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A Literature Survey of Multi Class Support Vector Machine Based Plant Leaf Disease Using Different Features Analysis: A Review

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***Abstract*— In this paper, we discuss on the machine learning algorithms have been widely used in the field of plant disease detection due to their ability to learn from data and make accurate predictions. Early detection and identification of plant diseases from leaf images using machine learning is an important and challenging research area in the field of agriculture this paper presents an overview of the use of machine learning for plant leaf disease detection. The study begins by outlining the different types of plant leaf diseases, and then discusses the various techniques used for plant leaf disease detection, including image processing and machine learning algorithms. The paper also reviews some recent advancement in the field, including the use of transfer learning and deep learning architectures for plant leaf disease detection.**

***Keywords*— Plant Disease; Machine Learning; Feature Extraction; Plant Leaf Disease; and Fungi Bacteria.**

I. Introduction

Disease, an impairment of the normal state of a living being that interrupts or modifies its vital functions. A disease is a particular abnormal condition that negatively affects the structure or function of all or part of an organism, and that is not due to any immediate external injury. Diseases are often known to be medical conditions that are associated with specific symptoms and signs [11].

A disease is often described by symptoms and affected tissues.

A diseased organism commonly exhibits signs or symptoms indicative of its abnormal state. Thus, the normal condition of an organism must be understood in order to recognize the symptoms of the disease. Nevertheless, a sharp demarcation between disease and health is not always apparent [12]. There are a variety of diseases that affect plants, which can each cause economic, social, and ecological loss. In this context, a timely and accurate diagnosis of plant diseases plays an important role in preventing the loss of productivity and quantity of agricultural products. Detection of plant diseases is usually performed manually [13-14].

Such processes are conducted by experts such as botanists and agricultural engineers, first by visual inspection and later in a laboratory environment [17]. These traditional methods are often time-consuming and complex processes. For these reasons, it has become important to automatically identify diseases based on image processing and machine learning.

Automatic plant disease diagnosis with visual inspection can be of benefit to users who have little or no knowledge of the product they are cultivating. There are different categories of disease in plant some of them are Fungi, Bacteria, Viruses and Nematodes [15].

A. Fungi

The largest group of plant pathogens, fungi come in a wide variety of forms. In general, they are multicellular organisms with a wire-shaped body [19]. These threads, called hyphae, have cell walls. When many yarns form together, they form a mycelium. The additional growth of a mycelium can produce fruiting bodies, where sexual or asexual spores form. The characteristics of spores, fruit bodies and mycelium are used to identify and diagnose fungal problems. Some fungi can survive and grow without a living host [20]. Others die if they are not in close association with a host. Fungi cause plant diseases by making toxins that kill plant cells, pushing in and plugging the vascular system of a plant, decomposing the roots or sending root-like structures in plant cells.

Fig.1. Fungi Disease in Plants

B. Bacteria

Bacteria are monocellular organisms which are much smaller and less complex than plant cells. Many have the size of a plant chloroplast. Some bacteria produce slugs that can attract insects that spread the bacteria in healthy plants. Bacteria can survive in unfavorable conditions in plant debris or even in seeds. Bacteria cause plant diseases by forming toxins or producing enzymes that break down the cell walls of the plant. Genetic Crown bacteria genetically generate their host plant to creategallsand amino acids, which gives bacteria a better place to live and the chemicals they need to grow and reproduce.

Fig. 2 Bacteria on Plants Leaves

II. LITERATURE REVIEW

Ref. No.	Techniques	Advantage	Disadvantage	Accuracy
Singh, U.P.,et. al[1]	MCNN(Multi-Scale Convolutional Neural Networks) for the classification	Performed in solving a number of plant leaves disease	MCNN, require large time for training data set.	Accuracy of 97.13%
Bhimte, N. R.,et.al [2]	k-means clustering	Early automatic detection of various type of diseases in plants.	The process of k-means clustering require Cluster section. that is semi auto learning process.	Accuracy of 94.63%
Saponaro,P.,et. al [3]	CNN (convolutional neural network) method	Frangi filter on real microscopy data, and found that the deep,CNN is totally automatic method not require any cluster selection process.	MCNN, require large time for training data set.	F1 score of 77.3 %.
Jagadeesh D. Pujari et al.[4]	Principle component analysis (PCA)	As the level of decomposition increases, it lowers the classification percentage so to manage the classification percentage PCA is used.	Loss of information while compressing the data found to reduce the number of dimensions.	Using Mahalanobis distance classifier accuracy is 83.17% and using Probabilistic neural network classifier is 86.48%.
Jagadeesh D. Pujari et al.[5]	Neuro-Knn	Robust to noisy training data and effective if the training data is large.	Chan vase segmentation is used which was based on an active contour model, working process is slow for large image size and also not capable to segment nearest objects.	Using ANN classifier and Neuro-Knn classifier accuracies are 84.11% and 91.54% respectively.
D S Guru et al.[6]	Probabilistic neural network	It takes less time to train the system and it has good extension properties.	It requires large memory space and slow execution of the network.	Using first order statistical feature accuracy is 88.5933% and using GLCM is 80.03%.
H. Al-Hiary et al.[7]	K-means clustering	By using otsu's method in segmentation phase makes computing faster and produce results more accurate.	Color co-occurrence method used for feature extraction is not reliable to large databases.	Accuracy of detection is 83% and classification is 94%.
Dheeb Al Bashish et al.[8]	Neural network classifier	More efficient.	Slow in processing.	Neural network classifier can successfully detect and classify with precision of 93%.
Huang KY et al[9]	Back propagation neural network and GLCM feature extraction	Very easy to implement and able to form difficult nonlinear mapping.	It is difficult to find the required number of neurons and layers, Learning process is	Effectively detected and classified to an accuracy of 89.6% while without classifying the disease

			also slow.	type only detection with an accuracy of 97.2%
Byadgi AS et al[10]	Segmentation technique-k-means, Classifiers-Artificial neural network and Support vector machine	SVM has a simple geometric definition and it is robust when the training sample has some discrimination.	Training process is slow and difficult to understand the algorithmic structure.	Classification accuracies using ANN lie between 68.5% and 87% while average classification accuracies increase to 77.5% and 91.16% using the SVM classifier.

III. DATA SETS

There are different disease data sets taken for performing proposed work such as Alternaria Alternata, Anthracnose, Bacterial Blight, Leaf Spot and healthy leaf.

A. Alternaria Alternata disease data set

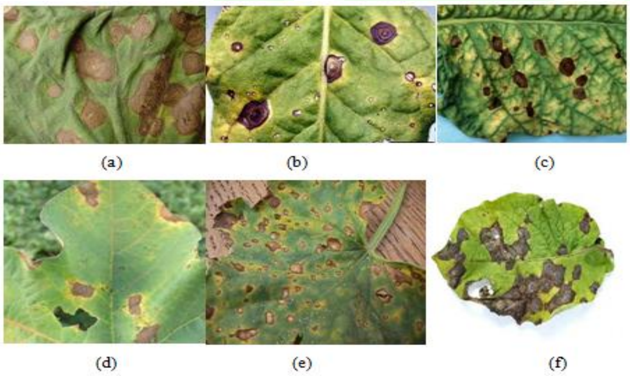

Fig. 3 Shows the Alternaria Alternata Disease Data Set [27]

In the above fig. 3 shows the Alternaria alternata disease data set images. The above figure shows only six images of this disease. Similar to that, another 20 images are taken in the data set for processing.

Anthracnose disease data set

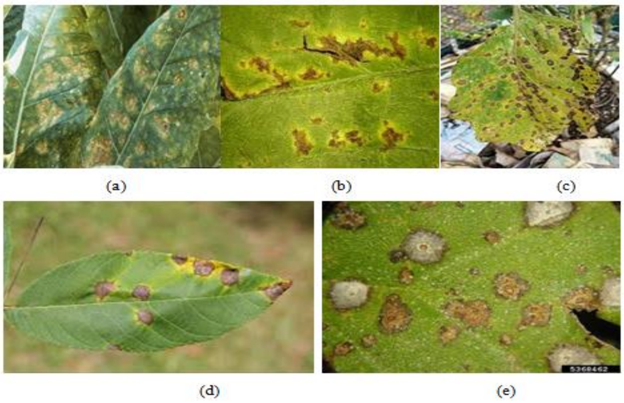

Fig. 4 Shows The Anthracnose Disease Data Set [27]

In the above fig. 4, five images of this disease are shown. Similar to that, another 20 images are taken in the data set for processing. Anthracnose is a group of fungal disease that affect a variety of plants in warm and humid areas, commonly infecting the developing shoots and leaves. Anthracnose fungi (usually *Colletotrichum* or *Gloeosporium*) produce spores in tiny, sunken and saucer-shaped fruiting bodies known as Acervuli.

B. Bacterial Blight

In the below figure 5 shows the bacterial blight disease data set images. The figure shows only five images of this disease. Similar to that, another 20 images are taken in the data set for processing and as per requirement, we may also increase or decrease the number of images. Bacteria are single-celled organisms that are much smaller and less complex than plant cells. Many are about the size of a plant chloroplast.

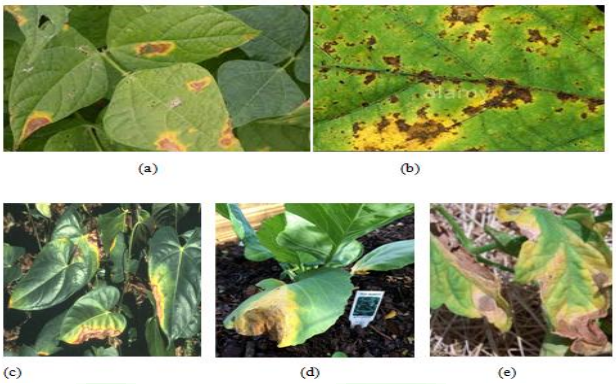

Fig. 5 Shows the Bacterial Blight Diseases Data Set [27]

C. Cercospora Leaf Spot

The below figure 6 shows only five images of the bacterial blight disease data set images. Similar to that, another 20 images are taken in the data set for processing. As per requirement also increases or decreases the images. Bacteria are single-celled organisms that are much smaller and less complex than plant cells. Many are about the size of a plant chloroplast.

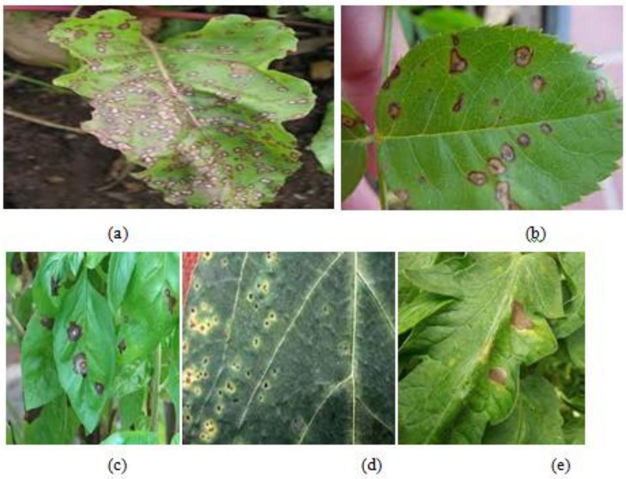

Fig. 6 Shows the Cercospora Leaf Spot Disease Data Set [27]

D. Healthy Leaves

The below figure 7 shows the healthy leaves without disease data set images. The below figure shows only five images of leaf without any disease. Similar to that, another 20 images are taken in the data set for processing.

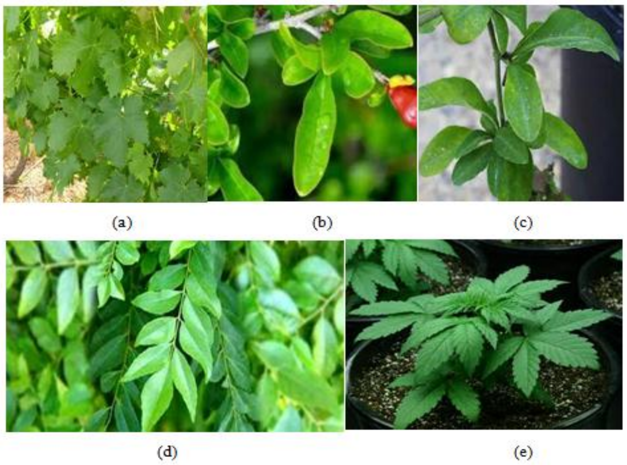

Fig. 7 Shows the Healthy Leaf without any disease data set [27]

IV. OUTCOME ANALYSIS PARMETER

The last non-destructive approach is the application of sensing in plant diseases. This is where data is obtained without having to be with the plant while observing. In this approach we use hyper-spectral and multispectral techniques in remote sensing. Hyper-spectral helps to provide high spectral and spatial resolution. Multispectral remote sensing provides the severity of the disease.

A. Result Parameters

There are different result parameters in disease detection in plants like classification of diseases, in this proposed work on different diseases. Therefore, detection of correct diseases is the major task of the proposed work. The next result parameter is affected region or affected area from diseases and the last one is accurate [22-26].

Accuracy

The detected part of a plant as a disease analyzed accurately. The accuracy of effected area calculation depends on true positive and true negative. True positive is an affected area calculated accurately. True negative is a non-effected part, detected accurately in plant leaf [22].

Precision

In information retrieval contexts, precision and recall are defined in terms of a set of retrieved documents (e.g. the list of documents produced by a web search engine for a query) and a set of relevant documents (e.g. the list of all documents on the internet that are relevant for a certain topic), cf. relevance [23].

Recall

In information retrieval, recall is the fraction of the relevant documents that are successfully retrieved. For example, for a text search on a set of documents, recall is the number of correct results divided by the number of results that should have been returned [24].

B. Classification

The major task of the proposed work is separated by machine learning the plant disease recognition and classification method by using image processing and soft computing techniques [25].

C. Affected Region (Area)

Effected area of the plant's leaf is known as an affected region.

V. CONCLUSION

In this survey paper discuss survey of different machine learning approaches for the identification of plant diseases using leaf images. As in plants suffer from different diseases which affect their normal growth. This survey consisted of the identification of diseases using handcrafted-features-based method and DL-based methods. We compared the performance in terms of the pre-processing and segmentation techniques used, the features used to classify the diseases, along with the dataset used in each paper. Through the survey of the identification of diseases using shape- and texture-based features, we can conclude that pre-processing and segmentation techniques play a major role in increasing accuracy. The SVM was the most widely used classification technique for the identification of diseases.

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