Plant Leaf Disease Detection

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***Abstract*— Plant leaf disease detection plays an important role in the field of agriculture. Early detection of the disease can prevent the loss of formers and help in the increasing the productivity of the crop. Diseases can be detected by different image processing and machine learning algorithms and pattern recognition. It is not a simple task to manually observe and classify leaf diseases, since it requires a lot of time, resources, commitment, etc. So, with an automated image processing and machine learning system, it's easier to identify diseases. Plant leaf disease detection consist of five basic steps; image acquisition, preprocessing, segmentation, feature extraction and classification. the denoising step can be achieved by application of different filters. This paper presents an analysis of various methods for detecting image processing plant leaf diseases.**

Keywords—agriculture, deep learning, image processing, machine learning, plant leaf disease detection.

I. Introduction

India's economy depends partly on agricultural productivity, and more than 70% of households rely on farming that belongs to rural areas. The agriculture industry pays more than 17 percent of the total GDP[1] and it is a great source of employment, and the total employment covered by the agriculture industry is more than 60 percent of India's total population. Therefore, detection and identification of plant or tree diseases plays an important role in Indian agriculture industry. Agriculture in India requires a number of crops. Various plants' strength depends on the roots and leaves, since they are the main portion of plants and trees. Early on the signs of plant disease can be seen on the leaves as they are the most sensitive part of plants[2]. Earlier experts manually monitored crop fields to identify the disease in plants, but this method was very time consuming[3]. Recently, a large number of semi-automatic and automatic detection systems have been developed for plant disease detection. These detection systems are less costly and reliable than farmers' previous conventional methods[4]. These detection systems primarily use deep-learning image processing concept.

In order to boost the agricultural sector and the Indian economy, precise identification of diseases is important for plants. Using leaf images, researchers and scientists proposed different ideas for efficient identification and detection of plant leaf diseases.

The central part of the Indian economy is agriculture. Agriculture's tremendous commercialization has a very diverse impact on our climate. The use of organic chemicals has resulted in vast volumes of chemical accumulation in our environment, soil, water, air, wildlife, and even our own bodies. Artificial fertilizers have a short impact on production, but a longer-term detrimental effect on the ecosystem where they continue to contaminate groundwater for years after leaching and run-off. Artificial fertilizers have a short impact on production, but a longer-term detrimental effect on the ecosystem where they continue to contaminate groundwater for years after leaching and run-off.

Currently, the diagnosis of crop disease often depends on manual identification, but some issue exists, on the one hand it can be wrongly diagnosed by farmers because their experiences typically judge the symptoms. The treatment of the disease, on the other hand, may be dallied over because the technician or specialist will not go to the locale in time to diagnose it. Relative to the vision of the person, computer image processing techniques take on certain characteristics such as speed, enormous information and distinguish small diversity that cannot be differentiated by the eyes of the person, so that image processing techniques can enable farmers to judge the causes and severity of crop diseases.

Digital image processing consists of different approaches using the Aided Diagnosis tool to avoid factors like noise and distorted signal in the process. Image processing is an important element in agriculture to assess plant disease more accurately. To find out early-stage plant diseases that are highly effective for detection and recognition. The harm caused by evolving, re-rising, and far-reaching species is crucial in plant frameworks and monetarily prompts potential misfortune. Infections spread overall, harming the plant's ordinary functioning and further harming the money-related situation by significantly decreasing the amount of plants.

Many systems have been suggested to solve or atleast minimize the challenges, depending on the implementations, by making use of image detection, pattern recognition, and machine and deep learning classification.

II. Methodolies to recognize plant leaf disease detection

The generalized block diagram of plant leaf disease detection is as shown in Fig.1.

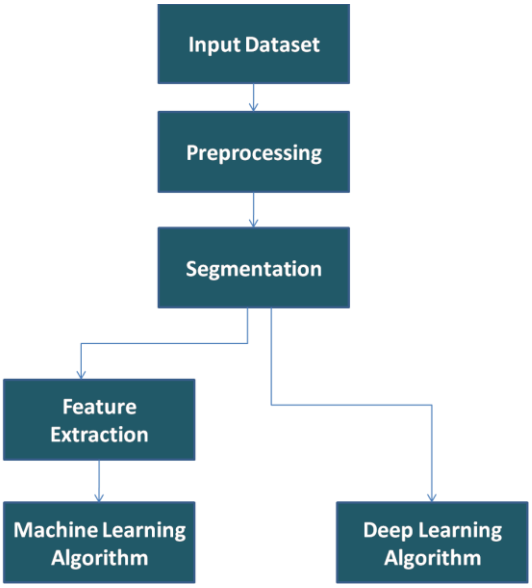

Fig. 1. Framework of plant leaf disease recognition algorithm

The detailed explaination of each block is explained below.

A. *Image acquisition*

In the image acquisition, images of plant leaves are acquired to perform certain image operations [5]. Images may be acquired through a digital camera or downloaded from an authenticated image database. The images and their features are stored in an image database[6]. The image database consists of healthy set and diseased set of images[7]. Image database efficiency depends on image eminence, so high quality images should be available[8]. Database performance determines system vigor[9]. Images are modified to device-independent color space[10].

Diseased databases of plant leaves are also available. To the best of our knowledge, the PlantVillage Dataset (PVD)[11] is the only publically available dataset. Using GoogleNet[12] and AlexNet[13], the dataset curators built an automatic disease detection system, achieving accuracy of 99.35%. The images in the PVD, however, are taken in laboratory settings and not in the actual environment as a result of which their real-world usefulness is possibly low. To create a freely available dataset, we have create real-life images of healthy and unhealthy plant leaves. The sample images of 'PlantVillage' datasets are as shown in Fig.2

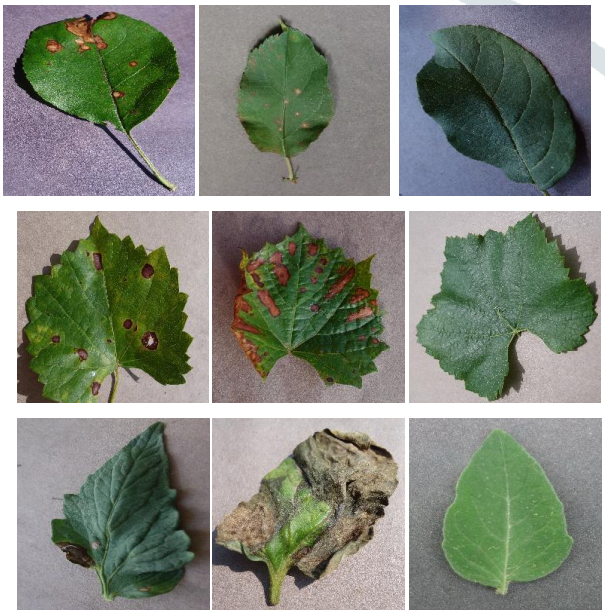

Fig. 2. Samples of diseased and healthy leaf of PlantVillage Dataset

B. *Preprocessing*

Pre-processing are used to make the image applicable for further processing. The image is resized in plant disease detection preprocessing[5]. Pre-processing images requires image enhancement, color transformation, noise removal[6]. Image enhancement improves image quality to improve visuality. The RGB image is transformed to grayscale in color space conversion using different color models including CIELAB, YCbCr and HSV. Various filter is used to remove noise[7]. The RGB image is translated into CIELAB, YCbCr and HSV since RGB is device-dependent color space and image processing system requires images in device-dependent models of color space[14]. After resizing, transforming and improving color space, Histogram equalization methods are used to designate intensities[15].

C. *Segmentation*

Based on the field of focus, the image is divided into various parts. The segmentation of the image splits the image into the same meaningful region. In Image Segmentation, based on similarity between different elements, the image is segmented into different parts. The parts having same features are grouped together[16],[17],[18]. Segmentation can easily analyze images. Image segmentation may be Local segmentation considering a particular part of the image and Global segmentation considering the entire image[29].

D. *Classification*

In machine learning, an exhaustive survey compared disease identification and classification techniques. Support Vector Machine (SVM), Artificial Neural Network (ANN), K-Nearest Neighbor (KNN), and Convolutional Neural Network (CNN) classification Methods for the identification of plant diseases. Machine learning classification is of two type; supervised and unsupervised. In the supervised classification, the set of graded groups is known in advance but is not known in the unsupervised learning set and Classifiers for classification purposes[19]. Classification techniques are:- ANN[6][19], decision tree[19], SVM[19],[20], Fuzzy measure etc.[21],[22].

Machine-learning methods have two big drawbacks. Second, they are highly dependent on variables trends and the features to be extracted. Second, before adapting to real-world implementations, classifiers must be trained several times. The most promising methods in data mining are NNs. The function of NNs is attention to the human nervous system. Basically, NNs are very useful for pattern recognition without any explicit recognition rules[23]. Cui et al.[24] have stated that NNs need less formal statistics in order to model complex nonlinear interactions.

E. *Evaluation Metrics*

The proportion of the type of disease and the section of the infectious region would be provided by the classifiers. The performance estimation of the outcome is based on accuracy measures.

Accuracy: The accurately predicted observation ratio is the cumulative number of measurements. It is quantified as,

$$Accuracy = \frac{Currently\ predicted\ observations}{Total\ number\ of\ observations} \quad (1)$$

The percentage of leaf disease is calculated using equations (2). This will provide gravity to the disease. This information will help farmers decide how much pesticide to use or select how much.

$$Percentage\ of\ disease = \frac{Pixel\ in\ diseased\ portion}{Total\ pixel\ in\ leaf\ area} \quad (2)$$

III. Conclusion

In this paper, the different methods for plant leaf disease detection has been reviewed. It is observed that only one dataset i.e. PlantVillage is available publically for research. Hence there is a need of development of plant leaf disease dataset. The most of the existing systems were implemented using machine learning algorithms. Mostly SVM and KNN algorithm is used by the many researchers for classification of the disease. Recently, it is observed that deep learning algorithms are used which are more accurate and performed on more number of plant disease.

In future, there is a scope of development of benchmark dataset for plant leaf disease for Indian as well as foreign crops. Also, there is need of implementation of robust and highly accurate classifiers which can be invariant to the environment conditions like deepCNN for plant leaf disease classification.

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