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A Survey Paper on Crop Disease Identification and Classification Using Pattern Recognition and Digital Image Processing Techniques

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Abstract: *Agricultural scientists play an important role in detecting and finding cure for plant diseases. Sometimes manual identification of disease is time consuming and laborious process. One of the most important factors contributing to low yield is disease attack. Many studies show that quality of agricultural products may be reduced due to various factors of plant diseases. In banana plant, diseases which are commonly observed are panama wilt, yellow sigatoka, black sigatoka, banana streak virus and banana bunchy top virus [10]. The banana plant leaf diseases not only restrict the growth of the plant but also destroy the crop. Banana plant leaf diseases must be identified early and accurately as it can prove detrimental to the yield. Hence, a machine learning method is required to identify the affected leaf images in timely manner. The images required for this work are captured from the fields using digital camera. The captured images are then processed on computer using pattern recognition and digital image processing techniques. These techniques will help in identifying banana plant diseases thereby increasing the yield of banana [10]. This a survey paper on disease identification and classification of banana crops. A summary of various techniques for disease identification and classification is also done.*

Keywords: *Pattern recognition, image processing techniques, ANN, SVM, PNN, MSOFM & GA.*

I. Introduction

Agriculture is an important source of income for Indian people. Farmers can grow variety of crops but diseases hamper the growth of crops. One of the major factors responsible for the crop destruction is plant disease. Different plants suffer from different diseases. The main part of plant to examine the disease is leaf. The major categories of plant leaf diseases are based on viral, fungal and bacteria. The diseases on leaf can reduce both the quality and quantity of crops and their further growth. The easy method to detect the plant diseases is with the help of agricultural expert having knowledge of plant diseases. But this manual detection of plant diseases takes lot of time and is a laborious work. Hence, there is a need for machine learning method to detect the leaf diseases. Computer can play a major role to develop the automatic methods for the detection and classification of leaf diseases. There can be various pattern recognition and image processing techniques that can be used in the leaf disease detection. The leaf disease detection and classification of leaf diseases is the key to prevent the agricultural loss. Different plant leaves bear different diseases. There are different types of methods and classifiers to detect plant leaf diseases.

Automatic detection of plant diseases is an important task as it may prove beneficial in monitoring large field of crops, and thus automatically detect diseases from symptoms that appear on plant leaves. Thus automatic detection of plant disease with the help of image processing techniques provide more accurate and guidance for disease management. Comparatively, visual identification is less accurate and time consuming. Hence, it is required to design and develop a machine learning method to detect disease of banana plant leaves in timely fashion to help the farmers to increase more yield of banana.

II. Advances In Image Processing For Plant Disease Detection

2.1 Literature Survey

In order to know about the previous research work done in this direction, several studies dedicated to the topic were referred. The literature survey is done in chronological order from year 2007 to 2016.

Stephen Gang Wu et al in 2007, [1] has developed a leaf recognition algorithm to extracted features and highly efficient algorithms for recognition purpose. A Probabilistic Neural Network (PNN) was used for recognition of plant leaves. The accuracy of recognition observed was 90%.

A.Meunkaewjinda et al in 2008, [2] has developed a system for identification of leaf diseases of the grape plant. The proposed system consists of three steps: 1) grape leaf color extraction from complex background, 2) grape leaf disease color extraction and 3) grape leaf disease classification. In this analysis, back-propagation neural network with a self-organizing feature map together used to recognize colors of grape leaf. Further Modified Self Organizing Feature Map (MSOFM) and Genetic Algorithm (GA) developed for grape leaf disease segmentation and SVM for classification. Finally filtration of resulting segmented image is done by Gabor Wavelet and then SVM is again applied to classify the types of grape leaf diseases. This system can classify the grape leaf diseases into three classes: Scab, rust and no diseases. Average disease detection rate was 97.8 %.

Shen Weizheng, et al in 2008, [3] has considered an image processing based method for grading the leaf spot disease in plant leaves. They performed an analysis on all the influencing factors that were present in the process of segmentation. Otsu Method was used to segment the leaf regions. In the HSI color system, H component was chosen for segmentation of the diseased spot. Further, Sobel operator was taken into function in order to examine the edges. Finally, grading was done by estimating the quotient of the diseased region and leaf areas.

Dheeb Al Bashish et al in 2010, [4] has acquired images that are segmented using the K-means techniques and segmented images are passed through pre-trained neural network .The images of leaves taken from Al-Ghor area in Jordan. There are 5 common diseases are in leaves were selected for research; they are: Early scorch, Cottony mold, Ashen mold, late scorch, tiny whiteness. The experimental result indicates that the neural network classifier that is based on statistical classification support accurate and automatic detection of leaf diseases with a precision of around 93%.

Yuan Tian et al 2010, [5] has presents a SVM-based Multiple Classifier System(MCS) for pattern recognition of wheat leaf diseases. Further author has used stacked generation structure and Mid level feature generation to improve the performance of recognition of disease of the wheat plant. The proposed approach has obtained better success rate of recognition.

Basvaraj S. Anami et al in 2011, [6] have proposed better machine vision system in the area of disease recognition, both the feature color and texture are used to recognize and classify different agriculture product into normal and affected using neural network classifier.

Sanjeev S Sannakki et al in 2011, [7] plant pathologists mainly rely on naked eye prediction and a disease scoring scale to grade the disease. It proposes an image processing based approach to automatically grade the disease spread on plant leaves by employing Fuzzy Logic. The results are proved to be accurate and satisfactory.

Suhaili Beeran Kutty et al in 2013, [8] have considered an artificial neural network based system to classify the watermelon leaf diseases of Downney Mildew and Anthracnose. This classification is based on the color feature extraction from RGB color model which is obtained from the identified pixels in the region of interest. The true classification results also depict the value of 75.9%.

P.R. Rothe et al in 2014**,** [9] have developed a graph cut based approach for segmentation of images of diseased cotton leaves. The Gaussian filter was used to remove the noise present in the images for segmentation. The color layout descriptor was used for content filtering and visualization. Mainly there are three diseases in cotton leaf like Bacterial Blight, Myrothecium and Alternaria.

Godliver Owomugisha et al in 2014, [10] has attempted to detect diseases in the banana plant such as banana bacterial wilt (BBW) and banana black sigatoka (BBS) that have caused a huge loss to many banana growers. There are various computer vision techniques which led to the development of an algorithm that consists of three main phases. 1) The images of banana leaves were acquired using a standard digital camera; 2) It involves use of different feature extraction techniques to obtain relevant data to be used and 3) where images are classified as either healthy or diseased. Extremely Randomized Trees performed best in identifying the diseases achieving 0.96 AUC for BBW and 0.91 for BBS.

Sanjeev S Sannakki et al in 2015, [11] has used Back Propagation Neural Network (BPNN) classifier for detection of plant diseases based on visual symptoms occurring on leaves. Two diseases of pomegranate plant namely Bacterial Blight (BB) and Wilt Complex (WC). Images of healthy and unhealthy leaf samples are captured by digital camera, enhanced and segmented to detect infected portions. Color and texture features are extracted and passed through BPNN classifier which correctly classifies the disease being occurred, thereby helping farmers in effective decision making. The accuracy in classification was 97.30%.

Sachin D. Khirade et al in 2015, [12] has discussed about segmentation and feature extraction algorithm that can be used for the detection of plant diseases by using the images of their leaves. Author has made 5 steps to detect the diseased plant leaf. The five steps are: image acquisition, pre-processing, segmentation, feature extraction and final classification of diseases. Image acquisition used the transformation structure for RGB leaf image. Then image is pre-processed to remove the noise and enhance the image contrast. Segmentation is done for the partitioning of image into various feature parts using k-means clustering, ostu

filters, etc. This segmented image is further used for feature extraction and finally classifications are performed using various classifications techniques. In this way, plant diseases can be efficiently identified.

K. Muthukannan et al in 2015, [13] has developed a neural network algorithm for diseased plant leaf classification. The neural network techniques such as feed forward neural network (FFNN), learning vector quantization (LVQ) and radial basis function network (RBF) were tested for two different diseased leaf image classifications such as bean and bitter gourd leaves. The performance is measured using classification parameters such as Accuracy, Precision, Recall ratio and F_measure. With these four parameters the performance is analyzed and based on the analysis the FFNN classification approach provides better result.

P.R. Rothe et al. in 2015**,** [14] has used a pattern recognition system for identification and classification of three cotton leaf diseases i.e. Bacterial Blight, Myrothecium and Alternaria. The images required for this work are captured from the fields at Central Institute of Cotton Research Nagpur, and the cotton fields in Buldana and Wardha district. Active contour model is used for image segmentation and Hu's moments are extracted as features for the training of adaptive neuro-fuzzy inference system. The classification accuracy was found 85%.

Aakanksha Rastogi et al in 2015, [15] have developed a Machine Vision Technology and Artificial Neural Network (ANN) is of great use for automatically detecting the leaf plant as well as for leaf disease detection and grading. The proposed system uses Euclidean distance technique and K means clustering technique for segmentation of image to segment the leaf area, disease area and background area of the input leaf image in order to calculate the percentage infection of the disease in the leaf and to grade them into various classes. Then it helps to identifying correct pesticide and its quantity to overcome the problem in an effective manner.

2.2 Summary of Literature Survey

As per above literature survey it is found that the following machine learning methods are used by different researchers for plant disease detection and analysis:

1. Probabilistic neural network (PNN).
2. BPNNs used for perceiving shades of the grape leaves; MSOFM & GA use for grape plant leaf malady segmentation; Gabor wavelet based image processing technique.
3. The Otsu Method was used to segment the leaf regions and HSI color system used for segmentation of the diseased spot. Further, Sobel operator was taken into function in order to examine the edges of the disease spots.
4. K-means based image processing technique and neural network.
5. SVM-based Multiple Classifier System.
6. Neural network classifier.
7. Naked eye prediction and fuzzy logic.
8. Artificial neural network and RGB.
9. Image segmentation and Gaussian filter.
10. Color histograms were extracted and transformation was from RGB to HSV and RGB to L*a*b*.
11. BPNNs.
12. Image segmentation, RGB and K-means clustering.
13. Neural network techniques.
14. Active contour model is used for image segmentation.
15. The combination of Artificial Neural Network (ANN), Euclidean distance technique and K means clustering technique used.

III. Machine Learning Methods

Machine learning is the subfield of computer science. It evolved from the study of pattern recognition and computational learning theory in artificial intelligence, machine learning explores the study and construction of algorithms that can learn from and make predictions on data. Machine learning methods are:

3.1 k-Nearest Neighbor: k-Nearest Neighbor is a simple classifier in the machine learning techniques where the classification is achieved by identifying the nearest neighbors to query examples and then make use of those neighbors for determination of the class of the query [4, 15].

3.2 Support Vector Machine: Support Vector machine (SVM) is a non-linear Classifier. This is a new trend in machine learning algorithm which is used in many pattern recognition problems, including texture classification. In SVM, the input data is non-linearly mapped to linearly separated data in some high dimensional space providing good classification performance. SVM maximizes the marginal distance between different classes [2].

3.3 ANN: The feature vectors are considered as neurons in ANN. The output of the neuron is the function of weighted sum of the inputs. The back propagation algorithm modified SOM; Multiclass Support vector machines can be used [15].

3.4 SOM: SOMs operate in two modes: training and mapping. "Training" builds the map using input examples (a competitive process, also called vector quantization), while "mapping" automatically classifies a new input vector. The self-organizing map describes a mapping from a higher-dimensional input space to a lower-dimensional map space. The procedure for placing a vector from data space onto the map is to find the node with the closest (smallest distance metric) weight vector to the data space vector.

3.5 GA: The genetic algorithm is a method for solving both constrained and unconstrained optimization problems that is based on natural selection, the process that drives biological evolution. The genetic algorithm repeatedly modifies a population of individual solutions.

IV. Conclusion

The survey of different papers studied have given different identification and classification techniques which have been summarized above. As per the survey, this paper has made an attempt to study machine learning methods which are used by researchers for disease identification and classification of plants. These machine learning methods help agricultural experts in detection of disease in the plant in timely fashion, then the experts will suggest the medicines to the farmer. As per suggestions of agricultural experts, the farmer will give the treatment for the diseased plant in a timely manner which will increase the crop yield.

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