State of the Art of Plant Disease Detection and Classification Techniques

Ravinderjit Kaur[1], Amardeep Kaur[2]
[1,2]*Punjabi University Regional Centre for Information Technology and Management , Phase 7, SAS Nagar (Mohali)*

Abstract- The plant disease affects the major profit in the agriculture field. These plant diseases are responsible for the major loss in the farming field. The various diseases are caused by different reasons such as fungi, bacteria, viruses etc. Due to these reasons the different parts of the plants are affected and that can be bark, fruit, leaf etc. A number of studies suggest the computer techniques are used for plant diseases detection and classification. The computer aided image processing technique can be used to detect the plant disease on the initial stage of their growth. These methods enhance the throughput and the production rate.

Keyword- Digital image processing; plant disease; classification.

I. INTRODUCTION

The agriculture is the main income source for about 70% population in India which is a country under progress. Major resource of national income depends on farming. In this process the major hindrance is the plant disease that occurs on different parts of plant and it affect the quality of agriculture product[1]. The main reasons of these plants may be due to some viruses, fungi etc. In earlier times the naked eye observation was done by the observatory which is still done but this approach is inefficient and time consuming too[2]. It is impossible to examine large area of field by naked eyes. The identification of the various diseases in fruit plants is a time consuming process for novice as it involves the domain expert participation. The disease present in plants affects the production and quality of the produce[3]. They may be present in different parts of the plant such as stem, bark, leaf, root or even fruit[4].

The paper shows various plant disease detection techniques and their accuracy and other parameters in tabular form. The diseases that are found in orange fruit plant is discussed in detail and categorized in different forms like viruses, bacterial etc. The disease symptoms, causes and management are shown in tabular form. The previous work is studied which shows various computer aided technique for detection and classification of plant diseases. This paper is divided into three parts where the first part includes the introduction of the plant disease. The second part consists of the background which gives detailed information about the leaf diseases present in the orange plant. The third and the final section which is state of the art give a detailed survey of the work that has been already done in the similar topic. A table that describes the related work which shows the different technique and there result is shown in tabular form in state of the art part.

II. BACKGROUND

A. Leaf diseases

The energy of leaf is extracted by disease fungi, bacteria and other tissue from the plants[5] . These fungi diseases are the reason for the most of damage and are categorized by rusts, rotted tissues, moldy coatings, blotches, wilting and scups. These are major issues and these needs to be answered for the early detection of the plant diseases [6].These plant disease identification techniques can help in the prevention of the decrease of the quantity of products and the yield is lost in agricultural products. Citrus is one of the mostly widely grown fruit crop[7]. Citrus has many types and one fruit that comes under citrus category is Orange. Orange suffers from many diseases and detecting these diseases is very necessary. The diseases which are mostly seen on orange plant leaves are sooty mold leaf, tip or marginal leaf burn, citrus greening and cigar leaf curling. Detailed orange plant diseases are represented in tabular form.

B. Orange Disease Table

Orange leaf diseases are categorized into the following ways: The various categories are bacterial, virus, fungi and oomycete.

1) CATEGORY – BACTERIAL

The bacteria are responsible for plant disease which mainly affects roots, stem, leaves and internal and external symptoms. These symptoms include over growth, leaf spot, cankers, scabs etc. The bacterial infection can shift from one plant to another.

2) CATEGORY – VIRAL

These are small infectious particles consist of nuclear acid core and protein coat. Viruses are responsible for various diseases in plants. The yellowing of leaves is caused by

viruses. The infected plant shows variety of symptoms such as leaf distortion, abnormities in fruit and flower.

DISEASE	SCIENTIFIC NAME	SYMPTOMS	CAUSES	MANAGEMENT
Tristeza disease	Citrus tristeza	Light green foliage leaves , leaves dropping from trees	Virus	Quarantine procedures are used to control tristeza.

3) CATEGORY – FUNGAL

Fungi are present in the environment which is main reason of fungal diseases. The come through the air and attack various parts of plant like leaves, stem etc. The plants are damaged and in some cases it may die.

NAME	SCIENTIFIC NAME	SYMPTOMS	CAUSES	MANAGEMENT
Anthracnose	Colletotricham gloeosporioides	Leaves covered in dark fungal spores.	Fungus	(i) Appropriate fungicides should be applied to entire tree.
Armillaria root rot	Armillaria mellea	Trees may wilt and collapse. Leaves become chlorotic and drop from tree.	Fungus	(i)Affecting trees should be removed.
Black root rot	Thielaviopsis basicola	Leaves of the plant may be chlorotic.	Fungus	(i)Keep glass house well lit and warm during winter to encourage root growth.
Melannose	Diaporthe citri	Leaves can be crinkled and distorted.	Fungus	(ii)Pruning and fungicides

NAME	SCIENTIFIC NAME	SYMPTOMS	CAUSES	MANAGEMENT
Citrus Canker	Xanthomonas	Raised lesions on leaves at leaf margin or tip	Bacterium	(i) All infected trees should be removed and destroyed. (ii) Application of copper sprays
Citrus Greening	Huanglongbing	Yellowing of leaf veins, blotchy molting	Bacteria	(i)Can't be cured, infected trees should be removed.
Stubborn disease	Spiro plasma citri	Stunted trees, leaves shorter and broader, cupped and upright.	Bacterium	(i) Plants should be grown in an enclosure to prevent trees. (ii) Infected plants should be removed.

4) CATEGORY – OOMYCETE

Oomycetes are group of various organisms are plant pathogens. These are also known as water molds. Oomycete is responsible for diseases such as downy mildew, late blight etc.

DISEASE	SCIENTIFIC NAME	SYMPTOMS	CASUSES	MANAGEMENT
Phytophthora gummosis	Phytophthora spp.	Pale green leaves with yellow veins.	Oomycete	Plant disease free nursery, well draining soil.

III. STATE OF THE ART-

D. Cui et.al. [1] The techniques detect soybean rust by multispectral image sensor. The different level of severity was done using multispectral sensors. Three image processing parameters used were RIA (ratio of infected area), LCI (lesion color index) and RSI (rust severity index) were describe the degree of severity. The sensing method does real time filed scouting. The idea of this research was to develop a systematic approach capable of reliable and sensitive detection and quantify the diseased area of soybean based on images which were multispectral. The rust intensity was used to differentiate the used reflectance value.

S. R. Dubey et.al.[2] This method gives that apple fruit diseases were detected and classified using image processing. The diseases that were commonly seen in apple were apple rot, apple scab, and apple blotch. The fruit disease identification technique using k mean segmentation was done using three steps. Classification was done using multi-class SVM. CLBP feature was used to show accurate result. The two color spaces i.e. RGB and HSV and these two color spaces were used to compare the results. The accuracy was 93%. The number of images was 391 and the four different categories were apple blotch, apple scab, apple rot and normal apple. The HSV color space the classification accuracy was 80.47%. For GCH and for CCV it was 86.47% and 90.97 for LBP and for CLBP it was 93.14%.

M. K. R. Gavhale et.al.[3] This approach suggests that the timely detection of various plant diseases was necessary for both quality and quantity. It was difficult for farmers to control these diseases. This technique gives a disease detection system for plants. The productivity was improved using this technique. Advantages and disadvantages of various techniques were mentioned. The major technique explained were BPNN, SVM, SGDM and K-mean clustering.

P. B. Padol et.al.[4] In this approach image processing is done using Gaussian filtering, resizing and thresholding. K-mean was used to segment the image and feature extraction is performed using color and texture features. The diseases that are present in grape leaf are Anthracnose, powdery mildew and downy mildew. This method process gives automatic detection of diseases present on grape leaf. This process provides less expensive, fast, automatic and accurate method for classification and detection of various diseases present on grape leaf. To detect the type of disease SVM was used. The proposed technique provides an accuracy of 88.89%.

D. Cui, Q. Zhang et.al.[5] As per this method the airborne spores produced by the soybean rust infect the areas of soybean and loss of yield. 80% of the yield was lost in experimental trials in Asian countries. This approach develops the image processing approach for detecting rust from multi spectral images. This method was based on the HIS (hue saturation intensity) color model for infected area segmentation. RIA (ratio of infected area) and RCI (rust color index) were the two parameters used for disease diagnostic. These two parameters were extracted and used to indicate the rust severity. The centric method was used for automatic rust detection. Laboratory scale test validates the result.

J. Francis et.al. [6] The author provides image processing algorithm that was used in this method to detect and identify the pepper plant leaves. This approach was used to detect the disease of plant on early stage so as to improve the quality of the product. India is country of spices and pepper is the mostly cultivated and exported to other countries. The pepper was cultivated and it requires 15-40 degree Celsius. This approach uses the neural network for classification. Back propagation was used for supervised learning method. The process uses MATLAB R2012A. Healthy and unhealthy plants were differentiated using this approach.

J. Qin et.al.[7] The approach was used to detect the canker lesions on citrus fruit using hyper spectral reflectance imaging coupled with PCA based classification. The detection accuracy was 92.7%.The wavelength were 555, 677,718 and 858 nm. The wavelength was between 400 and 900 nm.

M. S. Arya et.al. [8] The researcher gives that the quality and quantity were suffered because of the various plant diseases. There could be many reasons for plant diseases such as fungi, virus, infections, environmental issues etc. In this approach

the image processing technique was used to detect the unhealthy part of plant in this process the plant leaf was processed using MATLAB. The detection was done using image processing and genetic algorithm with arduino was used. The concept of conveyer belt system was used for classifying the leaves. The affected area was differentiated by Otsu's method. The disease was monitored at very early stage.

M. Dhakate et.al. [9] As per the researcher pomegranate was affected by bacterial blight, leaf spot and fruit spot. The proposed work was used to detect and classify these diseases using GLCM method and ANN network. 500 images were taken for this approach. The different category taken was healthy and diseased parts of the plant. The accuracy was 90%.The healthy leaf result was 100% and the different diseased plant gives 87.50% for bacterial blight, 83.33% for fruit rot and 85.71% for fruit spot disease.

K. Hrishikesh P et.al.[10] The author suggests that the digital image processing gives an advanced approach to detect the plant disease as compared to the traditional photography technique. Naked eye inspection was not effective in large fields. This approach provides a machine vision for automatic inspection, robot guidance and process control. The diseases like brown spots, bacterial diseases and late scorch were examined. The classification was obtained by minimum distance criterion was 86.77%. SVM classifier improves the detection by 94.74%. The algorithm was tested on plants species namely mango, sapota, potato, lemon. The diseases were detected with minimum computational effort.

S. R. Dubey et.al.[11] This approach gives that the manual detection of diseased fruit was time consuming and inefficient. This approach uses defect segmentation on color images. It was based on color feature with K mean clustering algorithm which was unsupervised. There were two stages for defect segmentation. Firstly the based on the color and spatial features the pixels were clustered. After that merging them to specific region was done. The computation efficiency was increased in these two steps. This method gives a robust feasible to detect the defected region. This study uses apple diseases such as apple rot, apple scab and blotch. K-mean clustering makes three to four clusters. The calyx and stem are also segmented based on k-mean.

J. D. Pujari et.al.[12] This study gives image processing technique for various horticulture/agriculture crops affecting from fungal diseases. The early examination and classification of fungal diseases was done in this approach. The photographic technique was used in description of plant disease. Fungi take their energy from plant to live. The computer vision system (CVS) was developed. Statistical features using block-wise, Gray Level Co-occurrence Matrix (GLCM), and Gray Level Run length Matrix (GLRLM) were extracted from image samples. The gray level co-occurrence matrix (GLCM) and grey level run length matrix (GLRLM) were taken from image sample. The nearest neighbor classifier was used for classification. The average accuracy was 94.08%.

S. Vetal et.al. [13] This paper suggests that the main factor behind the reduction in both quality and quantity was crop disease. To prevent the agricultural loss, identification of plant disease was necessary. The paper gives an automatic detection and classification approach. Neural network based classifier was used for classification. This paper gives the various images processing method for automatic detection of crop disease. The histogram shows that the healthy wheat has maximum peak occurrence as compared to the unhealthy wheat. The frequency of occurrence of normal color is more than different colors. The accuracy in case of neural network was 80.21% and accuracy in case of support vector machine was 89.23%.

M. Islam et.al.[14] The image and computer based was used to quantitative plant disease. The approach merges image processing and machine learning to diagnose the leaf images. The plant village data of potato plants was used to detect the diseased leaf. 300 images were taken and the support vector machine was used for segmentation. The diseases of potato were late blight and early blight. The automated system was developed using multi class SVM for image segmentation. The potato diseases late blight and early blight was done with little computational effort. This approach was feasible, time saving and efficient for farmers to identify diseases.

N. Krithika et.al. [15] As the researcher says identification of each diseased leaf is a challenging process. This paper gives an approach for grape leaf diseases. The Skeleton of leaf was identified on the basis of grape image. For estimating the positions and direction of leaf skeletons were used. This method reduces the recognition time and computation complexity because it combines leaf disease and leaf identification. The retrieval of Skeleton was done using tangential direction based segmentation. The diseased leaf was classified using KNN classification algorithm. GLCM features were classified and extracted using images of grape field.

N. R. Bhimte et.al.[16] This approach shows that cotton was cultivated by most of the farmers in India. The productivity and yield was lost because of cotton diseases. Diagnose of these diseases is necessary on early stage. This approach uses an automatic identification of disease using image processing technique.SVM was used for classification based on features like color and texture. Classification was done based on testing and training. The dataset was of 130 images and

among these 50 images were of bacterial blight disease, 30 of them were healthy leaves and 50 images were of magnesium deficiency. RGB images were converted into i*a*b color space.GUI model was used to show these diseases. The accuracy was 98.46%.

C. Related Work:-

AUTHOR/YEAR	TECHNIQUE	RESULTS	PARAMETERS
M. Dhakate /2008	GLCM and ANN	Disease detection based on different pomegranate disease.	90% accuracy is achieved
J. Qin, T. F. Burks, M. S. Kim, K. Chao, and M. A. Ritenour/2008	Hyper spectral reflectance	Canker diseases are detected	Accuracy is 92.7%
S. Arivazhagan, R. N. Shebiah, S. Ananthi, and S. V. Varthini/2013	Texture features	Texture analysis for detection and classification of plant.	Accuracy=94.7% efficiency
S. R. Dubey, P. Dixit, N. Singh, and J. P. Gupta/2013	SVM and K mean	Classification result are detected	Accuracy value is 93%
J. D. Pujari, R. Yakkundimath, and A. S. Byadgi/2015	GSM and remote sensing	Various fungal diseases are classified.	94.08% accuracy is obtained
P. B. Padol and A. A. Yadav/2016	SVM classifier	The color and texture feature are extracted.	88.89% is the accuracy result
S. Vetal and K. R.S/2017	Neural network and SVM	Histogram depicts the result for tomato disease	The accuracy is 89.23%.
M. S. Arya, K. Anjali, and D. Unni/2018	Genetic algorithm With arduino	Classification and automatic detection of plant disease.	Speed, accuracy

IV. CONCLUSION

In this review paper the several image processing techniques are explained in order to detect the plant diseases. The automatic detection methods used are neural network, SVM, KNN etc. The accuracy comparison of various algorithms is discussed. These techniques are used to give fast, effective, accurate result in disease detection of plants. The automatic detection gives better results as compared to the traditional methods of plant disease detection such as naked eye observation. The efficiency, speed and other factors are also explained in detail for various plant diseases.

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