IJREAT International Journal of Research in Engineering & Advanced Technology, Volume 8, Issue 5, October - November, 2020
ISSN: 2320 – 8791 (Impact Factor: 2.317)
www.ijreat.org

A SURVEY ON DISEASE IDENTIFICATION OF PLANTS AND CROPS USING IMAGE PROCESSING

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Abstract— This paper provides survey on different techniques that are used for plant and crop disease classification. A farmer cannot identify the symptoms causing to plants or crops by the naked eye. So, crop protection can be done by using computerized image processing technique that can detect diseased section of plants, fruits or crops. There are many classification techniques such as k-Nearest Neighbor Classifier, Probabilistic Neural Network, Genetic Algorithm, Support Vector Machine, and Principal Component Analysis, Artificial neural network, Fuzzy logic. Selecting among the classification method is always a difficult task because the result can vary for different types of input data. This paper provides an overview of different classification techniques used for plant and crop disease classification
Keywords– k-nearest neighbor, PNN, SVM.

I. INTRODUCTION

India happens to be one of the agricultural country, where in about 70% of individuals are dependent on agriculture. The agriculture not only provides necessary food for human existence and consumption but also is important for improvement in economy of the country. Our country happens to be leading producer of milk, pulses like red gram, chickpea, etc., and second leading in rice, wheat, spices and plantation crops. It is proved that the quality of the crop may be reduced due to various diseases affecting the crop. In a country like India an approximate of 18-20% crop yield is lost due to diseases found in crops. The crop disease is identified mainly with the help of infected portion observed on the part of crop; the infected portion may be leaf, stem, flower and pods. To overcome manual monitoring, a machine vision system is advantageous to identify the diseases of crop. Nowadays image processing techniques are being employed to attain automation in identification of the diseases affecting the crop. These techniques help in early identification of diseases and provide information about usage of pesticides at required time to maximize the yield of crop, and thus improve the growth in economy of agriculture in India.

II LITERATURE SURVEY

In this section describes the works related to identification of diseases affecting crops, fruits and vegetables are summarized in the following.

(Yan-Cheng-Zhang et al., 2007) paper titled **"Features selection of cotton disease leaves image based on fuzzy feature selection techniques"**, have proposed a methodology for early detection of cotton diseases.

(Santanu Phadikar, Jaya Sil, 2008) paper titled **"Rice Identification using Pattern Recognition Techniques"** described a method for identifying diseases affecting rice plants using pattern recognition techniques.

(Dheeb Al Bashish, et al., 2010) paper titled **"A Framework for Detection and Classification of Plant Leaf and Stem Diseases",** have proposed a framework of detection and classification of plant leaf and stem diseases. The method employs k-means clustering segmentation method and pre-trained neural network to detect and classify affected disease. The accuracy in detection and classification is 93%.

(B S Anami et al., 2011) paper titled **"Identification and Classification of Normal and affected agriculture/horticulture produce based on combined color and texture feature extraction"**, proposes identification of affected plant in agriculture/horticulture based on combined color and texture feature extraction and artificial network based classifier. The combination of features proved to be effective and the results were 86% for cereals and 80% for vegetables. The overall accuracy is 84%.

(P. Revathi, M. Hemalatha, 2012) paper titled, **"Classification of Cotton Leaf Spot Diseases Using Image Processing Edge Detection Techniques"** have introduced a work that concentrates on foliar fungal disease of cotton. The method employs color transformation, color filtering and edge detection techniques to detect cotton disease. The method gives around 98.1% accuracy.

(Sushma Huddar et al., 2012) paper titled **"Novel Algorithm for Segmentation and Automatic Identification of Pests on Plants using Image Processing"** have proposed a novel and unique algorithm to segregate and detect pests on plants. A distinct algorithm for detecting whiteflies affecting various leaves based on RDI (Relative

Difference Intensity) algorithm is proposed. The algorithm gives around 96% of accuracy.

(LiJian, Wang Lijian, LiYi, 2012) paper titled **"The Identification System of Wheat Pests Based on PCA and SVM"**, proposed a system which identifies wheat pests using PCA (Principal Component Analysis) and SVM (Support Vector Machine). Here, PCA is used to extract image features on wheat pests and SVM is used to classify wheat fests. The system identifies 8 kinds of pests and accuracy is about 81.25%.

(S S Sannakhi et al., 2013) paper titled **"Diagnosis and classification of Grape Leaf Diseases using Neural Network"**, have proposed a work to diagnose the disease on grape leaf using image processing and artificial intelligence techniques.

(Pramod Jandge et al., 2013) paper titled **"Automatic Detection and Classification of Plant Disease through Image processing"**, proposes recognition of plant diseases using image processing based on color, texture and shape. There are 2 algorithms discussed, one is color transformation for extracting HSI (Hue Saturation Intensity) values and other is momentum back propagation using Neural Network.

(Vidita Tilva et al., 2013) paper titled **"Weather Based Plant Diseases Forecasting using Fuzzy Logic"** proposes fuzzy logic based structure for plant disease forecasting system. The presented expert system estimates the probability of occurrence of disease in the plant by applying rules of fuzzy logic based on leaf wetness duration. The experiment was carried out on corn plant.

(Ganesh Bhadne et al., 2013) paper titled **"Early Pest Identification in Agricultural crops using Image Processing Techniques"**, discusses early automatic detection of pests on leaves namely whitefly at a mature stage.

(Kholis Majid et al., 2013) paper titled **"I-Pedia:Mobile Application for Paddy disease Identification using Fuzzy Entropy and Probabilistic Neural Network"** proposes a development of mobile application which handles identification of paddy plant disease using fuzzy entropy and classifier probabilistic neural network. Paddy diseases are extracted from digital paddy leaf images using fuzzy entropy and then the diseases are classified using PNN. The experimental results show that the accuracy of paddy disease identification is 91.46%.

(Douglas Baquero et al., 2014) paper titled **"An Image Retrieval System for tomato Disease Assessment"** derives a strategy to diagnose the disease affecting tomato leaves based on color structure descriptors and nearest neighbors.

(P R Rothe, R V Kshirsagar, 2014) paper titled **"Automated Extraction of Digital Images Features of three Kinds of Cotton Leaf Diseases"** proposes an automatic plant disease identification system. The method employs discrete cosine transform, support vector machine (SVM) and fuzzy inference scheme for plant disease identification.

(Pradnya R Narvekar et al., 2014) paper titled **"Grape Leaf Diseases Detection and Analysis using SGDM Matrix Method"** proposes a method for disease detection in grapes through leaf feature inspection. Leaf image is captured and processed to determine the health status of each plant. The method uses color co-occurrence features to detect disease in grapes.

(P R Rothe, R V Kshirsagar, 2014) paper titled **"Cotton Leaf Disease Identification using Pattern Recognition Techniques"**, presents a pattern recognition system for identification and classification of three cotton leaf diseases i.e. Bacterial Blight, Myrothecium and Alternaria.

(S S Sannakhi, V S Rajpurohit, 2015) paper titled **"An Approach for Detection and Classification of Leaf Spot Diseases Affecting Pomegranate Crop"**, proposes an approach for detection and classification of leaf spot disease on Pomegranate Crop. The approach begins by preprocessing the acquired image, then the disease affected part of the image is segmented using k-means and thresholding based segmentation. Further, the Haar Wavelet Transform method extracts a set of visual features of diseased portions. A fuzzy logic classifier identifies the affected disease type and provides treatment measures.

(S S Sannakhi, V S Rajpurohit, 2015) paper titled**, "Classification of Pomegranate Diseases Based on Back Propagation Neural Network"** proposes a study of Back Propagation neural network (BPNN) classifier for detection of plant diseases on pomegranate crop based on visual symptoms.

(Yowen Tian, et al...2012) paper titled **"Grading method of grape disease based on image processing"** introduces a new grading method of grape disease, wherein the crop disease is determined by computing the proportion of sickness spot area to normal leaf area. The method comprises of Image pre-processing, segmentation and statistical calculations were applied to achieve the improvement in accuracy of identification of disease and reduction in time and cost. The role of pre-processing step in this paper is they use full color information of crop disease image and take the R, G, and B value of each pixel considering as feature vector and an improved vector median filtering method is used to enhance the crop disease image for finding better edges, it's easy and simple to realize but limits with short in running time.

(Yong Wei, et al... 2012) paper titled **"A study of Image processing on identifying cucumber disease"** discusses a study of image processing on identifying the diseases affecting cucumber leaves by pre-processing using region growing method to extract scab area of leaves to get feature parameters of shape, color and texture and then through establishment of BP neural network pattern, the model identification accuracy of cucumber leaf disease can reach 80%, the diseases can be identified more quickly and accurately. The role of pre-processing is to improve image intelligibility; it includes image denoising, image background segmentation, and binary image. The image denoising is dealt with median filtering. The region growing method is used to extract a clearer pre treated gray background, the edge of binary image is extracted using global thresholding and OTSU method and along with morphological processing which includes four methods namely expansion, erosion, opening and closing operations.

(Baoshi Jin, et al… 2012) paper titled **"The key Information technology of soybean disease diagnosis"** introduces technology that combines image processing and artificial neural network, a new diagnose method is proposed which includes methods of division algorithm and Eigen value computation, established a three level neural network model to identify the disease spot areas through extraction of geometric features, color and texture features respectively. The role of pre-processing in this paper is to overcome the plant disease leaf that could be affected by noise sources in generation and transmission that will lead to quality degradation. The paper introduces local smoothing method to eliminate image noise, named median filter method that will sort the gray value of template pixel.

(Guanlin Li, et al… 2012) paper titled **"Image Recognition of Grape Downy Mildew and Grape Powdery Mildew based on Support Vector Machine"** provides an effective way for rapid, accurate identification and diagnosis of plant diseases. The method k-means clustering algorithm is used for segmenting the diseased image, Further the recognition of diseased leaf were done using Support Vector Machine and results of accuracy were about 90% to 93% respectively.The role of pre-processing in this paper to improve the operation speed of computer programs, the images were compressed in the same proportion without changing the image resolution using nearest neighbor method and denoising the plant disease images using median filter algorithm.

(Usama Moktar, et al… 2015) paper titled **"Identifying two of tomatoes leaf viruses using support vector machine.**" introduces an efficient approach to detect and identify the infected tomato leaves, each input image is segmented using k-means segmentation and descriptor is created using feature subset. Support vector machine algorithm is used for classification of infected images from datasets. The results show with an accuracy of 90% -92%.The role of pre-processing in this paper is in order to increase the efficiency of prediction process; the leaf images are required to be enhanced to improve the quality of leaf image, to consider this pre-requisite the images are manually cropped to extract a single leaf features and all the images are resized with same size and resolution.

(M.Malathi, et al.). paper titled **" A survey on plant leaf disease detection using image processing techniques."** provides survey on plant leaf image disease detection using image processing techniques, which indeed is necessary to improve both quality and quantity of agricultural product. The various roles of pre-processing in this paper are Histogram equalization is used for leaf images to increase the contrast in low contrast image, Image resizing of leaf images is done with same size and dimensions, The color leaf images are converted to HSI, and then the green pixels are masked and removed using specific threshold value, The leaf image is enhanced using histogram analysis, HSI enhancement and intensity adjustments, The RGB leaf image is converted to other color model.

(Haiguang Wang, et al…) This paper titled **"Image Recognition of Plant Diseases based on Back propagation networks"** proposes an automatic diagnosis of plant diseases and improves the image recognition accuracy of plant diseases; it includes applying of pre-processing, k-means clustering segmentation and back propagation networks was used to classify the plant leaf images. The accuracy results around 97.14%.

(Geng Ying,et al..) paper titled **"A study on the method of image preprocessing for recognition of crop diseases"** discusses regarding the method of pre-processing for recognizing crop diseases mainly regarding cucumber powdery mildew and downy mildew. This paper compares effect of two filters simple and median filter. Disease spots were separated through performing image edge detection and snake model and later got the desired results. The image pre processing made a good foundation for following effective characteristic parameters for the disease diagnoses and setting up pattern recognition system. The various steps involved in image pre-processing are Image clipping where in a tool VC is used to clip the region of interest area of the crop leaf from the complex background, Image smoothing here we use both simple filter and median filter so that the quality of image is not dropped from various noises during image collection.

(Sourabh Shrivastava, et al…) The work titled **"Color sensing and image processing based automatic soybean plant foliar disease severity detection and estimation"** focuses on problems associated with soya plant foliar diseases. It presents a fully automatic disease detection based on color image sensing and processing. Various parameters namely disease severity index, infection per region and disease level parameter for measuring the disease severity. The proposed method is tested on real database of

soya leaves. The role of preprocessing here is reduction of illumination variation caused by unpredictable sunlight during capture of images.

(Gloria diaz et al..) The paper **"Recognition and quantification of area damaged by oligonychus perseae in avocado leaves."** focuses on use of machine learning approaches for objective segmentation and quantification of leaf area in avocado leaves. The role of preprocessing here is addressing two major problems as contrast enhancement and color normalization between leaves. The contrast was enhanced using classical histogram equalization approach, whereas a color normalization approach based on the grey world normalization assumption. In this work the color distribution of all leaves were normalized to the color distribution of one specific leaf.

(Ms Kiran G et al..) paper titled **"Unhealthy region of citrus leaf detection using image processing techniques."** discusses the image processing techniques used in performing early detection of plant diseases through leaf feature inspection of citrus leaf.The role of preprocessing is to improve the image data that suppress undesired distortions as well as enhances the image features that includes space conversion and image enhancement. A simple DCT domain is used for enhancing color images by scaling the transform coefficients, this indeed improves the quality of image.

(Sachin Khirade,A B Patil) This paper titled **" Plant Disease detection using Image Processing "** discusses the methods used for detection of plant diseases using leaf images, also discusses some segmentation and feature extraction algorithm used in the plant disease detection. The role of preprocessing in this paper is for the captured leaf images through camera; the color transformation structure is created for the RGB leaf image and device independent color space transformation structure is applied. To remove the noise in image or other object removal, preprocessing techniques are applied. Image clipping is applied to crop the leaf image to get the interested leaf image region and image smoothing is done using the smoothing filter and Image enhancement is carried for increasing the contrast.

The paper titled**" Misclassification and cluster validation techniques for feature selection of diseased rice plant images."** aims at developing an appropriate data mining methodology to extract knowledge about the characteristics of diseases by analyzing the images acquired from the field. The role of preprocessing after acquisition of rice crop images, select only the infected portion surrounded by some normal portion is cropped, the noises due to dust , pores and water in the images are filtered by applying median filter to the resultant image.

The paper titled **" The identification of powdery mildew spores image based on the integration of intelligent spore image sequence capture device."** introduces a new method which could realize the automatic detection of the powdery mildew spores using various methods of image processing and finally identification using neural network method.
The role of preprocessing is to convert the color image to grayscale image to adapt lighting conditions and image enhancement is applied to eliminate the effect of noise and improve the image quality.

III. RESULTS AND DISCUSSIONS

The following table demonstrates regarding the summarized details of the paper surveyed

Sl no	Title	Authors	Detection Technique/Algorithm	Accuracy Parameters
1	A Framework for Detection and Classification of Plant Leaf and Stem Diseases	Dheeb Al Bashish, et al., 2010	k-means clustering segmentation method, pre-trained neural network	The accuracy in detection and classification is 93%
2	Identification and Classification of Normal and affected agriculture/horticulture produce based on combined color and texture feature extraction	B S Anami et al., 2011	color and texture feature extraction and artificial network based classifier	Results were 86% for cereals and 80% for vegetables. The overall accuracy is 84%.
3	Classification of Cotton Leaf Spot Diseases Using Image Processing Edge Detection Techniques	P. Revathi, M. Hemalatha, 2012	color transformation, color filtering and edge detection techniques	The method gives around 98.1% accuracy.
4	Novel Algorithm for Segmentation and Automatic	Sushma Huddar et al., 2012	A distinct algorithm for detecting whiteflies affecting various leaves	The algorithm gives around 96% of accuracy

	Identification of Pests on Plants using Image Processing		based on RDI (Relative Difference Intensity) algorithm is proposed.	.
5	The Identification System of Wheat Pests Based on PCA and SVM	LiJian, Wang Lijian, LiYi, 2012	Proposed a system which identifies wheat pests using PCA (Principal Component Analysis) and SVM (Support Vector M/c).	The system identifies 8 kinds of pests and accuracy is about 81.25%.
6	I-Pedia:Mobile Application for Paddy disease Identification using Fuzzy Entropy and Probabilistic Neural Network	Kholis Majid et al., 2013	fuzzy entropy and classifier probabilistic neural network.	The experimental results show that the accuracy of paddy disease identification is 91.46%.
7	Grading method of grape disease based on image processing	Yowen Tian, et al...2012	Grading method of grape disease	It's easy and simple to realize but limits with short in running time.
8	A study of Image processing on identifying cucumber disease	Yong Wei, et al... 2012	Global thresholding and OTSU method and along with morphological processing	accuracy of cucumber leaf disease can reach 80%
9	The key Information technology of soybean disease diagnosis	Baoshi Jin, et al… 2012	extraction of geometric features, color and texture features respectively	local smoothing method to eliminate image noise, named median filter method
10	Image Recognition of Grape Downy Mildew and Grape Powdery Mildew based on Support Vector Machine.	Guanlin Li, et al… 2012	k-means clustering algorithm is used for segmenting the recognition of diseased leaf were done using Support Vector Machine	Results of accuracy were about 90% to 93% respectively.
11	Identifying two of tomatoes leaf viruses using support vector machine.	Usama Moktar, et al… 2015	using k-means segmentation Support vector machine algorithm is used for classification	Results show with an accuracy of 90% - 92%.
12	A survey on plant leaf disease detection using image processing techniques.	M.Malathi, et al…	Histogram equalization	
13	Image Recognition of Plant Diseases based on Back propagation networks.	Haiguang Wang, et al…	k-means clustering segmentation and back propagation networks was used	The accuracy results around 97.14%.
14	A study on the method of image preprocessing for recognition of crop diseases	Geng Ying,et al..	performing image edge detection and snake model and later got the desired results.	
15	Color sensing and image processing based	Sourabh Shrivastava, et al…	disease severity index, infection per region and disease level	

	automatic soybean plant foliar disease severity detection and estimation		parameter	
16	Recognition and quantification of area damaged by oligonychus perseae in avocado leaves.	Gloria diaz et al	as contrast enhancement and color normalization between leaves	normalized to the color distribution of one specific leaf.
17	Unhealthy region of citrus leaf detection using image processing techniques.	Sachin Khirade, A B Patil	A simple DCT domain is used for enhancing color images by scaling the transform coefficients	
18	Plant Disease detection using Image Processing	Sachin Khirade, A B Patil	the methods used for detection of plant diseases using leaf images, also discusses some segmentation and feature extraction algorithm used in the plant disease detection.	

IV Conclusion

In this paper, we have given a brief survey on disease identification of plants and crops using image processing. The paper describes briefly regarding the authors name, a brief description of the detection techniques or algorithm used for their work, the data set on which the accuracy is attained and lastly accuracy level achieved by each paper. All the paper surveyed made use of detection techniques using image processing techniques.

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