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A Review on: Plant Leaf Disease Detection & Classification

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ABSTRACT

An expected 70% of the Indian economy relies upon agribusiness. Since there is developing Indian population, which is increasingly dependent on the agricultural yield, generation of the harvests must be improved. The end goal is kept in mind to develop progressively the diseases need to be examined in earlier. Diseases are investigated utilizing different image processing techniques the image processing is the technique which process the digital information stored in the form of images. The plant disease detection is the technique which detects disease from the input images. The plant disease detection consists of three steps: initially the image that is fed to input terminal is preprocessed, thereafter features of the image is analyzed according to their features segmentation is applied and in the last step image is classified using any of the classifier. In this paper, various techniques of plant disease detection are reviewed and discussed in terms of various parameters.

1. INTRODUCTION

Agriculture is much more than just a source of food for ever-increasing populations. Plant diseases, on the other hand, are threatening the resource's survival. In addition, plant diseases have caused significant economic losses in agriculture and forestry. As a result, early detection and diagnosis of plant diseases are critical for taking prompt measures. We can detect illness in plants using a variety of approaches. Some ailments are difficult to diagnose early on. They'll have to wait for a bit before they can find out what's going on. Under these circumstances, advanced analysis, which is generally done with robust microscopes, is required. Diseases harm the health of the plant, which has an impact on its growth. Therefore, it is critical to monitor the progress of the farmed crop to guarantee minimal losses. The main goal of the proposed study is to develop a solution to the problem of detecting plants leaf disease using the most straightforward approach while using the fewest computational resources possible to obtain results equivalent to state-of-the-art approaches. Automatic feature extraction is used to help categorize input images into illness classifications.

The suggested system attained an average accuracy of 94%-95%, demonstrating the neural network approach's viability even under adverse conditions. This article uses a miniature version of the convolutional neural network model to detect and diagnose illnesses in plants leaves. Our principal purpose is to find the illness in the morphology of plant leaves by using a transverse learning methodology. A modern approach such as machine learning and deep learning algorithms has been employed to increase the recognition rate and the accuracy of the results. Through various research, the field of machine learning for plant disease detection and diagnosis they implement transverse learning methods such as random forest, artificial neural network, support vector machine (SVM), fuzzy logic, K-means method, Convolutional neural networks, etc. The machine learning technology to identify leaf images, that is, the identification of unhealthy images is extracted by using supervised or unsupervised learning algorithms and the recognition is carried out through the different features of diseased and healthy plants.

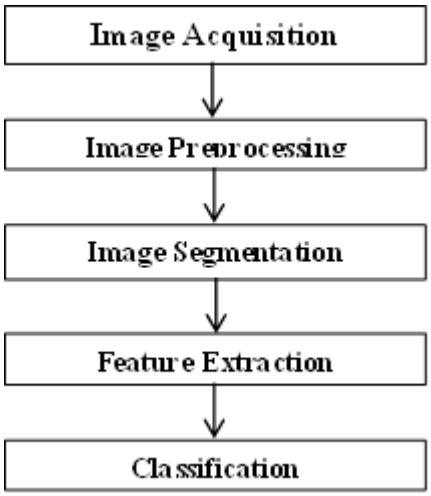


Figure 1: Block Diagram of Plant leaf disease detection

Input as a 2d dimensional image of leaf to the input terminal for the feature analysis which includes shape, texture, color, contrast, correlation, and energy. The shape and texture features are extracted at the local level and for analyzing the global medical image for color description the colored histogram is preferred and like k-mean cluster is preferred for segmentation grouping is a strategy for vector quantization, initially from signal processing, that is prominent for bunch investigation in information mining. k-means grouping intends to portion observations into k groups in which each recognition has a place with the bunch with the nearest mean, filling in as a model of the cluster and no of the classifier is used for classification k-nearest is very simple among the simplest of all machine learning that is a method for classifying objects based on closest training. Artificial Neural networks have demonstrated themselves as capable classifiers and are especially appropriate for tending to non-direct issues like leaf order. ANN is an interconnected gathering of hubs. Support Vector Machines depend on the idea of decision planes that characterize decision limits. A decision plane isolates between arrangements of items having diverse class memberships [5]. GLCM algorithm is based on the fitness function and is used for Image Retrieval Based on optimal Texture Features extracted from GLCM using Genetic Algorithm [12].

2. MACHINE LEARNING CLASSIFICATION

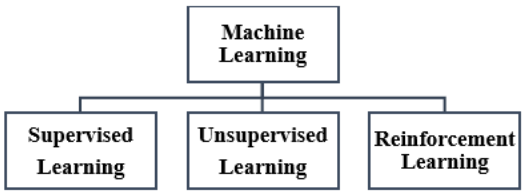


Figure 2. Classification of types of algorithms

A. Supervised Learning

In this algorithm with the help of the outcome variable and target this supervised learning algorithm are consist of the prediction with the help of a set of given predictors by using these variables the map of input to desired output function is generated, on the training data, until receiving the desired level of accuracy the training process remains continuous example Regression, Decision Tree, Random Forest, etc.

B. Unsupervised Learning

For the clustering population in various groups, unsupervised learning is used for segmentation of customers into several groups for unique and specific inventions so in this algorithm for the prediction and estimation without any target or outcome variable.

C. Reinforcement Learning

To ensure the specific reason the machine is trained in that manner by using this algorithm with the help of trial and error the machine trains itself according to exposure to an environment from the experience the machine learns automatically and the best possible knowledge will be captured for higher accuracy decision like Reinforcement Learning: Markov Decision Process. There are several systems picked in light of the reason that these classifiers have performed well in various genuine applications 5 distinctive Machine Learning methodologies for learning classifiers have been studied in this paper.

D. K- Nearest Neighbour (KNN)

KNN classifier is an instance-based classifier that achieves characterization of unknown occurrences by relating unknown to known by utilizing separation or such similarity functions. It's a slow learner which implies that this classifier can be tested and prepared at the same time. For allocates class of a larger part to the unknown instance, it takes K closest centers [11]. It is a simple algorithm because it classifies based on the majority vote and its k neighbor and is capable of both classification and regression problems the KNN is the best suitable algorithm, However, in the industry for classification problems KNN is preferred. With the help of the distance function, the measured K nearest neighbors amongst common class is the most case being assigned. These separation capacities can be Euclidean, Manhattan, Minkowski, and Hamming separation. For constant capacity first three capacities are utilized to fund the fourth one (Hamming) for categorical variables. For assigning the class of its nearest neighbor when K = 1, then the nearest neighbor can be simply assigned.

KNN can positively be mapped to our unmistakable lives. On the off chance that you need to learn about a man, of whom you have no proof, you may get a kick out of the chance to get some answers concerning his dear companions and the circles he moves in and access his/her data.

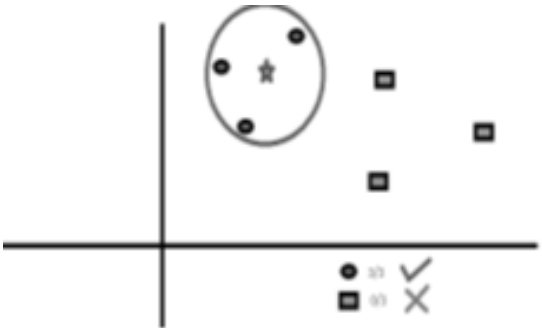
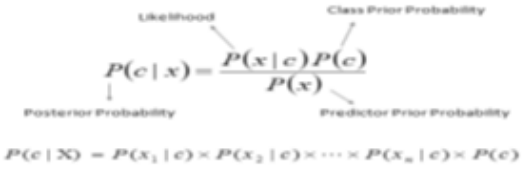


Figure 3. K- Nearest Neighbour Classifier

E. Naïve Bayes Classifier

Naïve Bayesian Classification is the establishment on Bayes' Theorem and is also generally known as a statistical implies [14] for effective classification the utilizations probabilistic investigation is required so that the Naïve Bayesian Classifier [14] give more exact outcomes in less calculation time when connected to the vast informational collections comprising of several pictures. It's a very simple algorithm that firstly just counts the bunch. TB holds If the assumption of that NB conditional is independent, like logistic regression a Naive Bayes classifier will quickly covert than discriminative models so that less training data are required And NB classifier still frequently does a great job in training when the NB assumption doesn't hold, appreciable thing is that while the obligation of something fast and easy that performs pretty well.



F. Support Vector Machine (SVM)

Support Vector Machine is a kernel-based classifier and it will be a machine learning procedure that is essentially utilized for order. In this, the data into two classes was created for direct partition which could be arranging information. SVM has been utilized for various reasonable issues, for example, face, gesture recognition [10], disease determination [8] voice identification, and glaucoma diagnosis. In the classification method of SVM n-dimensional space is plotting each data item with each feature value being the value of a particular coordinate. For example, in SVM two features are considered individual Hair length and height, in a two-dimensional space plot these two variables.

Presently, the information parts between the two contrastingly characterized gatherings of information so find that lines. This will be the line with the end goal that the separations from the nearest point in each of the two gatherings will be most distant away.

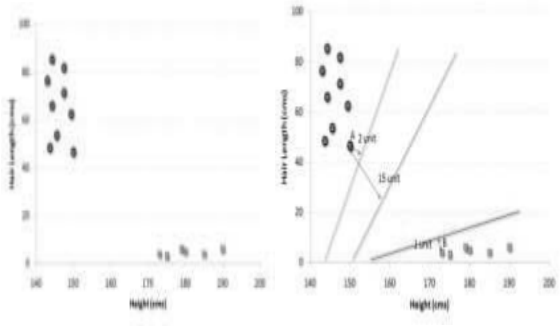


Figure 4. a) Diagram of SVM
b) Diagram of split SVM

G. Decision Tree

An IEEE copyright outline must run with your official Decision Tree Classifiers (DTC) including therapeutic determination, guess, discourse acknowledgment, character acknowledgment is viably used as piece of various locales Decision tree classifiers can change over the capricious decision into basic and justifiable choices. [7]

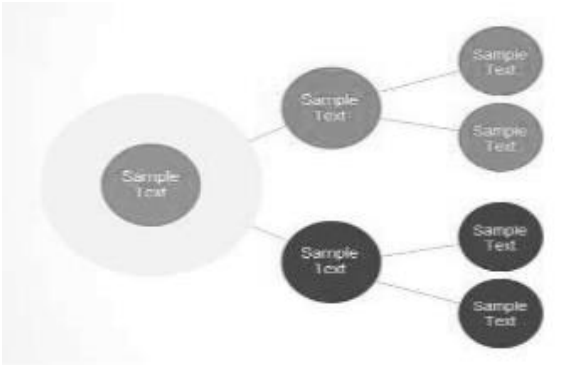


Figure 5: Decision Tree Classifier

H. K-means

To takes care of the bunching issue unsupervised algorithm [7] K implies is utilized this procedure trails an exceptionally straightforward and casual approach to order a given informational collection finished up a specific number of bunches are homogeneous and heterogeneous to peer bunches are Data focuses inside a group. Keep in mind expecting out shapes from ink blotch? k implies is marginally comparative this movement. appearance at the shape and spread to peruse what number of various groups/populaces are available.

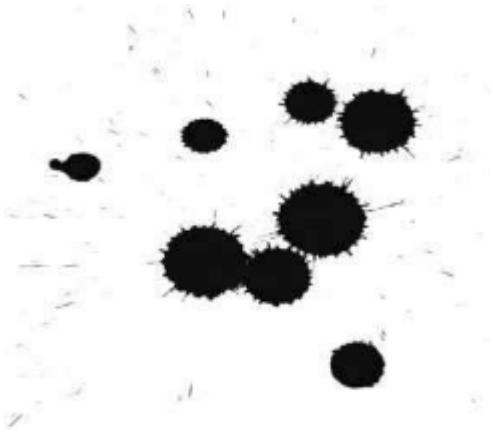


Figure 6: Decision Tree Classifier

How K-means forms cluster:

1. Each and each bunch is known as centroids and the K-implies pick k number of focuses.
2 . Each information point shapes a bunch with the nearest centroids.
3. There are new centroids it's given the existing bunch part for finding the centroid of each group...
4. Repeat stages 2 and 3. Locate the nearest separate for every datum point from new centroids and get related with new k-bunches as we have new centroids Repeat this procedure until the point that joining happens i.e., centroids do not change.

3. RELATED WORK

AnandR, VeniS, Aravinth J, et.al (2016) proposed [20] in today's scenario the identification and detection of the plant leaf is a major goal to cure this disease so in this paper the major issue in brinjal plant which is considerable and can be analyzed by using image processing and artificial neural network. Technique such as K-means clustering algorithm is used for segmentation and Neural-network is used for classification. These techniques are further used to detect and recognize the leaf disease the artificial neural network for detection model. So, for identifying brinjal diseases the number of parameters such as Area, Perimeter, Centroid, Diameter, and Mean Intensity is used.

Tomohiro Henmi, Akira Inoue, Mingcong Deng, Sinichi Yoshinaga, et.al (2016) proposed [21] Detection of fault in plants at the beginning stage and strategy to recognize plant blames early. The Early fault detection, support vector machine (SVM), one class SVM, generalized Gaussian kernel, water level Control experiment system is used in the paper. The SVM (Support vector machine) is utilized for the characterization and classification, an abnormal condition of data of plant is gotten a couple of minutes after the fact after blame happens after the occurrence of fault subsequently in the beginning time of deficiencies. Data is measured only when the plant condition is at an ordinary stage which is accessible in the learning phase of the technique Gaussian work is utilized to get the high capacity, summed up.

Aditya Parikh, Mehul S. Raval, Chandrasinh Parmar, and Sanjay Chaudhary (2016) et.al proposed [22] Most of the illness manifestations are reflected due to cotton leaf. The field pictures have a clutter background making and segmentation of leaf is exceptionally difficult underutilizing ordinary or a cell phone camera by a layman. 2 cascaded classifiers are utilized. The segmentations leaf is done by the first classifier. At that point utilizing hue and luminance from HSV and another classifier named color space is prepared to distinguish infection and discover its stage. The algorithm by the developer is summed up as it can be connected to any disease. However, as an exhibit, we recognize Gray Mildew; a generally common parasitic infection in North Gujarat, India. The test is that numerous maladies share comparative side effects amid beginning stages so more powerful highlights are required for their location.

Monzurul Islam, AnhDinh, Khan Wahid, and Pankaj Bhowmik, et.al (2017) proposed [23] about Highlighted in the current scenario, the identification, and detection to cure the disease by image processing and machine learning to achieve the optimum results with the help of plant leaf

database called plant village. The approach named image segmentation with support vector machine manifests the classification of disease of 300 images with more than 90% accuracy by automatic disease detection and implementation on a vast scale.

Thomas Truong, AnhDinh, Khan Wahid, et.al (2017) proposed [24] This paper exhibited the plan about the analysis of the fungal disease on crops due to environmental effect by using real-time approach internet of things and prevent it by using machine learning in which SVM (support vector machine regression) algorithm is used to process the data and predict day by day according to the environmental parameter. This paper shows the design of an Internet of Things (IoT) system consisting of equipment that is capable of sending real-time environmental data to cloud storage and a machine-learning algorithm to predict environmental conditions for fungal detection and prevention.

Amala Sabu, Sreekumar K, et.al (2017) proposed [25] In this paper plants have essential medicinal properties Automatic recognition of plant leaf is a challenging problem and difficult to search out in the area of computer perception. So basically, survey on the ayurvedic plant leaf recognition with the help of image processing and pattern recognition in which artificial neural network (NN), probabilistic neural network (PNN), nearest neighbor method (KNN), and support vector machine (SVM) techniques which are very helpful to detect and prevent the ayurvedic plant leaf. Based on its different features and appearance, a leaf is studied and observed. After the study and comparison of ANN, PNN, KNN, and SVM. The nearest neighbor method is the best classifier for the classification technique and prediction,

Vijai Singh and A. K. Misra, et.al (2017) proposed [26] that the in-agriculture field these days, there is worth mentioning the reason behind this obstacle which is disease detection in plants. If desirable measures are not taken it may adversely affect the plants which in turn reduces the productivity and quality of the plant. A typical example of a disease name little leaf disease is mainly found in pine trees in the United States of America. An automatic technique in the very first stage itself detect the symptoms of disease when they come in the leaf of plants. The automatic technique is used to detect and classify by using an image segmentation algorithm, which is profound for genetic algorithms and the classification of plant leaf diseases later. However, the efficiency of the purposed algorithm for classifying and recognizing the plant leaf disease with very fewer efforts, the better result was obtained.

Lanlan Wu, et. a (2017) proposed [27] In this paper while detection of the most noticeable region in the plant is essential to protect based on the view of visual consideration move with human visual observation was proposed in this investigation in which gradient, color, intensity features are obtained to frame up saliency model with acceptable of human behavior, by achieving the result from image segmentation observation by region growing access and visual attention model the salient locality were achieved At that point saliency delineate got from elements maps to mark ROI in the pictures. Has the advantage of concentrating on rapeseed plant locality and maintaining a strategic distance from weed areas in outside working conditions.

Jiang et al. [28] used a deep learning method to extract the disease features on tomato leaves, such as spot blight, late blight, and yellow leaf curl disease. This method predicted the category of each disease after continuous iterative learning, having accuracy increased by 0.6% and 2.3%

Sharma et al. [29] introduced an image acquisition, preprocessing, segmentation, and classification method based on artificial intelligence for the task of automatic plant leaf disease detection and classification, which can easily and quickly detect and classify plant leaf diseases in agriculture.

Lv et al. [30] proposed a plant leaf disease recognition method based on the AlexNet architecture for the enhancement of maize leaf features under complex environments. an AlexNet architecture network named DMS-Robust AlexNet improves the capability of feature extraction with dilated convolution and multistate convolution.

Liu et al. [31] for plant leaf disease identification generative adversarial network model have been proposed. It can generate images of four different leaf diseases and then fused DenseNet and instance normalization to identify real and fake disease images as well as feature extraction capability on a grape leaf. Finally, the method stabilized the training process by applying a deep regret gradient penalty. The results showed that the GAN-based data augmentation method can effectively overcome the overrating problem in disease identification, and this method can also effectively improve identification accuracy.

Liang et al. [32] for image recognition, multiple classifier integration methods were proposed which were divided into 3 parts. Firstly, healthy plant leaves were adopted, and then CNN was used to classify different plant diseases which were evaluated separately. Finally, it was evaluated for accurately diagnosing plant diseases by the integrated three models. Experimental results showed that on a split test set the top-1 accuracy approached 99.92%.

Jaisakthi et al. [33] designed a grapevine detection system based on image processing and machine learning. This system can segment grape leaves from the background by the grab-cut segmentation method. Global thresholding and a semi-

supervised technique was used by segmenting the diseased region from segmented leaves and then extracting segmented diseased parts, which were classified as healthy, rot, esca, and leaf blight by different machine learning methods. This method obtained a testing accuracy of 93% by SVM

Huang et al. [34] proposed an end-to-end plant disease diagnostic model-based deep neural network, which can reliably classify plant types and plant diseases. The model consists of two components: the leaf segmentation and the plant disease classifier, based on a two-head network that classifies plant diseases with the features extracted by various popular models. Experimental results demonstrate that this method can achieve 0.9807 plant classification accuracy and 0.8745 disease recognition accuracy.

Waheed et al. [35] proposed DenseNet architecture for corn leaf disease identification which uses the least parameters for efficient optimization. The above methodology shows a good effect on plant leaf disease identification. It can be seen from the above methods that the research in plant leaf disease identification is mainly concentrated on computer vision and machine learning, particularly the recent development of deep learning used in agriculture. However, these methods are rarely applied to plant leaf disease identification that can balance accuracy and efficiency. For structure and parameter adjustment we introduce a restructured dense residual network to improve the performance of disease identification and reduce the impact of the disease as much as possible.

CONCLUSION

In this paper, it has been concluded that plant disease detection is an efficient technology for disease detection in plant leaves. The plant disease detection techniques consist of common three steps which are pre-processing, segmentation and feature extraction, and classification. In recent times, various techniques have been proposed for plant disease detection which are based on these three steps. Image segmentation is performed utilizing K means clustering to distinguish the infected district's zone. In the subsequent stage, highlights are extracted from segmented districts utilizing feature extraction procedures, for example, GLCM. These components are then utilized for characterization into healthy or disease-affected types. Exploratory after-effects of classification by utilizing KNN classifier to classify data into more than two classes demonstrate. In the future, the technique will be designed which detect a disease from the leaves with maximum accuracy.

CONFLICT OF INTEREST

The authors declare that they have no conflict of interest.

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