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AN AUTOMATED APPROACH FOR CLASSIFICATION OF PLANT LEAF DISEASES USING RBFNN

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Abstract: Our Indian economy highly depends on the Agricultural productivity. Hence the detection of disease in plant leaf plays a vital role .If proper care is not taken or even the delay in taking preventive measures may cause serious effects on plants such as reduction in quality and also quantity. In this proposed method, an automated plant leaf disease detection will detect the disease by which the plant is affected. Here features are extracted using GLCM and Adaptive Histogram technique is employed for enhancement. Then for clustering FCM is used and finally segmented by SVM classifiers .After segmentation, detected leaf disease is viewed in the pop up box and also viewed in the hardware LCD set up.In case of detection of no disease "Healthy Leaf" will be displayed on the screen. Thus, this method helps to detect, the presence of any disease in the plant leaf at the earliest stage itself thereby preventing from much wider spread of the disease.

Keywords:

GLCM, Adaptive Histogram, FCM, SVM classifier.

Introduction:

Plants play an vital role in all the aspects of life. They serve as a backbone to strengthen the environment. Plants do suffer from diseases, which affects the normal growth of plants. These diseases affect influence plant including leaf, flower, fruit and stem. Detection of such plant diseases is an important task to perform. The existing method for the identification and classification of diseases from a plant is done with the help of human intervention and also even in some of the automated approaches they are detecting it based on the threshold value. This threshold value based approaches may cause some healthy leaf to be even detected as unhealthy or diseased one. Experts make direct observations by continuously focusing on the affected plants for a long period of time. Most of the time, these existing approaches of disease identifications are not efficient and unmanageable. So to monitor the plant disease at an early stage, use of some automatic method can be quite beneficial. Soft computing technique having the ability to simulate human thinking is having the capability to perform the task of identification and classification of such plant diseases spontaneously within time and cost effective manner. In this article, we have presented an automatic soft computing approach BRBFNN for identification and classification of disease from plant leaves. The proposed method uses Bacterial Foraging Optimization (BFO) to assign desirable weight to Radial Basis Function Neural Network (RBFNN) and to find the compatible region for the different disease present on the plant leaves in the training period. An automated plant leaf disease detection is a technique which takes the input image and convert it to gray image followed by preprocessing i.e feature extracted using GLCM .Then for enhancing the images Adaptive Histogram Equalisation is employed. And finally the segmentation is done with the help of SVM classifier. Hence this approach enables the automated detection of plant leaf detection in the agricultural field.

Literature review

[1] The plant serves as the basic need for any living organisms. They are the most important and integral part of our surroundings. Just like a human or other living organism does plant do suffer from different kind of diseases. Such diseases are harmful to plant in a number of ways like can affect the growth of the plant, flowers, fruits, and leaves etc. due to which a plant may even die. So in this work, we have proposed a novel method named as Bacterial foraging optimization based Radial Basis Function Neural Network (BRBFNN) for identification and classification of plant leaf diseases. The results, when compared with other methods, show that the proposed method achieves higher performance both in terms of identification and classification of plant leaf diseases.[2] In this study, when identifying 9 types of maize leaves, the two improved deep convolutional neural networks models, GoogLeNet and Cifar10, can achieve high identification accuracy, 98.9% and 98.8%, respectively. When the train - test set is 80 - 20 (80% of the whole dataset used for training, and 20% for testing), the classification algorithms used in this study allow the systems to acquire a diversity of sample conditions with strong robustness. Experiments show that it is possible to improve recognition accuracy by increasing the diversity of pooling operations, the reasonable addition of a *Relu*function and dropout operations, and including multiple adjustments

of the model parameter.[3].The goal of this paper is to develop a new weed detection and classification method that can be applied for autonomous weed control robots. In order to achieve this goal plants must be classified into crops and weeds according to their properties which is done by a machine vision algorithm. Plants growing between rows are considered as weed, while inside a row, where crops are mixed with weeds, a classification method is required. Accordingly in the initial step, plants pixels were segmented from background with an adaptive method which is robust against variable light conditions as well as plant species. After that, crops and weeds were classified according to features extracted from wavelet analysis of the image. Finally, based on positions of weeds, herbicide sprayers are told to spray right on desired spots. The whole algorithm is implemented in embedded systems and keil software which is appropriate for real-time in-field purposes. In order to evaluate the performance of the algorithm corn field images have been taken and selected, overall classification accuracy of95.89% was achieved[4]This paper gives the survey on different diseases classification techniques that can be used for plant leaf disease detection and an algorithm for image segmentation technique used for automatic detection as well as classification of plant leaf diseases has been described later. Banana, beans, jackfruit, lemon, mango, potato, tomato, and sapota are some of those ten species on which proposed algorithm was tested. Therefore, related diseases for these plants were taken for identification. With very less computational efforts the optimum results were obtained, which also shows the efficiency of proposed algorithm in recognition and classification of the leaf diseases.[5]A method focus on image processing is applied for automatic leaf unhealthiness classification which establish on leaf image processing. The project system can apply with the used of practical requisitions, due to the images are apprehended at once directly from the farmland without plenty efforts wanted through the farmers. The system approach will give advice to the farmer with minimum efforts. The farmer most effective require to seize the image of the plant leaf the usage of mobile camera and forward it to the DSS, without any additional inputs[6].This work presents a method for identifying plant leaf disease and an approach for careful detection of diseases. Thegoal of proposed work is to diagnose the disease of brinjalleafusing image processing and artificial neural techniques. The diseases on the brinjal are critical issue which makes the sharpdecrease in the production of brinjal. The study of interest is the leaf rather than whole brinjal plant because about 85-95 % of diseases occurred on the brinjal leaf like, Bacterial Wilt, Cercospora Leaf Spot, Tobacco mosaic virus (TMV). Themethodology to detect brinjal leaf disease in this work includes Kmeansclustering algorithm for segmentation and Neural-networkfor classification. The proposed detection model based artificial neural networks are very effective in recognizing leaf diseases[7].In this method accurate detection and classification of the plant disease is very important for the successful cultivation of the crops, this can be done using digital image processing. In this project, the detection as wells the remedy for curing it is achieved. This project utilizes GSM so as to send the message to every kind of mobile handset. This project utilizes various image processing techniques which provide accurate results. [8]In this paper they presents grape leaf disease extraction and classification system using colour imagery. The system provides desirable results. BPNN gives efficient grape leaf colour extraction with complex background while MSOFM & GA provides automatic adjustment for grape leaf disease colour extraction. Grape leaf disease appearance features using gabourfilters[9].In this method application of texture statistics for detecting the plant leaf disease has been explained Firstly by colour transformation structure RGB is converted into HSV space because HSV is a good colour descriptor. Masking and removing of green pixels with pre-computed threshold level. Then in the next step segmentation is performed using 32X32 patch size and obtained useful segments. These segments are used for texture analysis by colour co-occurancematrix. Finally if texture parameters are compared to texture parameters of normal leaf. The extension of this work will focus on developing algorithms and NN's in order to increase the recognition rate of classification process.**[**10].Main approach of this paper is to recognize diseases on the leaf. At first preprocessing is done which include two steps gray conversion Second stage is k-means based Image segmentation which eventually does image analysis. Third stage is feature extraction that include colour features and shape features. And after that classification of diseases is performed victimization our projected formula. The goal of this analysis work is to develop Advance automatic data processing system which will determine the illness affected a part of a leaf spot by victimization the image analysis technique. Prediction of the diseases and cuss recommendation is finished. The producers will amend the Yield and scale back the loss.

Limitations

- Not user friendly and requires Manual Control
- Time Consumption and Delay in detection of disease
- Less Accuracy,
- Less efficiency and performance

Proposed methodology

An automated approach for the plant leaf disease detection enables the detection of plant disease and to display the name of the disease by which the plant is to be affected in the system pop up box and also in the LCD of the hardware set up. It also monitors the temperature as well as the pH of the soil moisture content .Thereby detecting whether the plant is affected due to such environmental parameters such as the acidity level and also helps in taking further steps in the recovery of plant leaf disease. In order to do this, first step is to collect some image sets, then trained using RBFNN and then tested without considering threshold value .If threshold is considered as in existing one it may cause healthy leaf to be detected as diseased or vice versa. Hence in this no threshold is considered. The captured image is pre-processed (RGB to Gray and filtered) ,Feature Extracted using GLCM ,Enhanced using Adaptive Histogram and further segmented using SVM classifier to obtain desired result.

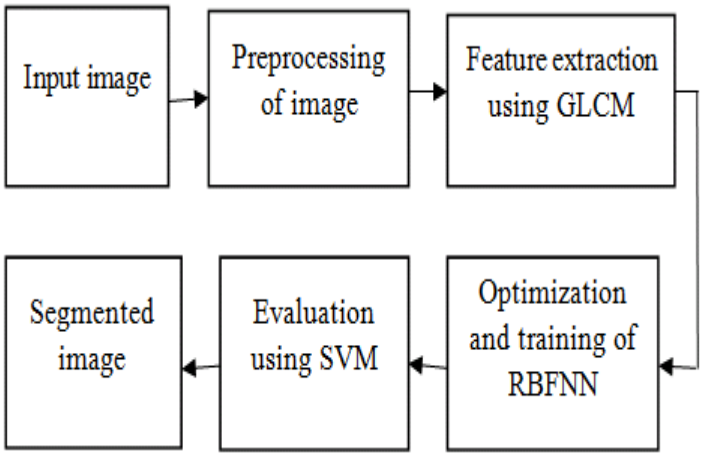


Figure1: Block Diagram

1. Image acquisition: It is the first method of digital image processing and it is described as capturing the image through digital camera or from the samples that are stored in database for further MATLAB operations.

2. Image processing: The main purpose of image pre-processing is to improve the quality of an image containing unwanted distortions or to enhance some image features for further processing. This method includes various techniques such as changing image size, filtering of noise, image conversion, enhancing image.

Gray image**:**

In photography and computing, a grayscale or greyscale digital image is an image in which the value of each pixel is a single sample, that is, it carries only intensity information. Images of this sort, also known as black-and-white, are composed exclusively of shades of gray, varying from black at the weakest intensity to white at the strongest. In photography and computing, a grayscale or greyscale digital image is an image in which the value of each pixel is a single sample, that is, it carries only intensity information. Images of this sort, also known as black-and-white, are composed exclusively of shades of gray, varying from black at the weakest intensity to white at the strongest.

Figure 2: Gray Image

Grayscale images are distinct from one-bit bi-tonal black-and-white images, which in the context of computer imaging are images with only two colors, black and white (also called bilevel or binary images). Grayscale images have many shades of gray in between. Grayscale images are often the result of measuring the intensity of light at each pixel in a single band of the electromagnetic spectrum (e.g. infrared, visible light, ultraviolet, etc.), and in such cases they are monochromatic proper when only a given frequency is captured. But also they can be synthesized from a full color image; see the section about converting to grayscale.

Median Filter:

The median filter is a nonlinear digital filtering technique, often used to remove noise from an image or signal. Such noise reduction is a typical pre-processing step to improve the results of later processing (for example, edge detection on an image). Median filtering is very widely used in digital image processing because, under certain conditions, it preserves edges while removing noise, also having applications in signal processing. The main idea of the median filter is to run through the signal entry by entry, replacing each entry with the median of neighbouring entries. The pattern of neighbours is called the "window", which slides, entry by entry, over the entire signal. For 1D signals, the most obvious window is just the first few preceding and following entries, whereas for 2D (or higher-dimensional) signals such as images, more complex window patterns are possible (such as "box" or "cross" patterns). Note that if the window has an odd number of entries, then the median is simple to define: it is just the middle value after all the entries in the window are sorted numerically. For an even number of entries, there is more than one possible median.

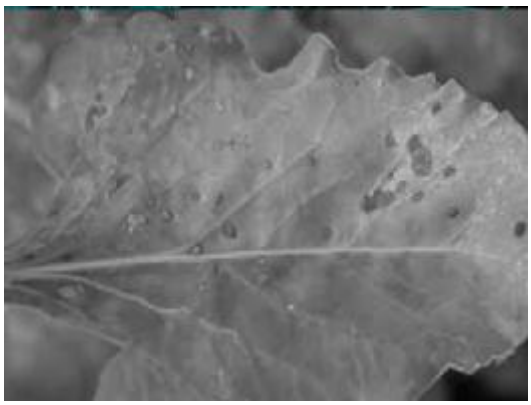


Figure 3: Filtered Image

- Assumption: signal and (additive) noise are stationary linear stochastic processes with known spectral characteristics or known autocorrelation and cross-correlation
- Requirement: the filter must be physically realizable/causal (this requirement can be dropped, resulting in a non-causal solution)
- Performance criterion: minimum mean-square error (MMSE).

Adaptive Histogram:

Adaptive histogram equalization (AHE) is a computer image processing technique used to improve contrast in images. It differs from ordinary histogram equalization in the respect that the adaptive method computes several histograms, each corresponding to a distinct section of the image, and uses them to redistribute the lightness values of the image. It is therefore suitable for improving the local contrast and enhancing the definitions of edges in each region of an image.

However, AHE has a tendency to over amplify noise in relatively homogeneous regions of an image. A variant of adaptive histogram equalization called contrast limited adaptive histogram equalization (CLAHE) prevents this by limiting the amplification.

Ordinary histogram equalization uses the same transformation derived from the image histogram to transform all pixels. This works well when the distribution of pixel values is similar throughout the image. However, when the image contains regions that are significantly lighter or darker than most of the image, the contrast in those regions will not be sufficiently enhanced.

3. Feature Extraction using GLCM:

A statistical technique of examining texture that considers the contiguous relationship of pixels is the gray-level co-occurrence matrix (GLCM), also known as the gray-level spatial dependence matrix. The GLCM functions describe the texture of an image by calculating how often pairs of pixel with definite values and in a specified spatial relationship occur in an image, developing a GLCM, and then extracting statistical measures from this matrix. (The texture filter functions, described in Calculate Statistical Measures of Texture cannot provide information about shape, that is, the spatial relationships of pixels in an image.)

4. Trained using RBFNN:

RBFNN is the special linear function having a unique competence of which increases or decrease two dimensionally with distance from the vicinity and capable of handling the complexity of the affected region exists on the plant leaf images. The efficiency of the Radial Basis Function neural network is further enhanced for region growing method used seed points and grouping them having similar attributes that help in feature extraction process. BFO with its imitating capability and multi-optimal function justifies to be an efficient and powerful tool for initializing the weight of RBFNN and training the network that can correctly locate different regions on plant leaf image with high merging speed and accuracy.

FCM: Fuzzy clustering is a form of soft means clustering in which each data point can be handled by more than one cluster. Clustering or cluster analysis includes assigning data points to clusters such that items in the same cluster are similar to a great extent, while items belonging to different clusters are as not similar as possible. Clusters are identified via similarity measures. These similarity measures considers distance, connectivity, and intensity. Different similarity measures may be selected based on the data or the application.

5. SVM:

SVM is a basic binary classification algorithm. Image filtering is performed, where in input image is passed through a median filter and sharpened. SVM may be used to perform image classification perfectly. It classifies the affected cluster on the surface of the leaf.

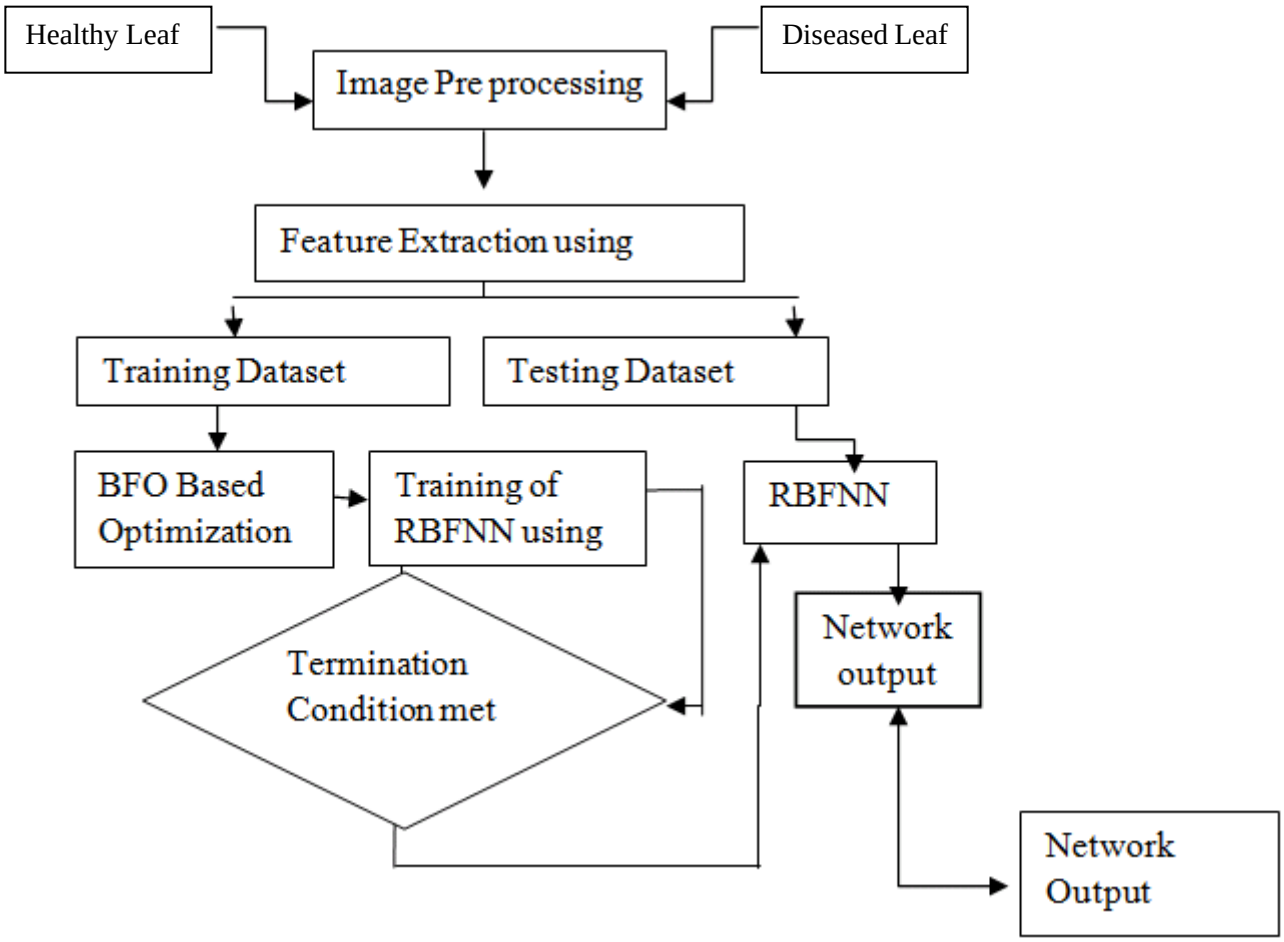


Figure 4: Flow Chart

Advantages

- Best suited for different illuminate condition
- The captured leaf image parameters were compared with the parameters of healthy leaf and disease was detected. According to disease pesticide control was done.

Results Obtained

The images were trained using RBFNN Techniques and testing is done by the image processing techniques using SVM Classifiers. The software processing steps are shown below .In the segmentation process, selection of the matched cluster number should be provided. The hardware set up is also shown below. Hence if the disease is detected the software setup shows the name of the disease in the pop up box whereas the hardware setup also shows the name of the disease in the LCD. If no disease is detected, it displays as healthy leaves.

Figure 5: Software Setup

Figure 6: Segmentation

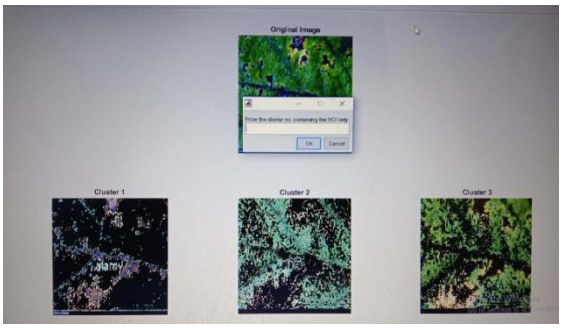


Figure 7: Hardware Setup

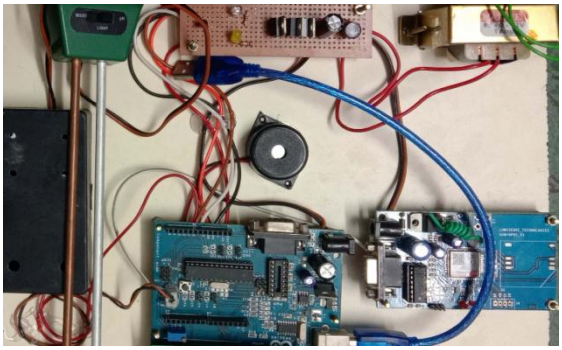


Figure 8: Software Setup Result

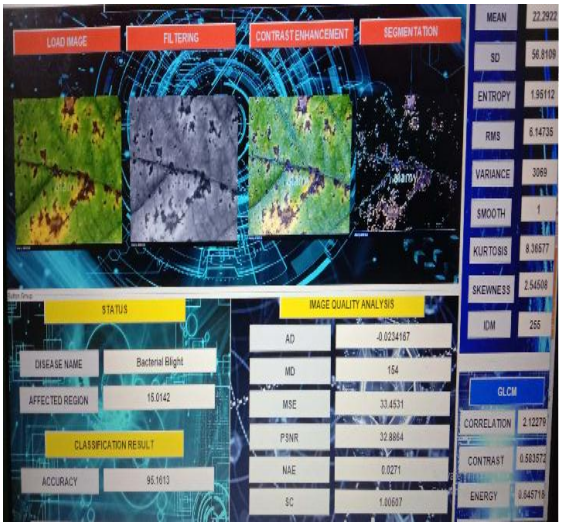
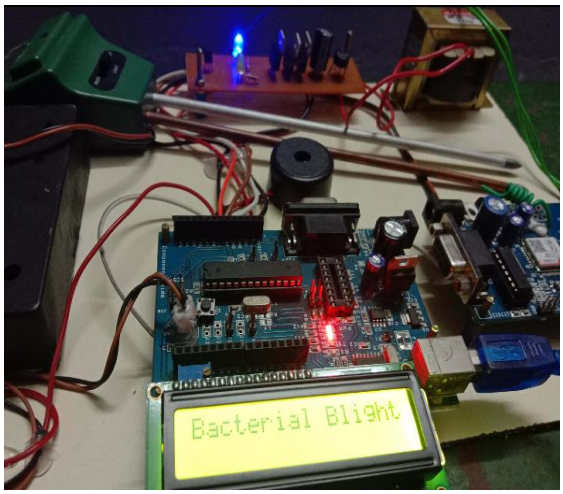


Figure 9: Hardware Setup Result



Conclusion

An automated approach for the plant leaf disease detection project is designed to detect whether the plant is affected by the disease or not and also to detect, by which type of disease the plant is affected. Hence the image processing techniques is employed in sequential steps such as RGB to gray image conversion, filtering, feature extraction followed by segmentation enables the detection of the plant leaf disease .If the leaf is affected by the disease it indicates name of the disease in the pop up box as well as in the hardware LCD setup .This system shall be implemented in agricultural crop fields and that will facilitate the monitoring of plants and updates the status by the name of the disease and if it is not affected by the disease it updates as healthy Leaf.

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