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Identification of Plant Disease using Image Processing and Pattern Recognition - A Review

D. Asir Antony Gnana Singh[1], E. Jebamalar Leavline[2], A. K. Abirami[1], M. Dhivya[1]

[1]Department of Computer Science and Engineering, Anna University, BIT Campus, Tiruchirappalli India

[2]Department of Electronics and Communication Engineering, Anna University, BIT Campus, Tiruchirappalli India

ABSTRACT

Agriculture is the backbone of the nation as it provides food and job opportunity to the humankinds and directly contributes to the economic growth of the nation. In agriculture, plant disease identification is more important one. If the diseases can be prevented early that would be more to helpful to farmers to save the crops. This paper conducts the literature review on identification of disease of the plant by using symptoms on leaves. There are several methods reported in the literature to identify the disease. Moreover, many researchers paid their attention in identification of plant leaf disease and some of them used image processing and machine learning techniques to perform the disease prediction. This paper presents a review on identification of plant disease using image processing and recognition.

Keywords : Plant Disease, Image Processing and Pattern Recognition, SVM, PNN, BPNN

I. INTRODUCTION

The economic level of most of the countries mainly depends on the growth of the agriculture. The agriculture field encounters recession due to plant disease. Insects affect plants and weaken their yield; therefore the famers suffer to increase productivity. Moreover, insects mostly affect the leaves and reduce the plant growth. Hence, there is a pressing need to identify the disease and help the farmers to increase productivity and to prevent diseases early. Many researchers conducted research on plant disease by observing the leaves.

The machine learning algorithm is used to identify the plant disease because it gives accurate and fast solution. Machine learning is a field of computer science that gives computers the ability to learn without being explicitly programmed. Machine learning is closely related to computational statistics, which also focuses on prediction making through the use of computer. In this machine learning approach, the sample images of leaves to understand the disease and leaf features can vary. Moreover, the samples of leaf images are given to the machine learning algorithm to identify the insects that affect the leaves. In machine learning algorithm, more number of levels help us to give the accurate solution. This algorithm can be deeply observed so that can give solution to any doubts. The features of the leaves are extracted from many images and stored for identification. Disease detection involves the steps like image acquisition, image pre-processing, image segmentation, feature extraction and classification. Image processing is a method to covert an image into digital form and performs some operation on it. Feature extraction start from an initial set of measured data and builds derived values (features) intended to be informative and non–redundant, facilitating the subsequent learning and generalization steps, and in some cases leading to better human interpretation. Feature extraction also is

related to dimensionally reduction. The machine learning algorithms are used to learn the features and develop the machine learning model to carry out the prediction. The reset of the paper is organized as follows. Section 2 reviews the literature and the Section 3 concludes the paper.

II. RESEARCH ON PLANT DISEASE DETECTION

This section presents the researches that are conducted by many researchers in plant disease identification. The plant disease is a common disease that can occur by bacteria, fungi, virus, and nematodes. The plant disease can affect the growth and yielding of the vegetable, fruit, and cereal crops. Therefore, many researchers conducted the research for detecting and identifying the plant disease for eradication. The plant disease identification is carried out in many ways. In general, the plant disease identification process comprises of different phases such as leaf image acquisition, leaf image pre-processing, leaf image segmentation, feature extraction form the leaf image and classification process. Chaitale G .Dhaware et al discussed different techniques that are used for leaf image pre-processing and the image segmentation algorithm for automated plant leaf recognition [1].

Chitsu Hlaing et al presented paper on plane disease recognition for smart farming using model based statistical features. In this paper, the authors reported that the scale-invariant feature transformation (SIFT) leads to high computational cost in identifying the plant disease recognition. Hence, they derived a Generalized Pareto Distributions from SIFT texture feature for plant disease recognition. Moreover, they used SVM classification algorithm along with the ten-fold cross validation method to validate the results of the proposed method [2]. Jagadeesh D. Pujari et al presented a method to detect the fungal disease in the crops sing image processing approach [3].

Preetha Rajan et al presented a crop disease detection system using support vector machine (SVM). The image processing technique is used to extract the features from the infected images and the extracted features are used to train the support vector machine to detect the infected crops [4]. M.Ramakrishnan et al explored groundnut leaf disease detection using the back propagation classification algorithm. Initially, the leaf image is acquired and (red, green, blue) RGB to HSV (hue, saturation, value) conversion is performed. Then, the color and texture features are extracted and classification is performed using the back propagation algorithm to train and classify the groundnut leaf images [5].

2.1 Paddy (Oryza sativa) field disease detection

Rice is the very essential cereal for human food. Rice is cultivated in various parts of the world. The paddy field can be affected by bacteria and fungus and the diseases namely narrow brown spot disease, brown spot disease, and blast disease can be caused by these infections. Manual detection of the paddy disease is difficult and it may not be accurate due to limited to human vision and perception during observation. Therefore, computer based recognition is very essential to carry out the disease detection. The diseases are identified and classified based on the appearance of the leaf, stem, tillers, panicle, spikelets, and grain of the paddy plant. In order to perform the computer based paddy field disease recognition, initially, the paddy plant or the paddy field is captured by the camera and the image is processed and the features are extracted from the images. The machine learning algorithm learns the features and develops the model to carry out the disease recognition.

Many researchers paid their attention in paddy field disease detection. R.P.Narmadha et al employed image processing technique to predict the paddy leaf disease by their symptoms. The k-mean clustering algorithm is used for the prediction of the leaf disease with higher accuracy [6]. Auzi Asfarian et al proposed paddy disease identification method using texture

analysis with fractal descriptor based on Fourier spectrum. In order to develop the proposed method, initially the affected paddy leaves are collected for each category of disease. Then, the lesion area was cropped manually from all leafs. Each lesion image is converted into HSV color space. Then the saturation components are extracted and the histogram equalization is applied. The images are sharpened using Laplacian filters. Moreover, the fractal descriptors are extracted from each lesion image. Then the classification is performed using probabilistic neural networks (PNN) [7].

Santanu Phadikar et al presented the pattern recognition technique for rice disease detection. In this approach, image processing based feature extraction is performed and the extracted features are given to the neural network to train the model for predicting the rice disease [8]. Amrita A. Joshi et al presented an approach for detecting the rice disease with image processing techniques. The feature extraction is performed and the classification is performed using minimum distance classifier and k-nearest neighbor classifier for detecting the rice disease (kNN) [9].

2.2 Flower disease detection

Flowers are very essential for the world since the flowers feed to the birds, animals, human, and insects. Moreover, it provides medicines for the humans and animals. The flowers are helpful for pollination that is essential for yielding fruits and vegetables. Therefore, identifying the flower disease is essential to save the flower from disease. Some of the researchers paid their attention to detect the disease of the flower. Getahun Tigistu et al discussed flower disease identification method using artificial neural network. In order to identify the flower disease, the disease affected flowers are collected and pre-processing is performed followed by segmentation to identify the region of interest. The Gabor feature extraction technique is employed to extract the texture features of the images and also the dimensionality of the features are reduced. Further, the artificial neural network is used to train the features and classify the images [10].

2.3 Fruits disease detection

Fruits provide many health benefits to humankind and animals. Moreover, they help to maintain good health as a part of healthy diet. Many researchers conducted the research on detection of fruit disease. Biswas sandika et al presented a grapes disease identification system using the random forest-based classification. This system classifies the three different types of diseases that occur in the grapes. The disease identification is carried out using the combination of image processing technique and machine learning approach. The performance was compared with four classification algorithms namely SVM, PNN, BPNN, and Random Forest [11]. Haiguang Wang et al presented a plant disease identification method to detect the diseases occur in the grape and wheat field using the back propagation networks. The image processing technique is employed to extract the features from the infected grape and wheat plant images and the predictive model is built using the back propagation networks. The k-means clustering algorithm is used to segment the infected images for extracting the features [12].

Kiran R. Gavhale et al developed a disease detection system for identifying the unhealthy region of citrus leaf using image processing. Initially, the images are captured from the plant. Then the RGB to different color space conversion is carried out followed by image enhancement. The segmentation of the image is performed using k-means clustering algorithm. Texture features are extracted using statistical GLCM (gray level co-occurrence matrix) and the color feature are calculated in term of mean values. The classification is performed using the support vector machine [13].

2.4 Vegetable disease detection

Vegetables provide many health benefits for the humankind and animals. However, vegetable crops are very much prone to several diseases. Many

researchers conducted research on detection of vegetable disease. Belsha. N et al presented an enhanced content based image retrieval system and classification of infected vegetable. In this method, they used the image processing algorithms, feature extraction techniques and the classification process to identify the infected vegetable [14]. Zulkifli Bin Husin et al presented a leaf disease detection system for the chili plant using the leaf features inspection technique. In this approach, the leaf images are captured and features are extracted for detection using the image processing and pattern recognition techniques [15]. Pooja Pawar et al presented a cucumber disease detection system using artificial neural network. This system uses the image processing technique and image feature extraction technique to extract the features from the cucumber leaf and the extracted features are used to predict the cucumber disease using artificial neural network [16].

R.Anand and Aravindh J et al presented eggplant leaves disease classification using image processing technique. K-means clustering algorithm and artificial neural network are employed for the segmentation process and classification respectively [17]. Jobin Francis et al presented a study on the prediction system to detect disease in pepper plants using the soft computing schemes. Moreover, they reported different phases of forming the detection system and presented an image pre-processing technique. The presented techniques are evaluated with different pepper images and the results are analyzed [18].

III. CONCLUSION

Agriculture is the backbone of the nation since the agriculture provides food and job opportunity to the humankinds and directly contributes to the economic growth of the nation. In agriculture, plant disease identification is very essential for early detection and prevention of the plant diseases that would be more helpful to the farmers. This paper conducted the literature review on identification of disease of the plant by using symptoms on the leaves. Also, this paper reviewed the image processing and machine learning techniques for disease prediction in various plant groups such as paddy, flowers, fruits and vegetables.

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