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A Survey on Plant Leaf Disease Identification

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Abstract— In this paper we present survey on the various types of leaf diseases in plants and their identification process. An identification problem deals with associating a given input pattern with one of the distinct classes. Plant leaf disease identification is a technique where leaf spot disease is identified based on its different morphological features. There are various successful identification techniques like Probabilistic Neural Network, Genetic Algorithm, Back Propagation Neural Network and Principal Component Analysis (PCA). Deciding on the method for identification is often a difficult task because the quality of the results can be vary for different input data. Plant leaf disease identification has wide applications in the field of Agriculture to increase the productivity. The goal of this survey is to provide an overview of different identification techniques for plant leaf disease and gives the general approach which use these techniques.

Keywords— Neural Network, Genetic, Disease, PCA, Plants.

I. INTRODUCTION

India is an agricultural country and about seventy percentage of the population depends on agriculture. Where plant leaf diseases widely affect the production of the country here this survey provides a brief description on various identification techniques. Disease identification is a tedious task and mostly diseases are seen on the leaves or stems of the plant.

The Image RGB characteristic pixel numbering strategies is broadly connected to farming science, and it has extraordinary point of view particularly in the plant insurance field, which at last prompts crop administration.

The purposes for applying image analysis in plants are as follows:

- To detect the boundaries of the affected area.
- To identify the Object correctly
- To find diseased leaf, stem, fruit.
- To quantify affected area by disease.
- To determine the color and feature of the affected area.

Etc [1][6][7].

Numerous Research work creates the development registering framework to distinguish the maladies utilizing contaminated images of different plant leaf spots. Images are captured by advanced cam portable and handled utilizing image becoming, and then the tainted piece of the leaf spot has been utilized for the grouping reason for the train and test.

II. DIFFERENT TYPES OF PLANT LEAF DISEASE

There are many types of plant Leaf Spot Diseases:

- Fungal
- Bacterial
- Viral

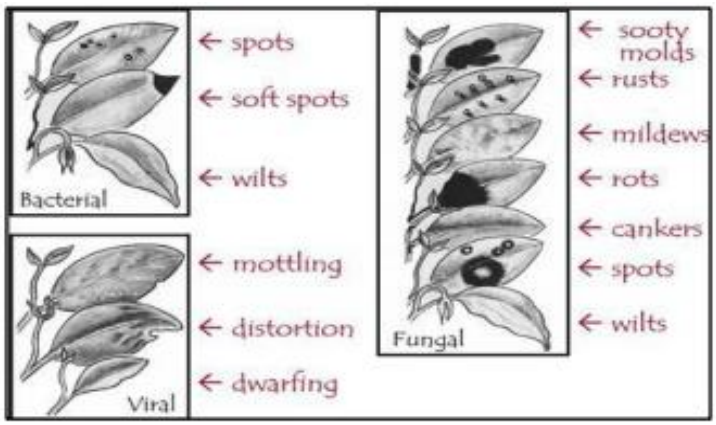

Fig. 1: Various types of leaf disease

Most leaf diseases are caused by viruses, fungi and bacteria. Viruses are extremely tiny particles consisting of protein and genetic material with no associated protein. Fungi are identified primarily from their morphology, with emphasis placed on their reproductive structures and Bacteria are considered more primitive than fungi and generally have simpler life cycles with difference that bacteria exist as single cells and increase in numbers by dividing into two cells during a process called binary fission [16].

Many researchers have proposed image-processing and pattern recognition techniques in agricultural applications for detection of weeds in a field, sorting of fruits and vegetables, detecting diseases etc. Automatic detection of plant diseases is an essential research topic as it may prove benefits in monitoring large fields of crops, and detect the symptoms of diseases as soon as they appear on plant leaves.

III. DIFFERENT TECHNIQUES OF IDENTIFICATION

Identification is the technique by which many leaf diseases are detected and then the appropriate action can be taken for the control of leaf disease in the plants. There are many techniques present for this identification purpose among which should be taken into account is a tedious task.

A. Manual

In this method a person who has the knowledge of the plant leaf has been called for inspection for the plant and the leaf disease is identified by the knowledge and experience of that person and then the appropriate pesticide is suggested by that person. This all process happens manually so it is time consuming and has a lot of chances of being misconception of correct leaf disease identification.

B. Genetic Algorithm

Genetic algorithm (GA) is a class of optimization procedures inspired by the biological mechanism of reproduction Genetic Algorithms are mainly used for feature classification and feature selection. The basic purpose of genetic algorithms (GAs) is optimization. GAs give a heuristic way of searching the input space for optimal x that approximates brute force without enumerating all the elements and therefore bypasses performance issues specific to exhaustive search. Genetic algorithm is used effectively in the evolution to find a near-optimal set of connection weights globally without computing gradient information and without weight connections initialization [1]. Though solution found by genetic algorithms is not always best solution. It finds "good" solution always. Main advantage of GA is that is adaptable and it possess inherent parallelism. Genetic Algorithms handle large, complex, non differentiable and multi model [8][17].

C. Back Propagation Neural Network

Artificial neural networks were initially developed according to the elementary principle of the operation of the (human) neural system. Since then, a very large variety of networks have been constructed. All are composed of units (neurons), and connections between them, which together determine the behaviour of the network.

Grape leaf image with complex background is taken as input. Thresholding is deployed to mask green pixels and image is processed to remove noise using anisotropic diffusion. Then grape leaf disease segmentation is done using K-means clustering. The diseased portion from segmented images is identified. Best results were observed when Feed forward Back Propagation Neural Network was trained for classification [2][8].

D. Principal Component Analysis

Principal components analysis (PCA) tries to describe the important variability in the data in a reduced number of dimensions. Principal component analysis (PCA) is a mathematical procedure that uses orthogonal transformation to convert a set of observations of possibly correlated variables into a set of values of linearly uncorrelated variables called principal components. The number of principal components is less than or equal to the number of original variables [3][11].

E. Probabilistic Neural Network

Probabilistic neural networks can be used for classification problems. It has parallel distributed processor that has a natural tendency for storing experiential knowledge. PNN is derived from Radial Basis Function (RBF) Network. PNN basically works with 3 layers. First layer is input layer. The input layer accepts an input vector. When an input is presented, first layer computes distances from the input vector to the training input vectors and produces a vector whose elements indicate how close the input is to a training input [4]. The second layer sums these contributions for each class of inputs to produce as its net output a vector of probabilities. Radial Basis Layer evaluates vector distances between input vector and row weight vectors in weight matrix. These distances are scaled by Radial Basis Function nonlinearly [4]. The last layer i.e. competitive layer in PNN structure produces a classification decision, in which a class with maximum probabilities will be assigned by 1 and other classes will be assigned by 0. A key benefit of neural networks is that a model of the system can be built from the available data. Fig.1 shows architecture of PNN.

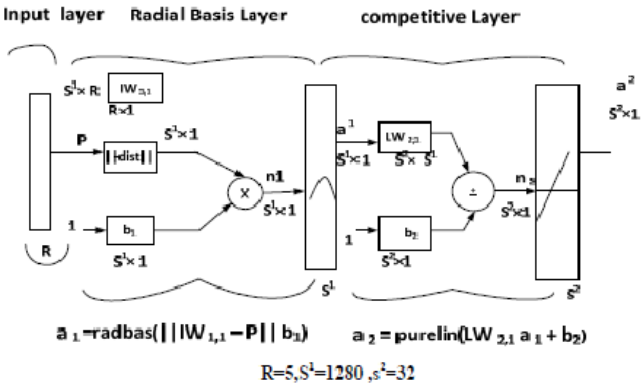

Fig.2: Architecture of PNN

Paddy diseases are extracted from digital paddy leaf images using fuzzy entropy and then the diseases are classified using PNN. The experiment result shows that the accuracy of paddy diseases identification is 91.46% [4].

IV. GENERAL APPROACH

The various image processing and neural network approaches can be applied for the identification of the leaf diseases on the plant. A projected approach for this identification is show in the fig. 3 Plant leaf diseases identification process.

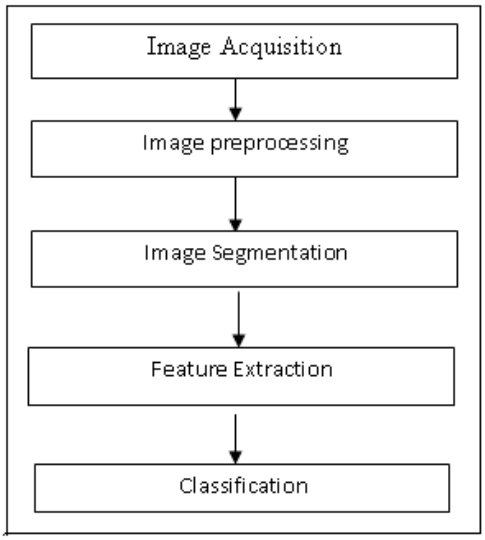

Fig. 3: Plant Leaf Disease Identification Process

A. Image Acquisition

Initially, the digital images are acquired from the circumstances using a digital mobile camera or digital camera and given as input to the identification system. This is the image in which the leaf disease has to be identified by the system.

B. Image Pre-processing

Image pre-process tasks are the initial stage before feature extraction. There are three steps of image pre- processing, i.e., image cropping, image converting and image enhancement. The image is cropped on leaf diseases area, and then converted to gray levels. In this process the noise are eliminated from the captured image to enhance the image quality.

C. Image Segmentation

Image segmentation is the methodology of apportioning a digital image into different fragments (sets of pixels, otherwise called super pixels). The objective of segmentation is to improve and/or change the representation of a image into something that is more significant and less demanding to examine. The consequence of image segmentation is a situated of sections that aggregate cover the whole image, or a set of forms removed from the image (see edge detection). Each of the pixels in a locale are comparative as for some trademark or registered property, for example, shading, force, or surface. Nearby districts are essentially diverse as for the same characteristic(s). At the point when connected to a pile of images, normal in restorative imaging, the subsequent forms after image segmentation can be utilized to make 3D recreations with the assistance of interpolation calculations like marching cubes.

D. Feature Extraction

Feature extraction is a special form of dimensionality reduction. At the point when the info information to a calculation is so vast it would be impossible be transformed and it is suspected to be exceptionally repetitive, then the

data information will be changed into a decreased representation set of features (likewise named features vector). Changing the info information into the set of features is called features extraction.

E. Classification

Image classification, a theme of example distinguishable in PC vision, is a methodology of arrangement in view of relevant data in images. "Logical" implies this methodology is concentrating on the relationship of the adjacent pixels, which is additionally called neighborhood. The objective of this methodology is to arrange the images by utilizing the logical data. According to the classification result the disease of leaf is identified and the appropriate action can be taken by the farmers in the initial stage of disease for its control.

V. RESULTS

TABLE 1: COMPARATIVE STUDY OF IDENTIFICATION TECHNIQUES

Identification Techniques	Merit's	Demerit's
1.Genetic Algorithm	Efficient search method for a complex problem space, Handle large, complex, non differentiable and multi model spaces	Not the most efficient method to find some optima, rather than global and Complications involved in the representation of training/output data
2. Back Propagation Neural Network	This model is easy to understand, and can be easily implemented as a software simulation.	This method is time-consuming and complex
3.Principal Component Analysis	Choose weights depending on the frequency in frequency domain and Used for variable reductions	Does not perform linear separation of Classes and The largest variances do not correspond to the meaningful axes
4. Probabilistic Neural Network	Adaptive to changing data, Tolerant of noisy inputs	Large complexity of network structure and Long training time

VI. CONCLUSION

According to the analysis of table1 the Probabilistic Neural Network is much faster and more accurate than any other identification technique.PNN networks are relatively insensitive to outliers. PNN networks generate accurate predicted target probability scores and PNNs approach Bayes optimal classification.

The general approach can be applied to determine the color and feature of the affected area of the diseased plant, to identify the Object correctly and to find diseased stem, fruit also along with the leaf.

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