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Plant leaf disease detection by Features Selection and Learning Approaches Review

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ABSTRACT

Agricultural productivity is something on which the economy highly depends. This is one of the reasons that disease detection in plants plays a vital role in the agriculture field, as having disease in plants is quite natural. If proper care is not taken in this area, then it causes severe effects on plants and due to which respective product quality, quantity, or productivity is affected. In this proposed approach optimized segmentation to find active area for features and reduce noise, then extract texture base features and learning by ensemble classifier approach. In Proposed framework main emphasis on getting sufficient features from disease and learning combination of classifier use linear and nonlinear classification function.

Keywords**:** *Image Processing, Image Segmentation, K-Mean Clustering, Feature Extraction*

1. INRODUCTION

1.1 Image Processing

In agriculture research of automatic leaf disease detection is essential one in monitoring large fields of crops, and thus automatically detects symptoms of disease as soon as they appear on plant leaves. From recent researches we come to know many technique of image processing is extremely helpful to [27]:

- Detect plant leaves, fruits, and stems from products that are influenced by ailments/diseases.
- Quantify the regions influenced by the ailment in plant leaves, stems, and fruit.
- Detect the state of the region of fruits, stem, and leaves that have been influenced.
- Determine the shade of the influenced regions, and lastly,
- Find out the shape and size of organic products.

1.2 Fundamentals of Plant Diseases

In the area of crop production, plant ailment/disease is a noteworthy factor that corrupts the prominence and amount of the plants. The Regular methodology followed in plant sicknesses involves the process of classifying and detecting the model. Both the detection and classification models are generally examined by the IT and Engineering fields.

1.2.1 Bacterial Diseases: The bacteria-based disease, for the most part, alluded to the "Bacterial leaf spot". It initiates as the yellow-green lesions on undeveloped leaves which typically observed as disfigured and bent, or as dim, water-splashed, oily - showing up sores on more experienced foliage [5].

1.2.2 Viral Diseases: The viral ailment/disease displays some level of decrease underway and the life of virus-contaminated plants is typically short. The most accessible side effects of infection contaminated plants commonly appear on leaves, however, some viruses (infection) may cause on the roots, fruits, and leaves. Viral illness is extremely hard to break down. Leaves are viewed as wrinkled, twisted and development might be small because of the infection [5].

1.2.3 Fungal Diseases: The fungal-based disease can impact the contaminated yield, weeds, seed, soil and spread by water and the wind. In the early form, it appears on lower or increasingly seasoned clears out as gray-green, water-soaked spots. A short time later these spots are dark and by then there is a development of white fungal distributed on the basements. In wool shape streak i.e. yellow to white streak over the upper surfaces of more seasoned clears out occurs. It gets distributed externally on the surface of the leaf making it turn yellow [5].

1.3 Stages for Plant Disease Detection

This section presents basic steps for detection of plant disease as represented in fig.1.1

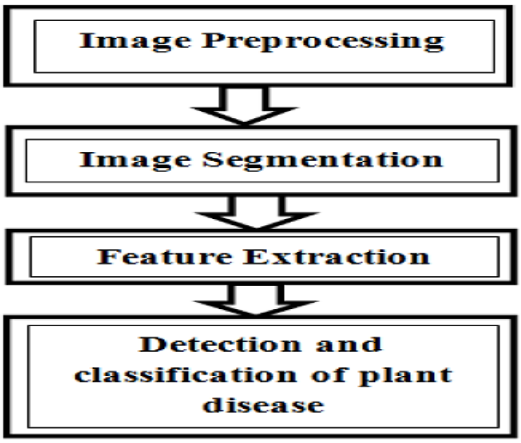

Fig. 1: Elementary steps for detection of plant disease

A. Image Pre-processing

The pre-processing of the image is to expel noise from an image or other item expulsion using diverse pre-processing procedures. In this process, we utilize image-based scaling. The scaling of an image is utilized to change over the original image into thumbnails because the pixel size of the real image is vast and it needs a huge time for the general procedure. Henceforth in the wake of changing over the image into thumbnails, the size of the pixel diminishes and it will need less amount of time [8, 13].

B. Image Segmentation

Image segmentation means representation of the image in more meaningful and easy to analyse way. In segmentation a digital image is partitioned into multiple segments can define as super-pixels. It is also a decision-oriented application is considered as the most utilized strategies to characterize the image pixels precisely. It is a significant apparatus (tool) in numerous fields including social insurance, picture preparing, traffic picture, design acknowledgment image processing, health care, pattern recognition, traffic image, and so on [6, 12, 26]. The process of image segmentation involves various methods such as edge-based, threshold-based, and neural network-based, and cluster-based. From various strategies, one of the most proficient techniques is the clustering strategy. Once more, there are various kinds of clustering techniques: Fuzzy C-means clustering, K-means clustering, subtractive clustering technique, and mountain clustering technique. K-means clustering presents one of the most utilized algorithms of clustering.It is straightforward and computationally quicker than the hierarchical type of clustering. These days image-based segmentation appears as one of the significant instruments in the medical region where it is utilized to extract RoI from its elementary origin. So medicinal pictures are segmented utilizing distinctive procedure and the results are utilized for further examination in medical (t) plant.

K-Means Clustering

The mechanism of Clustering represents a technique to separate a data set into a particular number of groups. K-means clustering is one of the mainstream strategies of clustering. In this clustering technique, it segments the data-based collection into a 'k' number data-based group [18, 23]. It groups a given data set into 'k' number of disjoint clusters. there are two separate stages for the k-means cluster algorithm. In the principal stage, it estimates the k-centroid and in the second stage, it carries every point to the cluster group having closest centroid from the distinct data point. Multiple techniques are used to characterize the separation of the closest centroid and Euclidean distance represents the most utilized strategies to be used in the analysis [6]. When the procedure of grouping is completed, the new centroid is recalculated for each of the clusters and dependent on that centroid, another Euclidean distance is determined among each middle and every data-based point and it further allocates various points in the group cluster having least Euclidean distance. Every cluster in the segment is characterized by the centroid and by its member objects. The centroid for every cluster represents the point to which the aggregate of distances from all the objects in the cluster is limited. Thus, K-means implies an iteratively built algorithm that limits the aggregate of distances from every object to its cluster-based centroid [1, 6].

C. Feature Extraction

Feature Extraction represents a significant part of the detection of disease. It assumes a significant role in object identification. Feature extraction [1, 16] is a kind of proportionality decrease that effectively presents an image-based region of interest in terms of the compact feature-based vector. It assumes a role in image identification. The process of feature-based extraction is utilized in numerous applications of image processing. Color, Texture edges and morphology represents the features to be utilized in disease detection. Texture represents how the shading or color is dispersed in an image, along with the rigidity of the image [6].

D. Plant Disease Detection and Classification

The last stage presents disease detection of the plant leaf. With the assistance of disease, the plants are classified and further, the disease is matched with the given (known) dataset. For the classification and detection of disease, a deep learning algorithm is executed. It is utilized to group or classify the quantified image into a suitable disease consequently it will be simple to recognize the sickness and discover the cure over the ailment of the plant.

1.4 Methods of Quantifying Leaf Disease Severity

There are a few techniques utilized by different analysts to evaluate the severity of leaf seriousness. A portion of these techniques is talked about. Plant leaf ailment or disease can be evaluated and measured either by the region been influenced or by the degree of which the disease has been established (how profound the warmth is) on the leaf that can be accessed through features such as texture and color [9, 15, 17]. The majority of the algorithms and the methods are used to evaluate the severity of the disease incorporate segmentation to isolate the symptoms to remove features and appropriately process the features to accomplish a measure for evaluating the severity of a disease.

1.4.1 Thresholding Method: Segmentation includes isolating a picture into regions (or their forms/ contours) relating to objects. We as a rule attempt to segment region by distinguishing mutual properties. Or then again, likewise, we distinguish contours by recognizing contrasts between distinct regions. In this way, a characteristic method to section such locales or regions is through Thresholding, the detachment of dark and light regions. Thresholding [30] makes twofold pictures from the grey-level by turning all the pixels underneath some threshold to zero and all the pixels about that threshold (edge) to one. Here, g(x, y) is a threshold form of f(x, y) at some global threshold (T),

$$g(x,y) = \{1 \quad if\ f(x,y) \geq T\ 0 \quad otherwise \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (1)$$

1.4.2 The use of Color Analysis: In plants, color analysis is the way toward investigating the color or shade of plant leaves utilizing shading designs/patterns. This technique was first evolved by a German Professor named John Wolfgang von Goethe (1749-1832). He utilized color examination to decide the

contrasts between various colors and made a research color psychology out of his discoveries. From then, shading or color examination has gotten mainstream in numerous fields of the scholarly community. Right now, color investigation has become a field of study and is increasingly valuable in different manners together with image processing.

1.4.3 Using Fuzzy logic: In computing, Fuzzy logic is a technique dependent on truth-based degrees as opposed to depending on Boolean logic which manages with the unusual false or true that is the strategy utilized by present-day PCs. (S.Bhaggiaraj et al, 2019) proposed a framework including image processing utilized for identifying the plant disease [3]. The leaf infections are recognized utilizing Fuzzy with ANN and PSO. This methodology assumes a crucial job in the precise discovery of leaf ailment.

1.4.4 Using Neural Network: Neural Network (NN) represents an Artificial Intelligence (AI) framework that looks to impersonate the human cerebrum. In the mid of 1950s, NN was first evolved by Bernard Widow of Stanford University. The neural system is utilized in different fields in computing particularly in image recognition frameworks, voice recognition frameworks, medicine, robotics, and so forth.

1.5. The utilization of Support vector machines (SVM): SVM represents learning models related to algorithms based on learning that investigate information to examine and classify the objects. They are usually discriminative classifiers that are dependent on decision planes that characterize decision-based boundaries.

2. LITERATURE REVIEW

G. Saranya et al. [1] propose the framework for example mostly utilized for distinguishing the plant ailment. The primary parts of disease distinguishing are to assist farmers with fast precision. The strategy depicted presently is utilized to outline the plant disease for the early discovery of plant ailment. It likewise commits future investigation on consequently assessing the security of the sickness.

Malusi Sibiya et al. [2]propose an algorithm for estimating the severity of disease in a plant leaf by utilizing the samples of maize leaf. In the analysis of literature, various analysts have addressed the issue of estimating the disease severity of plant leaves, yet a couple, for example, Sannakki et al., have utilized a technique based on fuzzy logic to decide the severity-based estimations of the plant

S. Bhaggiarajet al. [3] presents an algorithm based on the method of image segmentation that is utilized for automatic discovery of plant leaf ailments and portrays how the proposed framework deal with plant leaves which are influenced by utilizing the mechanism of image processing to identify disease or ailments. The process of segmentation of an input image presents an important viewpoint for disease discovery. It is accomplished through fuzzy logic for detecting the plant ailment. A test picture is taken and contrasted with and afterward utilizing Artificial Neural Network (ANN), the disparity is determined with database image separated parameters that are removed utilizing the GCLM i.e. Gray Level Co-occurrence Matrix (GLCM) technique.

Edna ChebetToo et al. [4] center around evaluating and fine-tuning state-of-the-art profound CNN for image-based classification of plant disease. An experimental examination of the profound or deep learning design is completed. The models assessed incorporate ResNet, Inception V4, VGG 16 with 50, 101 and 152 layers and DenseNets having 121 layers. DenseNets possesses a tendency to reliably improve in precision with a developing number of periods, without any indications of overfitting and execution disintegration.

Saradhambal.Get al. [5] propose an upgraded k-mean clustering to foresee the tainted zone of the leaves. A model based on the shading-based segmentation model is characterized to segment the tainted region and putting it to its important classes. Exploratory investigations were done on test pictures as far as time-based complexity and the region of the contaminated area. This work is utilized to identify the diseases of the plant and give answers to recover from the sickness. It shows the influenced piece of the leaf in percentage.

Shweta R. Astonkar et al. [6] This paper talked about the strategy utilized for the recognition of plant illnesses employing leaf images. The analysts segment the image by utilizing a k-clustering algorithm to produce the underlying centroid and the last segmented outcome in contrast with the k-means algorithm. It can further infer that the proposed mechanism of clustering involves improved segmentation process and after cluster development, it applies a deep-learning algorithm to discover a matched image. The researchers have discovered the z (estimating value) in each phase and contrast these and the dataset pictures and the value possessing less than the z value would be considered as the finalized value. The algorithm based on deep learning mechanism provides proper after-effect of the illnesses and sets aside less measure of effort for the process of detection than different techniques.

Vijai Singh et al. [7] presents an algorithm for the technique based on the process of image segmentation utilized for automatic classification and detection of plant leaf disease. It additionally covers a study on various techniques of disease classification used for the detection of plant ailment. The process of image segmentation presents a significant perspective for the detection of disease in plant leaf that is completed by using GA. To improve the rate of recognition in the process of classification. The hybrid algorithm, Bayes classifier, Artificial Neural Network, and Fuzzy Logic can likewise be utilized.

Pallavi.S.Maratheet al. [8] In this paper the identification as wells the solution for restoring is accomplished. This task uses GSM to send the message to each sort of versatile mobile handset. This paper uses different techniques of image segmentation which give precise outcomes.

Richard Marfo [9] This paper utilizes a technique named Triangular Thresholding technique with a composed algorithm to measure and detect the severity of parasites caused illness on leaves. It can likewise be utilized to recognize illnesses brought about by bacterial on plant leaves. The algorithm is assessed to offer up to about 97% precise outcomes. It keeps on giving proposals and suggestions made by the creator dependent on the discoveries of the examination to help different analysts who might want to direct research on a similar field of study.

SrdjanSladojevic et al. [10] This research paper talks about an additional methodology to deal with the enhancement of plant disease-based recognition model, given the classification of the leaf, via deep CNN. Novel training technique and a method are utilized for fast and simple execution of the framework. Out of the healthy leaves, this model helps observe 13 exclusive

categories of plant disease, with the capacity to identify plant leaves. As indicated by the information, this strategy for recognition of plant leaves has been proposed for the very first time. Every single primary step required for actualizing this model is completely portrayed all through the paper, beginning from image collection to make a database, surveyed by agriculture specialists.

Amar Kumar Deyet al. [11] In general this paper deals with leaf rot disease detection for betel vine based on image processing algorithm. The estimation of plant-based feature represents an essential component of plant research into and related applications. The data identified with plant features is particularly valuable for its applications in plant development modelling, agriculture-based research, and farm production. Barely a few techniques have been applied usually in the detection of leaf rot disease for betel vine leaf. The outcomes indicate a promising presentation of this automatic vision-based framework in practice with simple approval. This paper portrays the means to accomplish a proficient and cheap framework satisfactory to the agriculture specialists and the farmers too for contemplating leaf decay leaf rot infection in a betel vine leaf.

Ernest Mwebaze et al. [12] exhibited methods for removing various features from the images of leaf and show how extraordinary extraction strategies bring about various execution of the classifier. It at last displays the cellphone-based framework that utilizes the classification model figured out how to do an ongoing forecast of the condition of the wellbeing of a farmer's garden. This is usually done by the farmer uploading plant image in his garden and getting a disease score from a remotely built server.

Pranjali B. Padol et al. [13] In this paper a system is proposed to aid the process of classification and identification of grape leaf diseases utilizing SVM-based classification strategy. Firstly, a diseased region is revealed utilizing the segmentation process by K-means clustering, at this point both texture and colour features are extracted. At last, a classification strategy is employed to identify the sort of leaf disease. The planned frameworks efficiently differentiates and classify the inspected ailment with 88.89% of exactness.

K. Sumithra et al. [14] This paper exhibits an audit on different sorts of systems of image processing, for example, image enhancement, image restoration, image recognition, image restoration, and image segmentation has been talked about quickly and gives away from of uses utilized in image processing.

Aakanksha Rastogi et al. [15] This paper confers a basic and computationally capable technique utilized for identification if leaf ailment and reviewing grading utilizing machine vision technology and digital image processing. The proposed framework is separated into two stages, in the first stage the plant is perceived based on the features of the leaf, it incorporates pre-processing of leaf pictures, and features-based extraction followed by ANN-based classification and training for recognition of leaf. In the second stage the disease/sickness present in the leaf is usually classified, this procedure incorporates K-Means based segmentation of defected zone, include classification of disease using ANN methodology and feature-based extraction of the defected portion. After this disease grading is usually done based on the measure of ailment present in the leaf.

Sachin D. Khirade et al. [16] examined the techniques utilized for the discovery of plant disease utilizing the images of the leaves. This paper additionally examined some segmentation and feature-based extraction utilized in the detection of plant disease.

Vijai Singh et al. [17] summarizes amethodology of image segmentation and provides an algorithm for the segmentation utilized for automatic detection along with the classification of plant leaf disease. It also studies various classification methods utilized for plant leaf disease detection representing a significant aspect for the detection of disease in a plant leaf. This step is completed utilizing a genetic algorithm.

Prakash M. Mainkar et al. [18] summarizes and reviews various techniques of image processing for several species of the plant utilized for recognition of plant diseases. The significant systems utilized are GLCM, BPNN, and K-means clustering. A portion of the difficulties in these methods are optimization of the system for a particular plant, impact of the background noise in the gained picture and automation procedure for a constant automated screening of plant leaf ailment under practical field conditions. The proposed method represents an important methodology, which can essentially bolster an exact identification of leaf infections in a small computational effort. Further future work can be reached out by choosing better feature extraction; classification algorithms; better segmentation; and NNs to build recognition rate of the definite classification process.

Pradnya Ravindra Narvekar et al. [19] examines the successful way utilized in performing recognition of grape infections with the help of leaf feature review. The image of Leaf is caught and proposed to control the wellbeing status of every plant. The diagnosis of plant ailment represents an art just as science. The procedure of diagnosis (for example signs and symptom recognition), is characteristically visual and requires instinctive judgment just as the utilization of scientifically logical strategies. Photographic pictures of signs and symptoms of plant infections utilized broadly to improve the depiction of plant illnesses are precious in the investigation, diagnostics and so on.

Ghaiwat et al. [20] present a study on various techniques of classification to be utilized for the classification of plant leaf ailment or disease. For a specified test model, k-nearest-neighbour (kNN) strategy is by all accounts appropriate just as most straightforward of all algorithms for prediction of class. If the trained data is not linearly distinguishable, at that point it is hard to decide ideal constraints in SVM, which shows up its one of the downsides.

Sanjay B. Dhaygude et al. [21] This paper involves texture statistics application for distinguishing the plant leaf sickness. It firstly explains the process using colour transforming structure, where RGB is changed over into HSV space because HSV is a decent color (shading) descriptor. Covering and evacuation of green pixels with a pre-processed threshold level. The next step involves the process of segmentation using a patch size of 32x32 and acquired helpful segments. These segments are utilized for textural analysis via the color co-occurrence matrix. At long last, the textural parameters are contrasted with textural parameters of the ordinary leaf. The expansion of this work will concentrate on creating NN's and algorithms to build the rate of recognition of the classification process.

***S. Arivazhagan* et al. [22]** projected a programming solution for automatic classification and detection characterization of plant leaf disease. The advanced processing system usually contains four principlesteps, the first one involves a color transforming structure for the input RGB image, here green pixels are covered and removed employing explicit threshold value followed by the segmentation process, the textural statistics are usually computed for valuable segments. Lastly, the features extricated pass through the classifier. The efficiency of the proposed algorithm effectively performs the process of detection and classification of the analyzed ailments with 94% accuracy.

Sanjeev S Sannakki et al. [23] In the proposed framework, the image of a grape leaf with a complex foundation is taken as input. The phenomenon of thresholding is done to cover pixels green in color and it further involves the processing of the image to evacuate noise utilizing anisotropic diffusion. After this identification of the diseased section is done utilizing the K-means clustering. The infected section from the segmented image is recognized. Best outcomes were seen when Feed-Forward-Back-Propagation NN was prepared for classification.

2.1 Features Base Comparison Review

2.1.1 Shape Features Reviews

Table 1: Inference from Literature Review of Shape Features

Paper Reference	Dataset	Feature	Classifier	Result metrics	Advantage	Disadvantage
[35]	ICL leaf benchmark dataset	Shape	KNN	Accuracy-91.30%	Use of optimized shape features via SIFT Descriptor	Optimization takes more time for computation
[36]	Cifar-100	histogram of oriented gradient (HOG) use shape features	RCNN	Recall:89.80 Precision:95.12	Using the histogram base shape features which are capable to find effective discrete value.	It does not improve the continuous features
[37]	PicSOM's	Shape	KNN	Accuracy:78%	Improve features by finding the neighbour feature value	KNN does not use a dynamic approach.
[38]	crop position	Shape	ANN and KNN	Accuracy:92%	Improve position by shape features and its detection	It does not improve the texture of the position
[39]	P300	Shape	. Calibration Algorithm	Roc:88%	Improve EEG signals images position by shape feature	Not able to detect any pattern
[40]	ADNI dataset	Shape	SVM	Accuracy:84%	Shape feature improves by spectral features	Increase the computation of feature generation
[41]	NA	Shape	BPNN,SVM	Accuracy:90.8%	Cultivar shape classification by reducing the overlapping of features	It does not improve the texture of shape
[42]	Flavia	Shape	Alex net	Accuracy:98.75%	Shape feature improves by nonlinear mapping using Alex net	Increase the computation using of Alex net
[43]	Animal	Shape	SVM	Accuracy:90%	Bag of shape feature find a different combination	Increases the computation
[44]	Caltech-101	Shape	wavelet	Precison:78%	Improve the semantic relation of features	It does not improve other features.

3. CONCLUSION

This paper learned to recognise and classify environments of plants for stable and diseased plant pictures based on Machine Learning architectures. Analysis in a machine and Machine Learning approach the deep learning approaches improve significantly and improve. These results show machine learning not improve Classification of leaf disease because of the non-linearity mapping of features ignore in machine learning Training/Validation models are performed using an open dataset .This research offers an appealing means of diagnosing the infection type in various leaves. This is the first time we extent the Bayesian learning base CNN to our full understanding.

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