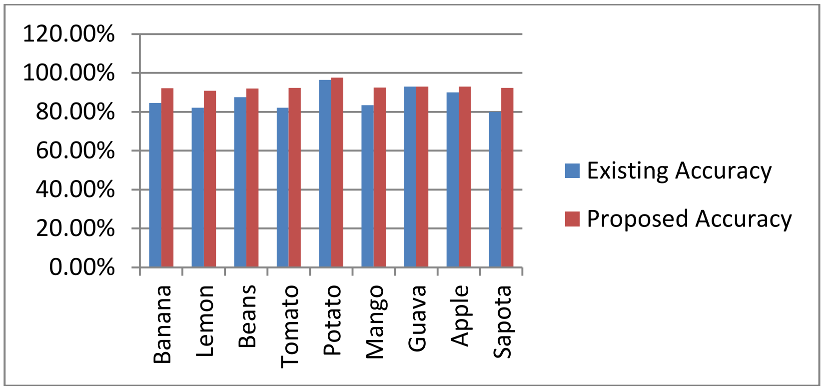


figure.3: comparative results of existing accuracy and proposed accuracy using svm

V. CONCLUSION AND FUTURE SCOPE

The diseases particular to those plants were adopted for our strategy. The proposed methodology utilized for detecting infected part of leaf is based on k mean clustering, threshoding for the segmentation of the diseased plant leaf image, GLCM (Gray Level Concurrence Matrix) for Feature extraction and finally these features are used as input to the SVM classifier that recognizes and classifies the diseased plant leaves. The experimental results show the proposed approach can recognize and classify the leaf diseases with a minimal computational effort and more accurately. By this technique, the plant diseases can be recognized at the initial stage itself. In future work, proposed work can be enhanced using other methods for segmentation and other classification. Further enhancement of proposed work can be focused on increasing the accuracy of identification and detection process and also it can reduce the execution time for processing the input image.

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