RECOGNITION OF PLANT DISEASE

Sagar Patil
Department of Information Technology
MIT College of Engineering
Pune, India
sagar.patil7007@gmail.com

Bharati Dixit
Department of Information Technology
MIT College of Engineering
Pune, India
bharati.dixit@mitcoe.edu.in

Anjali Chandavale
Department of Information Technology
MIT College of Engineering
Pune, India
anjali.chandavale@mitcoe.edu.in

***Abstract*—Agriculture is an important sector in Economic and Social life. Plant disease detection is an emerging field in India. Earlier systems were designed for either Monocot or Dicot plant family disease detection. Gradually, with scientific and technical advancement, more reliable and effective methods through lowest turnaround time are proposed and developed for early detection of plant disease. In this paper, the proposed system is being designed for the plant disease detection of Monocot and Dicot plant families. It improves the accuracy of recognition of plant diseases. The recognition of plant leaf disease is carried out mainly in three phases such as segmentation, feature extraction and classification. In the first phase, segmentation is carried out to segment the affected part of plant leaf using the K-means clustering technique. After segmentation color, texture and shape features are extracted. At last, extracted features are used for classification using Support Vector Machine to identify plant disease.**

Keywords- Classifier, Dicot Plant Disease, Feature Extraction, Monocot Plant Disease, Pre-Processing, Segmentation.

I. INTRODUCTION

Plant disease is one of the important factor which causes significant reduction in the quality and quantity of plant production. Detection and classification of plant diseases are important task to increase plant productivity and economic growth. Detection and classification of plant diseases are one of the challenging topic and much more discussed in engineering and IT fields.

There are various techniques emerged to detect the plant disease such as thresholding, region growing, clustering, watershed, etc. To detect plant disease the image should go through some processes like segmentation, pre-processing, feature extraction and classification. The pre-processing is an improved process of image data to suppress unwanted distortion or enhances some image features important for further processing [1].

The segmentation process consists of partitioning an image into meaningful regions and it is a vital process through which image features are extracted [2]. There are various features of an image such as grey level, color, texture, shape, depth, motion, etc. Classification process is used to classify the given input data into a number of classes and groups. It classifies the data based upon selected features [3] [4].

Basic categories of family plants and its differences are shown below,

a. Monocot family plant: These type plants have one seed leaf. The vein structures of Monocot family plants are parallel and straight.
   Examples: wheat, corn, rice, millet, lilies, daffodils, sugarcane, banana, palm, ginger, onions, bamboo, sugar, corn, palm tree, banana tree, and grass, turmeric [5] [6].
b. Dicot family plant: These type plants have two seed leaves. The vein structures of Dicot family plants are nested and complex structure.
   Examples: Cotton, potatoes, tomatoes, beans, honeysuckle, roses, peppers, strawberry, coffee [7].

Section 2 presents the related work. Section 3 presents a proposed work for recognition of plant diseases. Section 4 describes the programmer's design Section 5 discusses result analysis and section 6 concludes the paper.

II. RELATED WORK

In [1], the authors focused on automatic detection and classification of plant diseases. The plant leaf diseases spots have same in intensity but different in color. Thus color space transforms of RGB image is used for better segmentation of plant leaf disease spots. For image smoothing median filter is used and Otsu thresholding method is used to calculate threshold values to recognize the plant leaf disease spot. It does not give accurate results for Dicot family plant.

P. Revathi and M. Hemalatha [5] explored advance computing technology to assist the farmer in the plant development process. For capturing the infected cotton leaf images mobile camera is used. After the segmentation, color feature is extracted to get disease spots. For extraction of image features of leaf spots used the edge detection technique to recognize the plant diseases. The neural network is used to classify the plant leaf diseases. In this approach, segmentation process is not suited to Monocot family plant.

S. Dubey and R. Jalal [8] investigated the approach of detection and classification of apple fruit diseases. The proposed framework is composed of three steps such as segmentation, feature extraction, classification. K-means clustering technique is used for the image segmentation. Images are classified based on a Multiclass Support Vector Machine (SVM) and the feature is extracted from segmented image. The proposed approach is specific to apple fruit diseases and cannot be extended to other fruit diseases.

In [9], the approach focused on Cercospora leaf spot detection in sugar beet using hybrid algorithms of template matching and support vector machine. The approach adopts three stages; first, the robust template matching method is adopted for continuous observation of disease development, foliar translation and dynamic object searching. The second is a plant segmentation index of G-R which is introduced to distinguish leaf parts from the soil contained background for automatic selection of the initial sub-templates. Then, Support Vector Machine (SVM) is used for disease classification by a color feature named two dimensional, *xy* color histogram. The segmentation process is not suitable for the other Dicot family plant.

Yan, Han and Ming [10] proposed method to select features of cotton disease leaf image by introducing a fuzzy selection, fuzzy curves and fuzzy surfaces. The features used for diagnosing and identifying diseases are extracted from the fuzzy selection approach are. This approach removes the dependent features of image for reducing the number of features for classification.

Sannakki, Nargund and Kulkarni, Rajpurohit [11] proposed an approach to diagnose the disease using image processing and artificial intelligence techniques on images of the grape plant leaf. The grape leaf image is complex at background. The thresholding is used to mask green pixels. The input image is processed to remove noise using anisotropic diffusion. Then, K-means clustering technique is done with the help of segmentation. The results were classified using back propagation neural network and the diseased portion of segmented images is identified.

In [12], they investigated an approach for automatic identification of chilies plant diseases. For that, the extraction is done with CIELAB color transformation model and comparing the color feature for identification of disease. In feature extraction, no more effective work is done. To gain more accuracy appropriate work should be done.

Next paper [13] discussed about the monitoring of apples and grapes plant diseases. It gives suggestion to farmers for healthy yield and productivity. K-means clustering is used for artificial neural network and segmentation is used for classification of features. Also for counting the weight of mango, back propagation concept is used. Color, morphology and texture features are extracted for classification.

In [14], the approach focused on the identification of the visual symptoms of cotton plant diseases. In this approach, enhanced PSO feature selection method used with skew divergence method. Edge, texture and color features are extracted. The extracted features give as input to SVM, back propagation neural network (BPN), fuzzy with edge CYMK color feature and GA feature selection to identify the plant diseases. They focused on cotton plant diseases like Bacterial Blight, Fusarium wilt, Leaf Blight, Root rot, Micro Nurient, Verticilium Wilt. But, its complexity is higher than others and this approach is not applicable to the Monocot plant family.

III. PROPOSED WORK

In this paper, we are applying three techniques, namely image segmentation, feature extraction and classification to recognize the disease. Figure 1 shows the diagrammatical flow of the proposed system.

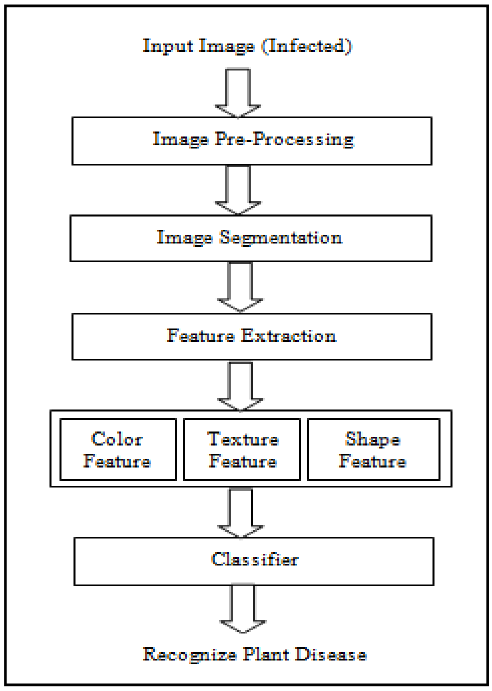

Figure 1 Flow of System Architecture

A. Image Pre-Processing:

The input image of an infected plant leaf is taken and the pre-processing of an image is done using median filter. The median filter is used for noise reduction. Pre-processing includes shade correction, removing artifacts, formatting and conversion from RGB to CIELAB color spaces.

B. Image Segmentation:

Segmentation refers to the process of clustering the pixels with certain properties into salient regions. This region corresponds to individual surfaces and natural parts of the objects. We used k-means segmentation algorithm to segment target regions. Segmentation process is applied on pre-processed image. Segmentation process divides the pre-processed image into multiple parts. So the infected regions of plant leaf is clearly visualize. It simply clusters the pixels with certain properties of clustered regions. Clustered regions are those areas in the image that represented visual symptoms of plant disease.

Algorithm 1: Segmentation based on K-means clustering technique.
Input: RGB image.
Output: Segmented image.
Start
Step 1: Select the value of k for image sample being clustered.
Step 2: Assign each pixel to the group that has the closest centroids i.e. nearest cluster centers.
Step 3: When all items have been assigned, recalculate the positions of the k -centroids.
Step 4: Repeat steps 2 and 3 until the convergence is attained, i.e. no pixels change the clusters.
End

C. Feature Extraction:

The affected areas of plant leaf vary in color, texture and shape. These are dominant in classifying plant disease symptoms. So, color, texture and shape features are considered for recognition and classification purpose. Color feature is extracted from L*a*b color space and it includes mean, variance, standard deviation, alpha (intensity), red, green, blue. Texture features are extracted from Gray Level Co-occurrence Matrix (GLCM) matrices. Measurements that are estimated using the GLCM matrix are entropy, energy, contrast, correlation, homogeneity, inverse difference moment and angular second moment. Lastly, shape feature like area, perimeter, skewness and kurtosis are extracted.

Algorithm 2: Extraction of Color, Texture and Shape features.
Output: Texture, Color and Shape features.
Start
Step 1: Use L*a*b color space on RGB image to calculate color features.
Step 2: Use GLCM function to calculate the texture features.
Step 3: Use segmented image to calculate shape features.
End

D. Classification:

Support Vector Machine (SVM) consists a set of related supervised learning method used for classification and regression. SVM is used to classify the infected plant leaf diseases. In this process, color, texture and shape features extracted from segmented image are considered. We have to train the SVM for classifying the plant disease images. SVM performs on extracted features of images and compare extracted features with test image features and gives the result.

Algorithm 3: Classification of plant disease
Input: Color, texture and shape features
Output: Classified affected image samples
Start
Step 1: Accept the affected cotton and turmeric plant images.
Step 2: Extract color, texture features using algorithm 2.
Step 3: Train the SVM with extracted features.
Step 4: Accept the acquicised images which are to be tested and perform Step 2.
Step 5: Recognize and classify image samples using the SVM classifier.
End

IV. PROGRAMMER'S DESIGN

A. Mathematical Model:

The proposed system is represented using set theory. Let *S* be the proposed system. Input to the system is nothing but the scattered data points in the given high dimensional dataset. System *S* is anticipated to obtain the optimal number of clusters. There are S_i numbers of states through which the whole system undergoes in order to achieve an intended solution. Here i = 1, 2, 3...10. The states interact with each other depending upon some meaningful criteria. The whole system starts and ends with two predefined states, i.e. (*S0*: Start and *S6*: End).

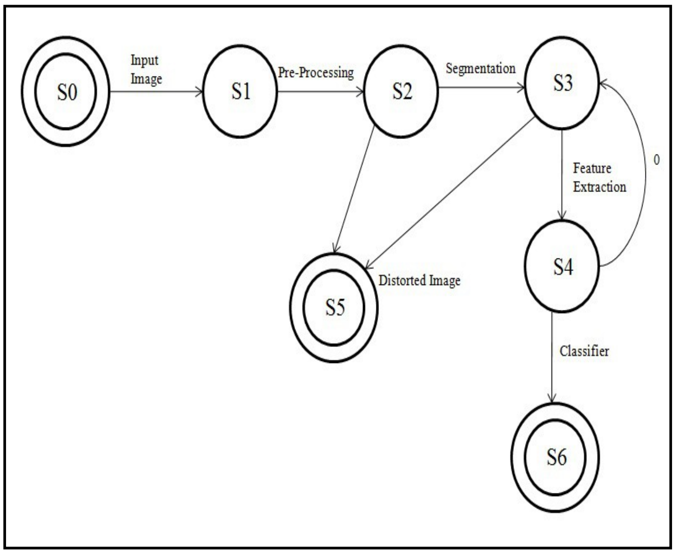

Figure 2 Mathematical Model

V. RESULT ANALYSIS

Cotton and turmeric leaves samples are taken from healthy plants and various infected plants. The input image of an infected plant leaf is taken and pre-processing is done. Pre-processing includes shade correction, removing artifacts, formatting and conversion from RGB to CIELAB color spaces. Segmentation is performed using K-means segmentation technique. After that color, texture and shape features are extracted from segmented image. The Figure 3 shows the implementation result of pre-processing, segmentation and feature extraction.

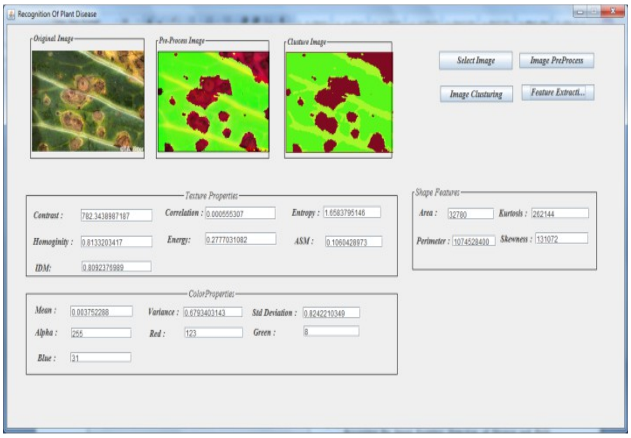

Figure 3 Implementation Result

VI. CONCLUSION

In this paper we have discussed several plant disease recognition techniques along with their benefits and limitations. We have segmented affected part of plant leaf images and extracted features such as color, texture and shape using feature extraction algorithm. Our further work will concentrate on classification of Monocot and Dicot family plant diseases. It is expected that the end results could able to recognize plant diseases with greater accuracy.

REFERENCES

[1] Piyush Chaudhary, Anand K. Chaudhari, Dr. A. N. Cheeran and Sharda Godara, "Color Transform Based Approch For Disease Spot Detection on Plant Leaf", International Journal of Computer Science and Telecommunications, 2012, pp. 65-70.

[2] Mr. Hrishikesh P. Kanjalkar, Prof. S Lokhande, "Feature Extraction of Leaf Disease", International Journal of Advanced Research in Computer Engineering and Technology, 2014, pp. 153-155.

[3] Jagadeesh Devdas Pujari, Rajesh Yakkundimath and Abdulmunaf Byadgi, "Grading and Classification of Anthracnose Fungal Disease of Fruits based on Statistical Texture Features", International Journal of Advanced Science and Technology, 2013, pp. 121-129.

[4] Rajesh Yakkundimath, Jagdeesh D. Pujari and Abdulmunaf S. Byadgi, "Classification of Fungal Disease Symptoms affected on Cereals Using Color Texture Features", International Journal of Signal Processing, Image Processing and Pattern Recognition, 2013, pp. 321-330.

[5] P. Revathi and M. Hemalatha, "Advance Computing Enrichment Evaluation of Cotton Leaf Spot Disease Detection Using Image Edge detection", IEEE, 2012.

[6] Ms. Rupali S. Zambre, "Classification of Cotton Leaf Spot Disease Using Support Vector Machine", International Journal of Engineering Research and Applications, 2014, pp. 92-97.

[7] Kandiannan, Thankamani, Srinivasan, Rajeev, "Turmeric Plant", Indian Institute of Spices Research, Indian Council of Agricultural Research, Kerala, 2008, pp. 3-7.

[8] Shiv Ram Dubey, Anand Singh Jalal, "Detection and Classification of Apple Fruit Diseases using Complete Local Binary Patterns", International Conference on Computer and Communication Technology IEEE, 2012, pp. 346-351.

[9] Rong Zhou, Shunichi Kaneko, Fumio Tanaka, Miyuki Kayamori, Motoshige Shimizu, "Early Detection and Continuous Quantization of Plant Disease Using Template Matching and Support Vector Machine Algorithms", International Symposium on Computing and Networking IEEE, 2013, pp. 300-304.

[10] Yan-Cheng Zhang, Han-Ping Mao, Bo Hu, Ming-Xi Li, "Features Selection Of Cotton Disease Leaves Image Based On Fuzzy Feature Selection Techniques", International Conference on Wavelet Analysis and Pattern Recognition IEEE, 2007, pp. 124-129.

[11] Sanjeev S. Sannakki, Vijay S Rajpurohit, V. B. Nargund and Pallavi Kulkarni, "Diagnosis and Classification of Grape Leaf Diseases using Neural Networks", International Conference on Computing, Communications and Networking Technologies IEEE, 2013.

[12] Zulkifli Bin Husin, Abdul Hallis Bin Abdul Aziz, "Feasibility Study on Plant Chili Disease Detection Using Image Processing Techniques", International Conference on Intelligent Systems Modelling and Simulation IEEE, 2012, pp. 291-296.

[13] Monika Jhuria, Ashwani Kumar, Rushikesh Borse, "Image Processing for Smart Farming: Detection of Disease and Fruit Grading", International Conference on Image Information Processing IEEE, 2013, pp. 521-526.

[14] P. Revathi, M. Hemalatha, "Cotton Leaf Spot Diseases Detection Utilizing Feature Selection with Skew Divergence Method", International Journal of Scientific Engineering and Technology, 2014, pp. 22-30.

[15] P. Revathi and M. Hemalatha, "Identification of Cotton Diseases Based on Cross Information Gain Deep Forward Neural Network Classifier with PSO Feature Selection", International Journal of Engineering and Technology, 2014, pp. 4673-4642.

[16] Smita Naikwadi, Niket Amoda, "Advances in Image Processing for Detection of Plant Diseases", International Journal of Application or innovation in Engineering and Management, 2013, pp. 168-175.

[17] Wenjiang Huang, Qingsong Guan, Juhua Luo, Jingcheng Zhang, Jinling Zhao, Dong Liang, Linsheng Huang, and Dongyan Zhang, "New Optimized Spectral Indices for Identifying and Monitoring Winter Wheat Diseases", Journal Of Selected Topics in Applied Earth Observations And Remote Sensing IEEE, 2014, pp. 2516-2524.