ISSN: 2321-7782 (Online)
Impact Factor: 6.047

Volume 4, Issue 7, July 2016

International Journal of Advance Research in Computer Science and Management Studies

Research Article / Survey Paper / Case Study

Available online at: www.ijarcsms.com

Comparative Analysis of PCA+BPA with Novel PCA+BPA+SVD Technique in Neural Network to Improve Plant Disease Detection Rate

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Abstract: ***The plants are affected by many types of diseases. Finding the area of disease or the affected part of plant and to attain accuracy is also a key challenge. Planters experience great troubles and also in changing from one disease control policy to another. So patterns are essential to recognize plant diseases. There are many types of pattern recognition algorithms which gives recognition of diseases with accuracy. In the existing work Back propagation Analysis (BPA) along with Principal Component Analysis (PCA) are used to diagnose plant diseases. These algorithms are learned from training supervision in neural network. There is a matter of accuracy in these algorithms. These algorithms are able to detect diseases in plant but inaccurate way. So to enhance the accuracy for plant diseases detection, a new method will be proposed. In this method BPA, PCA are combined with Singular Value Decomposition (SVD) to rises the accuracy of the plant diseases detection.***

Keywords: Artificial Neural Networks (ANN), Back Propagation Analysis (BPA), Principle Component Analysis (PCA), Singular Value Decomposition (SVD).

I. INTRODUCTION

Image processing is deals with the storing, transforming and recovering of an image. Image processing is the method of information processing, where the input is an image. Image processing is referred to processing of 2D picture by a computer. Digital image processing is referred as a two- dimensional function f (x, y), where x and y are the spatial coordinates and amplitude of the f at any pair of (x, y) is the gray level of image at that point. The Amplitude values of f and x, y are all finite, discrete quantities and the image is called a digital image.

Digital image processing can utilize a number of mathematical techniques because the data of a digital image is in the form of matrix or in the form of rows and columns Digital image processing has a wide variety of applications in the area of image compression, feature extraction, pattern recognition, classification and in multi scale signal analysis [10]. There are two types of images.

Analog images are that images which human looks like paintings, photographs etc. It is unbroken and cannot be cracked into pieces.

Digital images are the images that can be separated into number of pixels. Every pixel represented by numerical value.

Any Problem with the plant that produces harmful causes in the harvest is known as plant disease. For example: Bacteria, Fungi, Virus, Parasitic seed plants etc. Farming has become much more than purely a means to feed continuously rising populations. Plants have become an urgent foundation of energy, and are an essential part in the mystery to provide the solution of global warming problem [1].

Fig 1.1 shows that shows step by step process of image processing in Plant diseases detection.

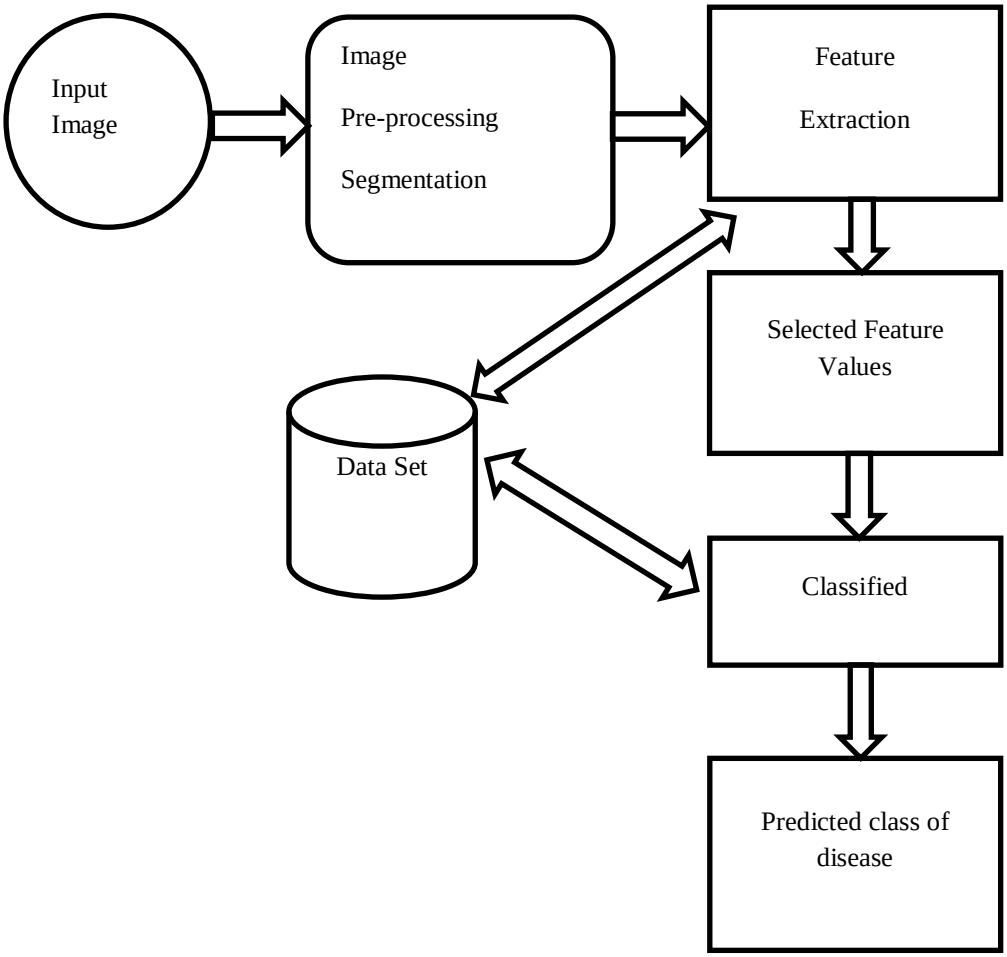

Fig. 1.1 basic steps to detect disease in plant

II. TECHNIQUES FOR PLANT DISEASE DETECTION

2.1 Artificial Neural Networks

Artificial Neural Networks are the electronic models which depend upon the neural structure of the brain. Artificial neural networks process the information like the human brain. ANN has a specific application in pattern recognition by learning process. So ANN's are used in the automatic diagnosis of plant diseases. Artificial neural networks are made up of number of nodes and these nodes typically organized in the form of layers. The nodes in the hidden layer gain signals from all the nodes in the input layer. Radial basis functions are the feed-forward neural networks. The data flows from an input layer to the output layer in feed-forward networks [1] [4].

2.1.1 BPA (Back Propagation Analysis)

Back-propagation is defined as an algorithm and it is used to train artificial neural networks. It is a mathematical algorithm. In back propagation, signals goes from output layer to the input layer. Back propagation is used to train any number of hidden units that are arranged in the form of layers. Back Propagation provides supervised training to neural networks [11].

2.1.2 PCA (Principal Component Analysis)

Principal Component Analysis is a statistical procedure that creates use of orthogonal transformation to convert a set of observation of correlated variables and it becomes more and more prevalent in signal processing uncorrelated variables [7].

2.1.3 SVD (Singular value Decomposition)

Singular Value Decomposition is defined as a substantial topic in linear algebra by many renowned mathematicians. SVD has number of theoretical as well as practical values. As compared to PCA approach SVD has better numerical properties. In SVD intrinsic properties are represented by algebraic features. For distribute the system into the groups of linearly self-dependent components. SVD is very comfortable and efficient. According to computational point of view, SVD is not fast due to more calculations. SVD is very simple and robust approach, it is fast and easy to implement [10].

III. RELATED WORK

Savita N. Ghaiwat et al. [1] proposed the survey on various classification techniques which are used for plant leaf diseases classification. In classification technique, the classification of plant's leaf is classified based upon its morphological features. K-Nearest Neighbor Classifier, Probabilistic Neural Network, Genetic Algorithm, Support Vector Machine, Principal Component Analysis, Artificial neural network, Fuzzy logic etc. are the classification techniques. This paper provides the conclusion that although the k-Nearest Neighbour method is simplest from all but the drawback is the time complexity. Neural networks are tolerant to noisy inputs but to understand the structure of an algorithm is difficult in neural networks. SVM is the best machine learning algorithm to classify high-dimensional data sets but it is more complex to understand and implement.

Prof. Sanjay B. Dhaygude et al. [2] represent the diagnoses of plant leaf is an important factor to protect them from serious outbreak. Many plant diseases are caused by fungi, bacteria, and viruses etc. They developed a processing scheme. In this scheme, for the input RGB image; a color conversion structure is created, this RGB image is transformed to HSI because RGB for the generation of color and HSI for the description of color. Using specific threshold value green pixels are masked and removed, an image is segmented and the valuable segments are extracted. At last, the presence of disease on the plant leaf is diagnosed.

Mr. Pramod S. landge et al. [3] proposed a software solution for classification and automatic detection of plant diseases with the help of image processing techniques. Agricultural experts render advice and can check crop images but in rural area's farmers have minimal contact to agricultural experts. Therefore, with the help of SMS they tried to provide an accurate and fast solution to the farmers. The experimental results of their survey will work.

Anand.H.Kulkarni et al. [4] proposed a methodology to diagnose a plant disease early and accurately with the help of diverse image processing techniques and artificial neural network (ANN). ANN classifier uses the mixture of color and texture features to identify and classify various types of plant diseases. ANN provides the better accuracy for plant diseases detection which is up to 91%.

Piyush Chaudhary et al. [5] proposed an algorithm using image processing techniques for disease spots segmentation. They compare the plant leaf color with disease spots, the disease spots are different in color but the intensity is same with the plant's leaf color. They differentiate the effect of HIS color model, CIELAB color model and YCbcr color model in the process of disease spot detection. They conclude CIELAB color model is the best color model due to its capability to wipe out of noise.

Jagdeesh D. Pujari et al. [6] presents the study using image processing techniques for identification and classification of fungal diseases affected on agriculture/horticulture crops. Some diseases have general symptoms but they do not have any adequate details. So the farmers face many problems. They designed the algorithms that are based on image processing techniques for classification and feature extraction. Vegetable crops, fruit crops, cereal and commercial crops selected for detection and identification of fungal diseases.

IV. PROPOSED METHODOLOGY

Neural pattern recognition employs the neural computing paradigm that has emerged with neural networks. There is problem of accuracy in existing methods to overcome this problem a method will be proposed with SVD technique to enhance its accuracy. In first two techniques BPA along with PCA has less accuracy which is unable to detect accurate diseases in plants. But with the help of SVD the accuracy of the plant diseases detection is enhanced and it can be detected accurately.

Fig 4.1 shows that after image declare train and training data sets before find key points or descriptors convert image into pyramid shape then do extreme detection in which the match each and every position of image which is compared with train data set image. Filtering process is done in between that because if some location of point is not clear then it will clear using Gaussian low pass filter. Then find direction of points in which all depends on angle after that comparison is done between left and right image. Set the threshold T (mostly in the range 0.3 to 0.7). It takes the ratio of first nearest distance to second nearest distance. If the value of key points less than this threshold, then match is found, otherwise there is no match. Matching is done and it gives the result that how many numbers of points will match in the final output. After matching complete, find image masking. A mask image is simply an image where some of the pixel intensity values are zero and others are non zero. On the basis of masking, it will draw histogram of that image. It shows the distribution of intensities in an indexed or grayscale image. After that find healthy and diseased portion of image then draw diseased area and get the final output Image.

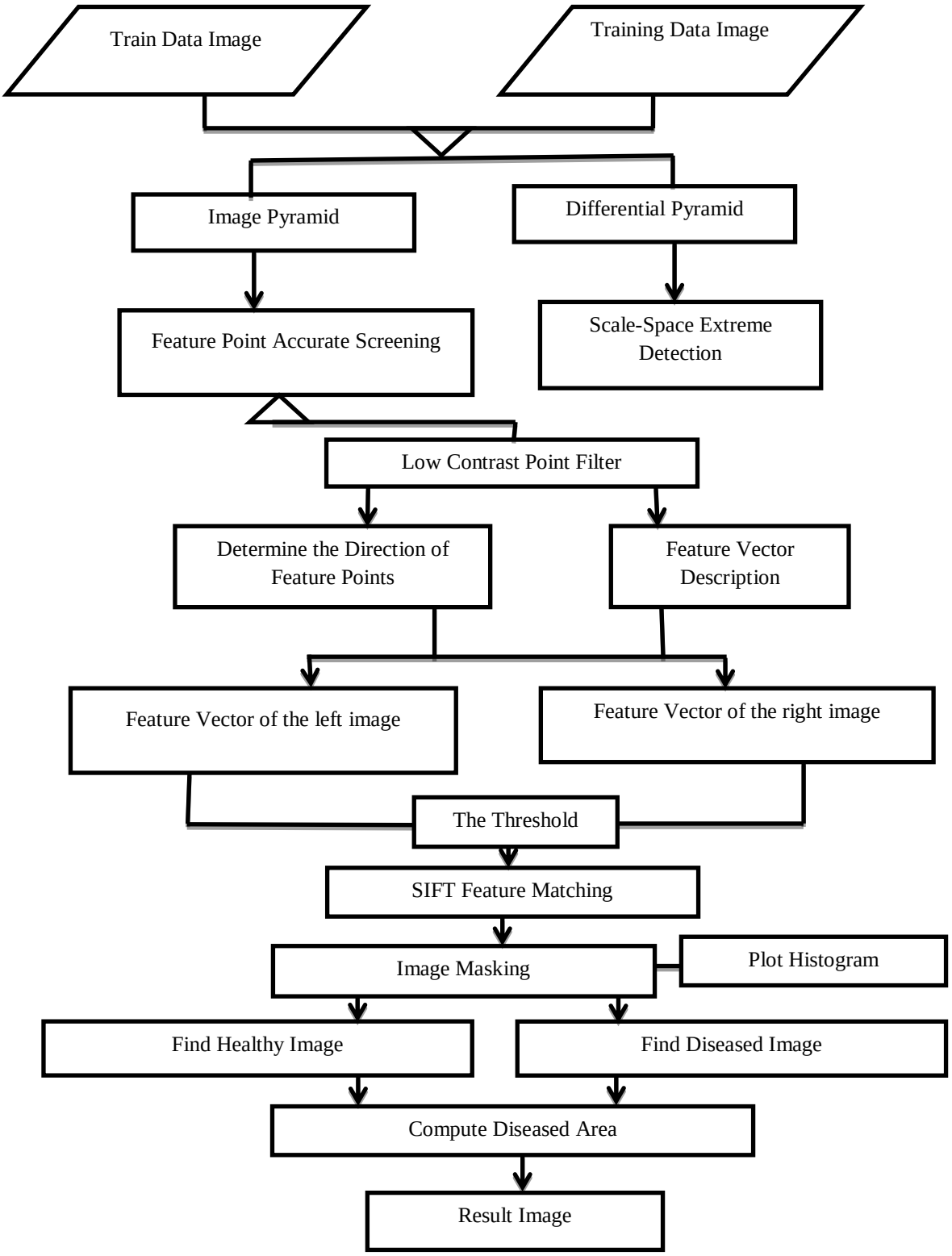

Fig. 4.1 Flow chart of proposed work

V. EXPERIMENTAL RESULTS

5.1 Problem Implementation

In this study, image recognition of plant's leaf disease done with the help of Back Propagation networks, a type of neural approach. Principle Component Analysis and Back Propagation Analysis detect the disease in Plant's leaf but they detect the disease inaccurate way. So accuracy is the problem in these techniques.

Fig 5.1 shows that the dataset is taken which contain multiple images and this dataset put into the folder named as training dataset. The second folder called train dataset contains some images. The images of the training folder are match with the images of the trained folder. For the feature matching SIFT is applied. In the figure, leaf whose features are matched will be extracted and in that leaf disease will be detected. The black background from the leaf is extracted which helps to know the cut portion of plant's leaf. The background pixels of the image are extracted to know the infected and uninfected portion of leaf. This will classify and gave results in the form of image that what portion of the image is infected. The accuracy Percentage is 64.29.

Accuracy = Sum (Ground Truth = Predicted Labels) / Ground Truth

Where Ground Truth = Total number of points, Predicted Labels = Number of points detected

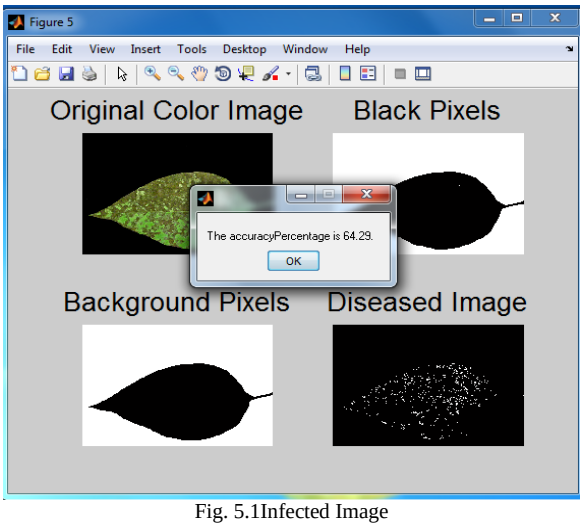

Fig. 5.1Infected Image

5.2 Solution Implementation

In this study, image recognition of grape and wheat diseases done with the help of BP networks, a type of neural approach. Principle Component Analysis and Back Propagation Analysis detect the disease in Plant's leaf but they do not detect the disease in an accurate way. So to increase accuracy of disease detection and to find the area of disease in plant's leaf PCA and BPA are combined with SVD technique.

Fig 5.2 shows that the dataset is taken which contain multiple images and this dataset put into the folder named as training dataset. The second folder called train dataset contains some images. The images of the train folder are match with the images of the trained folder. For the feature matching SIFT is applied. In the figure, leaf whose features are matched will be extracted and in that leaf disease will be detected using SVD. The black background from the leaf is extracted which helps to know the cut portion of plant's leaf. The SATURATION value of infected leaf is calculated which helps to increase the detected accuracy. In this figure the SVD technique is applied which helps to separate the uninfected portion of the leaf. The infected part of leaf is 5.56 % and the name of disease is White Rust. The accuracy percentage is 92.86.

Area Fraction = Sum (Diseased Image) / Entire Leaf Pixels

Where Diseased Image = Number of detected Points, Entire Leaf Pixels = Total number of points

Accuracy = Sum (Ground Truth = Predicted Labels) / Ground Truth

Where Ground Truth = Total number of points, Predicted Labels = Number of points detected

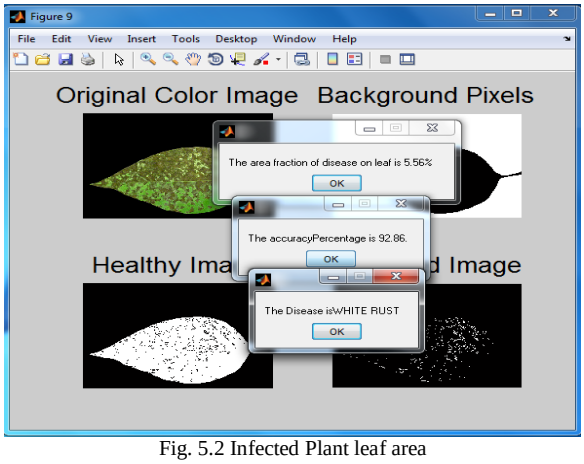

Fig. 5.2 Infected Plant leaf area

Fig 5.3 shows that the accuracy percentage of different techniques. By using Principal Component Analysis (PCA) along with Back Propagation Analysis (BPA) the accuracy percentage is 64.29 and when Principal Component Analysis (PCA) and Back Propagation Analysis (BPA) are combined with Singular Value Decomposition (SVD) then the accuracy percentage is 92.86.

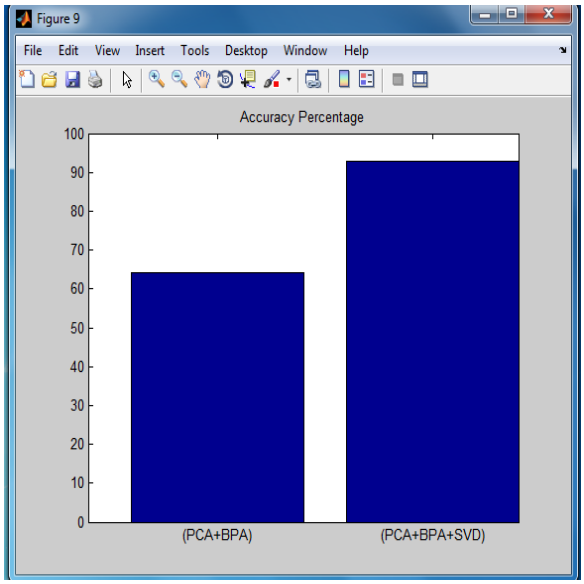

Fig. 5.3 Accuracy Graph

VI. Conclusion and Future Scope

In this study, two types of diseases of grapes and wheat are detected named grape downy mildew and grape powdery mildew and wheat stripe rust and wheat leaf rust with BP (Back Propagation) networks. Image recognition using Back propagation networks is conducted based on dimension reduced data obtained by PCA (Principal Component Analysis). PCA is used to reduce the dimensions of feature data of extracted images. By this method, the plant diseases can be identified at the initial stage and control can be obtained. Although the optimal recognition result is good and get the required results when the dimensions of the feature data is reduced by the PCA, but compared accuracies are lower. Better recognition results are obtained when PCA along with BPA are combined with SVD. PCA along with BPA have less accuracy which is unable to detect accurate diseases in plants. SVD technique enhanced the accuracy of the plant diseases so PCA+BPA+SVD techniques are used to detect plant diseases in accurate way. The scope of this study is to detect plant diseases in an accurate way and to find the area of disease in plant's leaf.

In future DCT (Discrete Cosine Transform), DWT (Discrete Wavelet Transform) techniques can be applied with SVD to improve its accuracy more.

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