ISSN No:-2456-2165

Plants Diseases Detection: (A Brief Review)

1st Siddhant Dev Mannu
Department of Information TechnologyIndian Institute of Information Technology, Sonepat
Haryana, India

2nd Dr. Sourabh Jain
Department of Information TechnologyIndian Institute of Information Technology, Sonepat
Haryana, India

Abstract:- Diseases in plant/crops cause major losses in terms of economy and productions as well as reduction in quantity and quality of agricultural goods/products. Plant disease affect the growth of their species. About 58% of Indian population, agricultural is the primary/elementary source for their livings. Since, 70% of Indian Economy is highly depends only on agricultural yields, so there is need to control the losses done by the diseases. To preventing the losses in quantity and improving the quality of agricultural goods, therefore early recognizance is very important. Still traditional methods being followed by the experts such as naked eye observation that is time-consuming and expensive. In this paper, image processing techniques and some others technique and methods are used for the detecting the diseases in plant are disscused. It's includes several steps like in image processing are: image acquisitions, image pre-processing, image segmentations, feature extractions and classifications of plant diseases.

Keywords:- *Plants Diseases Detection, Image Processing, Classifications.*

I. INTRODUCTION

India is a developing and cultivated country and its economy and populations highly depends on agriculture products. Agricultural represents roughly 17%of total GDP, giving more than 60 % of the populace with employment[7],[12]. In field of agricultural, detection of diseases parts in plant plays an critical role. In the modern times, farmers are as yet dealing with issues to finding the suitable pesticides and herbicides to plants[7]. The current technique for plants diseases detection is only naked eye observation in which experts can identify the disease present on plants. What's more, it is extremely challenging to the large teams of experts to monitoring the diseases in plants continuously. Mostly in backward area, Framer do not have any ideas and facility regarding how to contact the experts. In case farmer contact to expert it would be pricey and time-consuming. And it is much difficult to the farmer to overcome with new plant diseases. Therefore looking for new method which would be fast and less expensive and must be accurate, and which detect the diseases that appear on the leaf of plant automatically[14].

Plants diseases identifications by visual way is more difficult task and simultaneously, less accurate and shouldbe possible just in limited regions. If automatic detectionmethod is used then it takes less time, less effort and become more exact. In plants, a few general diseases are seen like yellow spots and brown, early and late burn, and others are viral, bacterial and fungal diseases[7]. Image processing is used for estimating impacted area of diseases and to decide the distinction in the color of the impactedregion[6].

II. BASIC STEPS FOR IMAGE PROCESSING

A. Image Acquisition

By and large, the task of reestablishing a image from the beginning is defined to be an image acquisition. The basic state that is required consistently for the grouping of work process is Image acquisition because of the need of a image in image processing. The image is regular which is acquired. First step, is to capture the plant leaf by using digital camera or mobile phone with high resolution for better quality and better results[10]. The captured image is in RGB (Red, Green, Blue) formats.

B. Image Pre-processing

In second step, captured image is pre-processeds to enhance the quality of image or to remove the noise inimage by removing undesirable distortions and enhances images details which is necessary for further processing and analyze task. Different techniques are used in image pre- processing. Image clipping is based on ROI (Region Of Interest)[10].

Image smoothing helps to improving the image quality anddone by using smoothing filter. Image enhancement is helpsto increasing contrast of the images to get the better results.RGB image is converted into grey-image by using colour conversion equation are written below:
$F(x)=0.2989*R+0.5870*G+0.114$ (1)

After that the histogram equalization is done which assign the intensities of image is fuctional on the images to improve the leaf disease image. The cumulative distribution functions that distribute the intensity values.

C. Image Segmentation

Image segmentation is that method in which an image is splits into various parts of same feature or having some likeness that is expressive and easy to analyse[6]. The segmentation should possible use, converting RGB to HSI model, Thresholding, K-mean clustering, Otsu's algorithm and etc.

ISSN No:-2456-2165

a) *RGB to HSI model*:

The RGB images is converted into the HSI (Hue, Saturation, and, Intensity) model for segmentation[8]. Boundary and spot detection helps to track down the contaminated part of the leaf. The thought of connectedness of pixels is expected for distinguishing the boundary. After that boundary and spot detection's algorithm is done.

b) Thresholding;

Image thresholding is an easy and effective method of convey a image into a frontal area and foundation. This is a sort of image segmentation method that isolates object by changing it from grayscale images into twofold images. This is most effective in image with elevated degrees of variety. Selection of threshold Values is the key attribute in the processing[14].

c) K-means Clustering:

The Kmeans clustering is utilized for characterization of objects based on set of features into Knumber of classes. And its utilized to get the require feature from the leaves. Furthermore, the feature of the contaminated part of leaves are improved by getting the contrast images of the leave and from the neural network[12].The primary point of this algorithm is to limit the amount of distances between the objects and their relating clusters.

d) Ostu's thresholding:

Ostu thresholding pick out the threshold values to minimizing the intra class difference of the threshold high contrast pixels. Ostu algorithm automatically execute the cluster based image thresholding, or the reducing the gray-level image to a Binary Image by adjusting all pixels.

The working of Ostu algorithm are follows:
Step-1: According to the ostu threshold, distinctpixels into two different clusters.
Step-2: Then find out mean of the each cluster. Step-3: Square the variance between the means.
Step-4: Multiply the quantity of each pixels in asingle cluster time the number in other.

The contaminated leaf shows the side effects of the disease by changing the shade of the leaf. Thus, it would be possible to detect the contaminated part of leaf by using greenness on leaves. Than the RGB, part are extract from the image. The thresholds is determined using the Otsu methods. Then the green pixels is concealed and taken out if the green pixel intensities are lesser than calculated threshold.

D. Feature Extraction

To identification of an objects, feature extraction have an important role. There are many application of an image processing where the feature extraction are used. Texture, color, edges, morphology, and so on are the elements which canbe used to detect plant diseases and these elements are considered in paper [8]. They have observed that morphological outcome gives improved outcome than the other elements. Texture means how the color is dispersed in the image, the harshness, hardness of the image. It is also be utilized for the recognition of contaminated plant regions. An edge in a image is a critical neighborhood changes in the images intensity. Morphological tasks apply an organizing component to an input image, making a result image of a similar size and shapes[8].

Interesting features of an image from where the required information's are extracted is called as feature extraction. The component of the Region Of Interest (ROI) will be smaller than the original images. GrayLevelCo-occurrenceMatrix (GLCM) is one of the best methods for texture analysis[10]. It uses 2nd order statistics methods for estimating the image properties. Resultant will be the amount of event of the pixel with specific intensity in the spatial space. Size of the GLCM will be founded on the quantity of gray level.

Feature extractions is the process which is done after segmentation. As Demonstrated by the segmented data and predefined dataset a few features of the image can be remove. This extraction could be the any of structural, statistical or signal processing. Gray Level Co-occurrence Matrices (GLCM), Color co-occurrence, Spatial Gray-level, SGDM technique, Gabor Filters, Wavelet Transform[14], and many more analysis have a fewtechniques utilized for feature extraction.

a) Color Co-occurrence Method:

The color cooccurrence matrix for various spatial distances is characterized in light of the most extreme/least of color parts between the three parts (Red, Green, Blue) of a pixel. The GLCM function distinguish the texture of a image by computing how frequently sets of pixel with explicit values and in a predefined spatial relationship happen in a image, making a GLCM, and afterward removing statistical measurement from the matrix. The GLCM matrix is a methods to evalute the spacial relationship of a image pixel. Co-occurrence matrix estimates the possibility of appearance of sets of pixel values situated at distance in image. And this algorithm is said to be GLCM. The matrix characterizes the possibility ofjoining two pixels. In this GLCM method both texture and color are taken into record to get a unique feature for that image. For that the RGB image is changed over into the HSI model. For the texture calculation, the SGDM matrix are produced and uses GLCM function so that feature is calculated.

E. Classifiers:

Classifiers are utilized to recognize and classify the various diseases that arise on plant leaves based on acquire features. There are the linear and nonlinear classifier that have been used in past work to identify the plants diseases are Support Vector Machine (SVM), KNearest Neighbors (KNN),Artificial Neural Network(ANN),Convolutional Neura l Network(CNN),Radialbasis functions, Probailistic Neural Net work(PNN) and Back Propagation Network and so on[14].There are some platforms such as MATLAB that are used toprepare and test these classifiers.

ISSN No:-2456-2165

III. RELATED WORK

A. CNN

Convolution Neural Networks is a network architecture for deep learning that have the capacity of handling complex data[2]. The function of CNN is to simplify an images into a simpler to-process form, without compromising the features that are necessary for getting a good prediction. There are different accessible architectures for CNN, for example, AlexNet[11], GoogLeNet[11], VGGNet, LeNet, ResNet, ZFNet and so on[13]. Its development has created a lots of interest among researcher in different fields of software engineering. In agriculture, these architectures has been used for the arrangement of plants diseases.

The CNN model involves an input layer, convolution layer, pooling layer, the fully connected layer and a result/output layer. In input, an images are provided so that easy to classify the disease in plants . The convolution layer is utilized for extricating the feature from the input images. The pooling layer figures the component values from the extracted component. Depending upon complexity of images, the convolution, pooling layer can be additionally expanded to get more details. Fully connected layer utilizes the result of previous layers and changes them into a solitary vector that can be utilized as a input for next layer. The result layer at long last systematize the plant diseases.

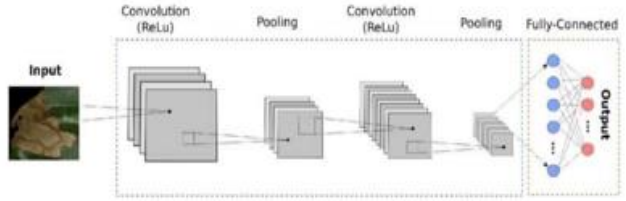

Fig 1:Plant disease classification through CNN classifier.

- Kamal et al. [2] in 2019 has proposed two models specifically Changed MobileNet and Reduced MobileNet by uses the depthwise distinct convolution architecture and their results were contrasted with MobileNet, VGG and AlexNet. There are some optimizers like Adam, SGD and Nadam are used in it. Nadam performed better and with a quicker convergence rate than the other two optimizers. In this work 82,161 images having 55 well defined classes of unhealthy and healthy plants were used from openly accessible PlantVillage dataset for the training and testing of the model.

B. ANN

ANN is a non linear statistical data handling model inspired by how data is handled by a biological system for example the brain[13]. It comprises of processing elements (PEs) or artifical neuron that are connect with coefficients, which form the neural structure. They assemble the information by identifying data patterns and connections and they learn through experience and not by programming. Artificial Neural Networks can be utilized for pattern extraction due to their capacity of getting significance from complex information.

The two kinds of ANN are the feed forward ANNs in which the way of behaving of any layer won't affect that equivalent layer and the feedback ANNs in which signals spread in the two directions by requiring network loops.

As displayed in figure 2, Artificial neuron involves a few data sources that can take any values in the range of 0 and 1, however just a single output[15]. For each inputs information the neuron has weight what's more, an overall bias.

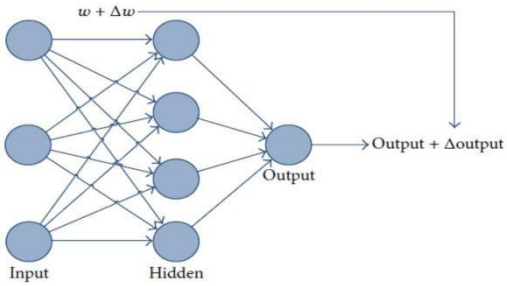

Fig 2: Classification using ANN classifier.

- Kumari et al. [3] in 2019 has proposed a automated framework/system for recognition of four classes of diseases in cotton and tomato plants. The sample of 20 plants images are taken from Plant Village dataset which is used in the paper. Images are segmented by using Kmeans clustering and identify features are extracted through GLCM technique, that are given as input to the ANN.

C. SVM

SupportVectorMachine is the famous Supervised Learning algorithm, which is utilized for the Classifications and Regressions problems. The main objectives of SVM algorithms is to makes the best line/decision boundary that can sort out n-dimensional area into the classes, so we can undoubtedly put the new data points in the right order later on and the best decision boundary is supposed to be hyperplane[4].SVM pick out the extreme point/vector that help in making the hyperplane. These outrageous cases are supposed to be support vectors and thus calculation is named as support vector machine. Consider the given chart, there are 2 unique categories that are characterized using a hyperplane or decision boundary:

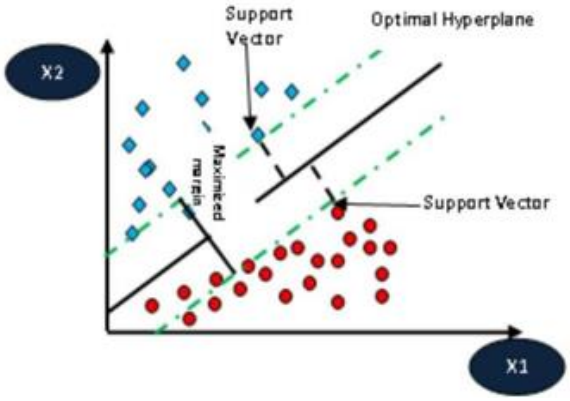

Fig 3: Classification using SVM classifier.

ISSN No:-2456-2165

- Bhimte et al.[4] in 2018 introduced a model which identified Bacterial scourge and Magnesium Deficiency in the cotton plants. The dataset comprised of 130 captured images, taken by the camera. Quality of an images are upgrad by using preprocessing techniques and afterward k-means clustering technique is used for segmentation. The improved images are then classifyby using the SVM classifier after the features have been removed by using GrayLevelCo-occurrence Matrix.

D. KNN

K-Nearest Neighbor is the most straightforwards Machine Learning Algorithms. K-NN can be used as Classification, Regression problems, and it's a nonparametric structural. It is additionally called a lazy learner algorithm since it doesn't learn from the training set promptly rather it stores the data and at the time of characterization, it perform an action on the data. KNN at the training stage simply stores the data and when it collects the new data, then it specify that data into a classes that is much related to new data. Here, the classification is done based on the calculated Euclidean distance metric.

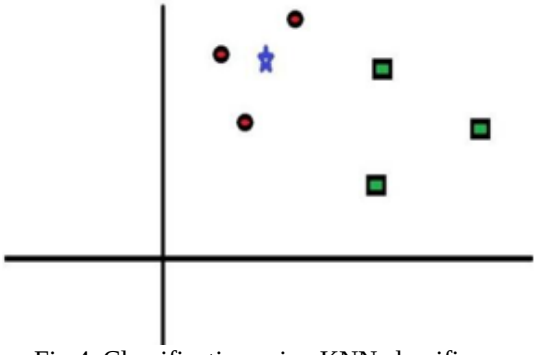

Fig 4: Classification using KNN classifier.

For K-NN classification three fundamental viewpoints as per the following:

> Simple resultant output interpretation.
> Short computational time.
> High prediction rate.

This technique generally used in regions like pattern recognition, text mining, and in agriculture/farming for characterizing different diseases in plants.

- Hossain et al. [5] in 2019 have examined plant diseasesfor example, anthracnose, alternaria alternata, bacterialblight, a leaf spot and used K-NN to characterize them. The dataset involves 237 leaf images obtained from the Arkansas plant diseases data base. The feature of plants have been removed by using the GLCM method. To exclude overfitting, the five fold cross approval was applied on the trained dataset.

IV. COMPARISON

Table 1: Summary of work done using CNN, ANN, SVM and KNN technique's.

Title	Technique's Used	Plants Used	Accuracy
Depth wise separable convolution architectures for plant disease classification.	CNN	Distinct Plants including Tomato.	The accuracy achieved by Mobile-Net, Reduced Mobile Net, and Modified Mobile Net were 98.65%, 98.34% and 97.65% respectively.
Leaf Disease Detection: Feature Extraction with K-means clustering and Classification with ANN.	ANN	Cotton and Tomato	The overall accuracy in the classification is 92.5 % using ANN.
Diseases Detection of Cotton Leaf Spot using Image Processing and SVM Classifier.	SVM	Cotton	The proposed system detected the disease in cotton plant with 98.46% accuracy.
A Color and Texture Based Approach for the Detection and Classification of Plant Leaf Disease Using KNN Classifier.	KNN	Various Plants Leaves	The classification performance of KNN on plant leaf disease provides 96.76% accuracy. This approach provides better results as compared to some existing methods.

V. CONCLUSIONS

Serious diseases in plants leads the annual losses of the agricultural yields and highly affect the economy of any country. Consequently, detecting the plant diseases at a beginning phase is very important for the prevention of such extreme losses later on. In this paper, Image processing steps and Classification techniques that are generally broadly used for the identification and detection the diseases on plants have been reviewed. The latest work has been anatomized and it is illustrate in the above tables. It is concluded that among the various techniques that already used in the current work done, The deep learning concepts, CNN approach gained the highest accuracy as compared to others techniques.

REFERENCES

[1]. S. D. Khirade and A. B. Patil, "Plant Disease Detection Using Image Processing," in International Conference on Computing Communication Control and Automation, Pune, 2015, pp. 768-771.
[2]. Kamal, K.C., Zhendong Yin, Mingyang Wu, and Zhilu Wu, (2019), "Depthwise Separable Convolution Architectures for Plant Disease Classification" Computers and electronics in agriculture.
[3]. C. U. Kumari, S. Jeevan Prasad and G. Mounika, "Leaf Disease Detection: Feature Extraction with K-means clustering and Classification with ANN," 2019 3rd International Conference on Computing Methodologies and Communication (ICCMC), Erode, India, 2019, pp. 1095-1098.

[4]. N. R. Bhimte and V. R. Thool, "Diseases Detection of Cotton Leaf Spot Using Image Processing and SVM Classifier," 2018 Second International Conference on Intelligent Computing and Control Systems (ICICCS), Madurai, India, pp. 340-344.
[5]. E. Hossain, M. F. Hossain and M. A. Rahaman, "A Color and Texture Based Approach for the Detection and Classification of Plant Leaf Disease Using KNN Classifier," 2019 International Conference on Electrical, Computer and Communication Engineering (ECCE),
[6]. Cox'sBazar, Bangladesh, 2019, pp. 1-6
[7]. Vijai Singh, A.K. Misra, "Detection of Plant Leaf Diseases using Image Segmentation and Soft Computing Techniques", Information Processing in Agriculture 4 (2017), pp. 41–49
[8]. S, Santhosh Kumar; Raghavendra, B. K. (2019). [IEEE 2019 5th International Conference on Advanced Computing & Communication Systems (ICACCS) - Coimbatore, India (2019.3.15-2019.3.16)] 2019 5th International Conference on Advanced Computing & Communication Systems (ICACCS) - Diseases Detection of Various Plant Leaf Using Image Processing Techniques: A Review.
[9]. Monica Jhuria, Ashwani Kumar, and Rushikesh Borse, "Image Processing For Smart Farming: Detection Of Disease And Fruit Grading", Proceedings of the 2013 IEEE Second International Conference on Image Information Processing (ICIIP-2013
[10]. P. Revathi, M. Hemalatha, Classification of Cotton Leaf Spot Diseases Using Image Processing Edge Detection Techniques, IEEE International Conference on Emerging Trends in Science, Engineering and Technology, pp-169-173, Tiruchirappalli, Tamilnadu, India, 2012.
[11]. Dr. Sridhathan C"Plant Infection Detection Using Image Processing."International Journal Of Modern Engineering Research (IJMER), vol. 08, no. 07, 2018, pp.13-16
[12]. Mohanty, S. P., Hughes, D. P., & Salathé, M. (2016). Using deep learning for imagebased plant disease detection. Frontiers in Plant Science, 7(September), [1419]
[13]. "Indian agriculture economy.". Available: http:// statistics times.com/economy/sectorwise-gdp-Contribution-ofindia. Php
[14]. Saleem MH, Potgieter J, Arif KM. Plant Disease Classification: A Comparative Evaluation of Convolutional Neural Networks and Deep Learning Optimizers. *Plants*. 2020; 9(10):1319.
[15]. Gavhale, Ms & Gawande, Ujwalla. (2014). An Overview of the Research on Plant Leaves Disease detection using Image Processing Techniques. IOSR Journal of Computer Engineering.
[16]. Sladojevic, Srdjan & Arsenovic, Marko & Anderla, Andras & Stefanović, Darko. (2016). Deep Neural Networks Based Recognition of Plant Diseases by Leaf Image Classification. Computational Intelligence and Neuroscience.