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A Review of Different Plant Leaf Diseases and an Analysis of Different Plant Leaf Diseases Identification Techniques

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Review Article

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ABSTRACT

This paper gives overview of Different plant leaf diseases and also analysis different techniques. In paper show various grouping strategies that can be utilized for plant leaf infections characterization. Distinguishing proof of side effects of illness by unaided eye is hard for rancher. Yield insurance in enormous casings is finished by utilizing electronic picture preparing procedure that can identify sick leaf utilizing shading data of leaves. There are so numerous grouping strategies, for example, k-Nearest Neighbor Classifier, Probabilistic Neural Network, Genetic Algorithm, Support Vector Machine, and Principal Component Analysis, Artificial neural organization, Fuzzy rationale. Choosing a grouping strategy is consistently a troublesome undertaking on the grounds that the nature of result can fluctuate for various information. Plant leaf illness arrangements have wide applications in different fields.

INTRODUCTION

The mother of all nations is agriculture. Agriculture research aims to improve the product's quality and quantity while reducing costs and increasing profits. Plant diseases may affect the quality of the agricultural product [1]. Pathogens, such as fungus, bacteria, and viruses, cause these diseases. As a result, detecting and classifying plant disease at an early stage is a difficult process. Farmers require skilled monitoring on a regular basis, which can be

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costly and time intensive [2]. Depending on the applications, many solutions have been presented that use image processing and some automatic classification technologies to address or at least mitigate the difficulties.

LITERATURE REVIEW

Types of plant disease fundamentals

There are different types of plant disease exist, but majority of these disease can be categorize into the three different categories which are bacterial disease viral disease and the fungal disease [3]. The most ideal way to detect the disease is the classification followed by detection. Classification is done on the basis of shape and texture features.

Bacterial disease

This is also known as bacterial leaf spot. Bacterial leaf spot is majorly detected in stone fruits such cherry, plum etc. In this disease black spots or dark spots occur on the different part of leafs. Yellow halos are also symptom of this disease. Spot size is of irregular nature [4-10]. Bacterial spots occur on the different part on the top and bottom start occurring and if these spots cluster together in any section of the leaf then this results in killing of that section by this disease. Wet and cool formation also contributes to the formation of the bacterial disease in the plant leaves. In these formations bacterial leaf spot can spread very quickly. Mostly bacterial leaf spot occur on the aged leaves but it can destroy the tissues of the new leaves too (Figure 1 and 2).

Figure 1. Bacterial disease in mango plantleaf.

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Figure 2. Bacterial disease effected mango.

Viral disease

Viral diseases are caused by viruses and as virus are intercellular, so these diseases attacks inside out. Viral diseases are sometime very difficult to identify [11, 12]. Virus can affect any region of the plants such leafs, roots, stem and others. Abnormal patterns are observed on the affected area green and yellow coloration is seen in leaves affected with the virus. The life span of the plant or its parts affected with the viral disease is very less. It directly affects the productivity and other factors. Wrinkles on the different part of the leaves are also primary symptom of these diseases. Every virus life span is very high as compared to the other types of the disease, because each virus if not properly cured give rise to new type of the virus so it is important for timely prevention of these disease (Figure 3 and 4).

Figure 3. Viral disease in mango plant leaf.

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Figure 4. Viral disease effected mango.

Fungal disease

Fungal disease occurs because of the fungi or fungal organism. One of the properties of the fungi is that it spread with wind and the water. Gray green spots on the leaf of the plants are observed and if not properly cured they start getting spread toward the outer region of the leaf [13, 14]. Wilting, scabs are the primary symptoms fungal disease. Fungal disease attack on the plant leafs result in the yellowness of leaves at end (Figure 5 and 6).

Figure 5. Fungal disease in mango plantleaf.

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Figure 6. Fungal disease effected mango.

Phoma blight

The symptoms of the disease are only noticeable on old leaves. The lesions are angular, small, irregular, yellow to light brown in colour, and initially spread across the leaf's lamina [15-18]. The color of the lesions changes from brown to cinnamon as they grow larger, and they become virtually irregular. Dark outlines encircle fully formed patches with dull grey necrotic centres. These spots coagulate into patches ranging from 3.5 to 13 cm in diameter in cases of severe infection, with the infected leaves eventually withering and defoliating totally. The pathogen is a seed-borne fungus, and primary infection is caused by inoculums found in the seeds. Fungi can also survive on glumes, fruit, and plant matter. The pathogen is a seed-borne fungus, and primary infection is caused by inoculums found in the seeds. Fungi can also survive on glumes, fruit, and plant matter (Figure 7 and 8).

Figure 7. Phoma blight disease in mangoplant leaf.

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Figure 8. Phoma blight disease effectedmango.

Sooty mould

Mealy bug, scale insect, and hopper control in orchards has been ineffective, resulting in widespread disease. The presence of a black velvety coating on the leaf surface, i.e. sooty mould, is used to detect the illness in the field. In extreme cases, the presence of mould on the whole surface of the twigs and leaves leads the trees to turn entirely black [19-22]. The amount of honey dew emitted by the insects indicated above determines the severity of infection. Insect dew clings to the leaf surface, providing the ideal conditions for fungal growth. The scale insects' honey dew secretions, which provide the essential medium for fungal growth, determine the severity of infection. Co-spores are airborne spores that are used to propagate the disease (Figure 9 and 10).

Figure 9. Sooty mould fungal disease inmango plant leaf.

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Figure 10. Sooty mold fungal disease effected mango.

Existing system

The current disease detection technology is based on a simple optical observation by professionals, which allows for the identification and detection of plant illnesses [23]. As a result, an enormous team of professionals, as well as continual monitoring by specialists, is required, resulting in exorbitant rates once farms are large. At the same time, in certain nations, farmers lack adequate facilities or the understanding that they will need to consult specialists. As a result, even while consulting professionals charge a premium fee, they are also time consuming. The suggested strategy comes in helpful in such a case for keeping a watch on wide fields of crops. It's also easier and less expensive to diagnose disease automatically by merely glancing at the signals on the plant leaves.

The most difficult aspect of leaf identification is describing the shape of the leaf. Several shape choices have been extracted so far to explain the leaf form. However, after capturing the leaf's image and identifying its features, there is no correct application to classify it. In plant leaf categorization, each leaf is classified according to its morphological options. Among the strategies used for classification are: k-Nearest Neighbor Classifier.

- Radial basis function
- Artificial neural networks
- Probabilistic Neural Network (PNN)
- Convolution neural network
- Support vector machine.

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K-nearest neighbor

A classifier determines which class a given point belongs to by calculating the minimal distance between it and other points. The goal is to calculate the distance between the query sample and each training sample and choose the neighbour with the shortest distance.

Radial basis function

A Radial Basis Function (RBF) is a real-valued function whose value depends only on the distance from the origin. The normally used measuring norm is Euclidean distance [24]. RBF's are the networks where the activation of hidden units is based on the distance between the input vector and a prototype vector. Artificial neural networks ANNs are popular machine learning algorithms that are in a wide use in recent years. Multilayer Perception (MLP) is the basic form of ANN that updates the weights through back propagation during the training. There are other variations in neural networks, which are recently, became popular in texture classification.

Probabilistic Neural Network (PNN)

It is based on the Radial Basis Function (RBF) network and has a distributed parallel processor with a natural tendency to store experiential information. Input layer, pattern layer, summation layer, and output layer are the four layers that make up the multilayered feed forward network. The operations are organised into a multilayered feed forward network with four layers: input layer, pattern layer, summation layer, and output layer. PNN is an implementation of a statistical algorithm called kernel discriminate analysis in which the operations are organised into a multilayered feed forward network with four layers: input layer, pattern layer, summation layer, and output layer.

Convolutional neural network

It is a neural network that has convolution input layers acts as a self-learning feature extractor directly from input images. Hence, it can perform both feature extraction and classification under the same architecture. Back propagation network: A typical BP network consists of three parts: input layer, hidden layer and output layer. Three parts in turn connect through the collection weight value between nodes. The largest characteristic of BP network is that network weight value reach expectations through the sum of error squares between the network output and the sample output, and then it continuously adjusted network structure's weight value. It is popular and extensively used for training feed forward networks. Also it has no inherent novelty detection, so it must be trained on known outcomes for training feed forward networks.

Support vector machine

SVM stands for support vector machine, which is a non-linear classifier and a newer trend in machine learning algorithms. Many pattern recognition tasks, including texture classification, are solved using SVM. SVM was created with only two classes in mind. This is accomplished by maximising the hyper plane's margin. Support vectors are

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The samples that were picked to identify the hyper plane were those that were closest to the margin. Multiclass classification is used to solve the problem, and it is effectively made up by numerous two-class SVMs, either using one-versus- all or one-versus-one. Plant disease classification has wide application in Agriculture (Table 1 and 2).

Table 1. Comparison of image segmentation techniques.

Segmentati on Techniques	Advantage	Disadvantage
k-means clustering	When there is large number of images in dataset, k-means is useful for segmentation. It puts similar pixels into one cluster and different in another cluster.	Time consuming We have to manually decide which cluster gives better result.
Otsu thresholding	thresholding When there are two classes in the image then Otsu is suitable	By default, graythresh() function of MATLAB takes threshold value of 0.5. But, this value may not be optimal for different scenario.
	During our experiments we found that otsu gives better result compared to k-means clustering for image segmentation.	Difficulty in selection of threshold value.
Canny and sobel	Canny edge detection can produce better edge detection with thin and smooth lines Sobel edge detection finds edges and corners more accurately.	For our dataset, canny edge detection does not find edges and corners precisely.
		Sobel edge detection does not work well in case of nitrogen deficiency of cotton leaf, when there is thin and smooth lines in the image.

Table 2. Comparison of classification techniques.

Classifi cation Technique	Advantage	Disadvantage
ANN	It has efficiency to handle noisy data. It is self-adaptive technique.	Selection of architecture of NN is difficult. NN training is time consuming.
SVM	SVM can be used for both linear and non-linear classification.	Difficult to choose kernel function parameter.
	It is simple to understand and gives accurate result compared to other classification techniques.	
PCA	It has low sensitivity to noisy data. It reduces memory requirement.	Does not perform linear separation of data. The covariance metric of the data is difficult to be evaluated accurately.

Noise filtering is done and features are extracted and then image is further classified to detect the diseased part. Author concentrate Support Vector Machine (SVM), Artificial Neural Network (ANN) Using image segmentation techniques and machine learning algorithms the information for ripening stages of crop and infected part recognition is made. The framework will show programmed determination ability with extremely successful execution for the further agrarian item investigation/review framework improvement.

The Eigen feature regularization and extraction technique was used to detect three diseases (Red Spots, Leaf Crumple, and White Spots). They were able to reach 90% accuracy in detecting Red Spot using the proposed method, which is based on the fungal disease. a product model framework for the discovery of malady in rice plant based on different pictures of the rice plants. Pictures of the tainted piece of the rice plant are taken utilizing

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computerized camera. With the end goal to identify the abandoned piece of the plant different procedures like picture division, picture developing and so forth. By utilizing neural system the tainted piece of the leaf is grouped. On the sick plant, image preparation and careful processing operations are combined. Procedures enshrined in writing preparing and designing picture examination strategies with the use of the self- organizing map, the sick part of the rice plant leaf is recognized in this exam paper.

The crop growth usingthe image segmentation techniques. Noise filtering is done and features are extracted and then image is further classified to detect the diseased part Methodology embraced in paper Support Vector Machine, Artificial Neural Network, Dispersion method, Self-sorting out element Using image segmentation techniques and machine learning algorithms the information for ripening stages of crop and infected part recognition is made. There were a few issues for doing extraction of vague shading pixels from the foundation of the picture. Neural arrange don't permit better division of the grape leaf illness pixels. The framework will show programmed determination ability with extremely successful execution for the further agrarian item investigation framework improvement.

Image acquisition, picture pre-processing, image segmentation, feature extraction, and classification were highlighted as phases in illness identification. Other approaches for diagnosing plant illnesses using photographs of leaves were also investigated. In addition, certain feature extraction and segmentation algorithms for identifying plant ailments are discussed in this study.

The major approaches to image processing and machine learning that can be used to identify and categorise plant diseases are briefly described. Based on essential criteria such as dataset size, number of classes (illnesses), segmentation and pre- processing procedures, classifiers and their accuracy, and so on, the authors examined 19 publications for work on rice plant diseases as well as other fruits and plants.

This research describes and tests a method for identifying and classifying apple fruit diseases. The proposed method begins with picture segmentation using the K- Means clustering methodology, followed by feature extraction from the segmented image and classification with a Multi-class Support Vector Machine. The accuracy of the proposed method is 93 percent.

Infected part in the plant can be detected with help of color, and other changing properties by using classification algorithm. Methodology embraced in paper Segmentation, RGB, Color transformation, Image acquisition Different pixel information is extracted and Green leaves pixel and diseased leaf pixel are compared by finding the ratio of pixel corresponding to the healthy leaf to the pixel corresponding to the infected leaf. Background is remove and different region of the images are formatted after the image acquisition. Using image segmentation to extract the image feature is best. But important thing is the level of the results which derived using are how much reliable.

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the various diseases in the different parts and then apply the suitable algorithm and to design the approaches in order to detect the diseases using artificial neural network. Two database of the image is used one for training and other for the testing. Methodology embraced in paper Image Segmentations ML calculations All the disease of the apple and grapes are correctly identified using digital image processing and machine learning neural networks. Results get improved when contrasted with the discriminative models. Machine Learning techniques are versatile and can also provide a unique methodology for data analysis, notably in the new field of 'plant pressure assessment.' It will also aid in the quality assurance process and the presenting of fresh determinations norms for complicated aggressive qualities such as biotic and abiotic stress, as well as yield.

The authors of this publication present an A crop disease diagnosis can be done using machine learning and an image taken with a smartphone. They've shown a five-class classification system for determining the disease status of a plant. A total of 5 classes were used to represent health, and 4 classes were used to represent diseases. In addition, the four illnesses' severity levels have been further categorised. The severity levels vary from one to five, with one indicating a healthy plant and five indicating a diseased one. They also put a variety of feature extraction techniques to the test to see how they affect classifier performance. Four of the most common diseases that harm cassava plants were chosen. Using his or her smartphone, the farmer can upload the image and acquire the illness score from the server.

The authors of the research primarily focus on the diagnosis of grape leaf disease utilising a variety of artificial intelligence techniques. The proposed project is broken into three sections: I Grape leaf colour segmentation for pre-processing ii) segmentation of grape leaf diseases; iii) disease analysis and classification. They used a self-organizing feature map and a back- propagation neural network to recognise the colour of grape leaves. In addition, for segmentation, a self-organizing feature map with genetic algorithms for optimization is utilised, and for classification, a support vector machine is used. In addition, the segmented image is given a Gabor wavelet filter for a more accurate characterization of illness colour features. Finally, a support vector machine is utilised to divide grape leaf disease into three groups: scab, rust, and no disease.

A genetic algorithm is used to do image segmentation, which is crucial for disease identification in agricultural products. If the leaf is impacted by any diseases, the NN classifier is then utilised to classify thedisease. Banana, beans, jackfruit, lemon,mango, potato, and tomato were used to test and execute the proposed algorithm.

The categorization of Anthracnose and Downey Mildew, two watermelon leaf diseases, using neural network analysis is the subject of this paper. Some of the infected leaf samples were obtained under controlled conditions using a camera with a specified calibration method. Color feature extraction from RGB colour model is used to classify watermelon leaf diseases, with RGB pixel colour indices retrieved from the identified Regions of Interest (ROI). Prosed architecture made use of MATLAB's Neural Network Pattern Recognition Toolbox and the Statistical Package for the Social Sciences (SPSS).

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The plant illness, this study uses a variety of neural network algorithms to identify the observed spot infections in the leaves. In this research, numerous form and texture features are used to categorise sick plants using Feed Forward Neural Networks (FFNN), Learning Vector Quantization (LVQ), and Radial Basis Function Networks (RBF).
K- means clustering is used to extract the diseased region of the leaf after pre- processing the digital camera-captured images. A range of machine learning algorithms based on colour and texture data are used to classify the selected part. In order to achieve high accuracy, it investigates the accuracy of a number of machine learning approaches, including K- Nearest Neighbors, Multi-Class Support Vector Machine, Naive Bayes, and Multinomial Logistic Regression. Some of the attributes are contrast, energy, mean, homogeneity, standard deviation, and coarseness.

To detect and diagnose cotton leaf disease, the researchers used image processing and machine learning technologies. A survey on background reduction and segmentation approaches was also covered. Based on the results of this study, the author concluded that colour space translation from RGB to HSV is useful for background removal. When compared to alternative background removal procedures, we found that the thresholding process produces good results. The author was able to create a binary image by masking green pixels in the background removed image and then thresholding the masked image. SVM has been found to be effective in illness categorization. Three of the five key steps proposed by the author have already been completed: Image acquisition, image pre- processing, and image segmentation are all part of the operation.

Maximal leaf colour detail was the most difficult component of the endeavour. It's a typical task to get an image with all of the details into a processable memory. As a result of a process, such graphics are formed. They are 6-10MB in size due to the superb resolution. With the help of a Nikon camera, this was possible. The D5200 camera was created, and it functioned admirably. From the beginning until the end of the paddy crop season, the second difficulty was to eliminate lighting circumstances. Even when the image capture time is set in stone, it fluctuates significantly. There is, however, a remedy. user-defined thresholding that can be changed and LCC shades that can be adjusted as needed.

Evaluate a software system that uses Image Processing to automatically identify and categorise plant diseases. Agricultural professionals who can evaluate crop photographs and offer advise are hard to come by in rural India. Due to delays, farmers frequently receive professional answers to their issues too late. The goal of this project is to create image processing algorithms that can detect agricultural problems based on colour, texture, and shape in order to automatically detect diseases or other variables that may harm crops and provide farmers with quick and exact replies *via* SMS. The development and deployment of these technologies will substantially aid in the application of selective chemicals, lowering costs and resulting in increased productivity and product quality.

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A study on several methods for detecting plant leaf disease. Although there are numerous automated or computer vision approaches for disease diagnosis and categorization, there is still a gap in this study area. A single approach will not be able to identify all diseases. We arrive at the following conclusion after studying the aforesaid classification strategies. The k-nearest-neighbor approach is one of the most basic algorithms for estimating a test example's class. The temporal complexity of making predictions is an obvious downside of the k-NN approach.

The region localization network (RDL- NET) is first used to precisely pinpoint the diseased leaf component in order to eliminate background interference. A region segmentation network (RSED- NET) with an encoder-decoder structure is then used to accurately segment the sick leaf area. SPEDCCNN and other segmentation algorithms are evaluated in various scenarios in order to ensure their robustness. The SPEDCCNN model can perform the illness segmentation task with higher than 90% accuracy under various scenarios, according to the P, R, F, A, O, and U findings. SPEDCCNN outperforms other segmentation methods in terms of segmentation time. SPEDCCNN outperforms other segmentation methods in terms of segmentation time. The segmentation time for a single image is only 0.21 s, indicating that SPEDCCNN may meet the crop disease leaf segmentation criteria. Furthermore, the author has explored various segmentation approaches, as well as their merits and drawbacks. In addition, the paper provides a brief overview of several segmentation approaches, as well as their benefits and drawbacks.

In this study, leaf disease photos are categorised using a convolution neural network of five, four, and three layers, and pesticides are recommended based on the leaf disease. Our result shows that CNN model having 3-convolution layer, 4-convolution layer and 5- convolution layer trained for 10, 15 and 20 epochs (cycles). Author used performance analysis of convolution neural network for classification and prediction of pesticide for leaf disease is performed on Plant Village datasets.

Automatic disease detection and classification of tomato leaf disease images. Different tomato leaf disease images from plant village dataset were used for experimentation. The images are classified into 10 different diseases. During the experimentation author have performed the segmentation of the leaf disease area using color based thresholding technique on HSV image [25]. The severity measurement is done using the percentage calculation of the diseased area with the leaf area. The tomato leaf disease diagnosis is performed using a classification approach.

The diseases of various plant leaves can be detected. When plants are infected with a variety of illnesses through their leaves, it has an impact on agricultural productivity and results in a loss of profit. There has also been a decrease in the quantity and quality of agricultural production. Leaves are necessary for a plant's rapid growth and increased crop yield. Farmers have a difficult time identifying illnesses in plant leaves. The goal of this study is to develop a systematic approach to detecting and recognizing plant illnesses, which will aid farmers and pathologists in prospect investigation.

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Automatic detection of cucumber disease using image processing techniques helps in monitoring large fields by identifying the diseases as soon as they appear on the leaf. the proposed method, AHE to enhance the image which not only enhances the low contrast image but also has the capability of reducing noise present in the image with an extended feature as Contrast limited adaptive histogram equalization (CLAHE)then LAB converted the image for K-means clustering.

CONCLUSION

In this research, we give a survey on the detection and classification of major agricultural plant leaf diseases utilising various image processing and machine learning techniques. Despite the fact that there are various strategies for infection identification and arrangement in computerized or PC vision, this testing stage is still required. All illnesses cannot be diagnosed with a single technique. After studying the aforementioned arranging strategies, we arrive at the following conclusion. The k-closest neighbor technique is likely the most straightforward of all the strategies for predicting a test model's class. Forecasting with the k-NN approach is time consuming, which is a significant disadvantage. Furthermore, noisy sources of information are responsive to neural organizations. However, understanding the computational design in neural organization is difficult. In characterizing high-dimensional informational collections, SVM was determined to be serious with the best available AI calculations.

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