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A REVIEW ON PLANT DISEASE DETECTION TECHNIQUES

Jamil Ahemad Abdul Hafiz Shaikh
M.E Student, Department of Computer Engineering, MCOER, Nashik.

Abstract: The prevention and control in plant disease plays vital role in architectural filed. Accurate and rapid diagnostic of disease helps to control the disease at early stage. The detection of plant disease using automatic technique is beneficial and reduces large work of monitoring each individual plant in the farm. A combined usage of image processing techniques and machine learning techniques helps to recognize the disease. This paper includes the study of existing systems for plant disease detection. The study includes various technique used for disease detection its advantages and limitations. Based on the existing work analysis, a new system is proposed. In the proposed system, plant leaf image features are extracted using Gabor filter and watershed segmentation algorithm which includes the color, texture and intensity property of image. Based on the extracted features the image is compared with existing disease training data. The test image is labeled with the related disease using classification technique.

Keywords— Image Processing, Machine learning, Plant Disease, Naive Bays, SVM, Random Forest

I. INTRODUCTION

In India the architectural productivity plays vital role in economy. Variety of plants and crops present in India. The plants have variety of characteristics and behavior. The Plant disease affects the productivity. The prevention and control in plant disease plays vital role in architectural filed. Accurate and rapid diagnostic of plant disease helps to control the disease at early stage. The disease detection in plants plays important role in architectural field. The automatic detection of plant disease using automatic technique is beneficial and reduces large work of monitoring each individual plant in the farm.

The plant diseases are mainly categorized in two sections: Biotic and Abiotic. Biotic diseases affect the plant stem and leaf. The Abiotic disease occurs due to unhealthy soil, wind and it affects root. For Biotic plant disease classification the plant leaf images are analyzed. The image features are extracted using feature selection algorithm using image processing technique. These features are matched with existing training dataset using machine learning classification technique. This technique assigns the class label for image based on the training information provided.

Analysis of Different Classification Techniques using machine learning is a challenging task in agricultural research area. It is very tough to find out the best classification algorithms for comparing in different algorithms in various datasets. The proposed work concerns with the algorithm and its capability to diagnose plant disease data accurately as well as quickly.

The proposed system works on plant disease detection using image processing and machine learning techniques. The plant leaf image is taken for processing and identification of disease. The segmentation is treated as preprocessing step. Then the system extracts image features in terms of color, texture and intensity. Further the data is provided to machine learning classifiers to categorize and correctly label the plant disease. For classification Random Forest, Naive bays and SVM algorithms are used.

The following section includes the existing system study for plant disease detection. The plant disease analysis includes leaf analysis, Fruit analysis. Based on the study of existing system an problem definition is proposed. Based on the proposed problem, new system is proposed in section IV followed by the conclusion.

II. RELATED WORK

R. Ramya , et. al. [1] proposes a cumulative study of various classifiers present in weka machine leaning tool for plant disease detection. The plant disease is identified using plant leaf image analysis. The features from images are extracted using color and texture based filters. For classification random forest, Zero R, Neive bays and SVM algorithms are used collectively to predict the result. Only color and texture filters do not appropriately find the disease in plant leaf using image processing.

S. Avinash .et.al.[2], proposes an improved image processing analysis for the detection of lung cancer. To overcome the drawback of analysis of only color and texture filters the watershed segmentation algorithm is combined with color and texture filters to improve the accuracy of detection. This paper proposes a lung cancer detection using image processing and techniques. It uses Gabor filter followed by watershed algorithm and then masking technique to correctly map the area. This technique does not use any classification algorithm for detection.

Vijai Singh, et. al.[3] proposes a technique for Detection of plant leaf diseases using image segmentation and soft computing techniques. This paper also focuses on plant disease detection using monitoring plant leaf. For labeling the correct disease it uses image processing and machine learning technique. For feature extraction it uses Segmentation algorithm whereas for classification it uses SVM classifier. In the future work of this paper state that, to improve classification accuracy hybrid approach of multiple classification

algorithms like naive bays, fuzzy logic can be used.

Hybrid Approach for Apple Fruit Diseases Detection is proposed by Bhavini J.[4]. This paper focuses on fruit disease detection technique. For detection it initially uses color and texture filters for extracted feature of fruit. For color and texture feature extraction it uses variety of combination of algorithms such as: GCH+ Gabor, GCH+LTP, Gabor+LTP, Gabor+CLBP+LTP, etc. After extraction of features random forest classification algorithm is used to correctly label the disease.

Comparative Analysis of classification Algorithms using WEKA tool is elaborated in the paper presented by Shivangi Gupta[5].There are various classification algorithms are proposed in machine learning. The weka tool gives the implementation of some classification algorithms in java. This paper proposes a comparative analysis of various classification algorithms. The test is conducted on various datasets downloaded from UCI repository and accuracy of classification is calculated for each classifier.

Smita Naikwadi, Niket Amoda [6] proposed system that automatically detect and classified diseases of plant leaf. Visually traceable and observable plant diseases or traits are studied using image processing techniques. Image segmentation as well as OTSU method is used. In this proposed system the mostly green pixels are masked by calculating threshold values with the help of OTSU method. The part with zeors Red , Blue and green value and present on the border of leaves is removed. Hence remaining part left is considered as a affected area and analyzed.

Mr. N.S. Bharti [7] proposes a study on Detection and Classification of Plant Diseases. The system detects the plant diseases using in phases:1 :feature Extraction 2: Masking and 3: Classification. In feature extraction it uses segmentation. And Find the green part of image. In masking phase it uses Ostu's method to mask green pixel. After masking the green pixel, the pixels having zero RGB value and pixels on leaf boundaries are removed. Then the affected area is correctly cropped from the leaf. The extracted features of damaged area are then provided to the ANN classification algorithm and disease label is extracted.

R. Ravikumar[8] present a system that work on identification of the sugarcane plant leaf disease. using Feed Forward Artificial Neural Network technique and Kmeans algorithm. This technique uses Feed Forward Artificial Neural Network using Multilayer Perceptron (MLP) and Simple K means algorithm.

Milos Ilic[9] , et.al., proposes a technique for early fruit disease detection. This is disease prediction system. It uses previous plant disease data with various other parameters. For disease prediction it uses mathematical regression methods. This helps to suggest important chemical protection for plants.

Meenakshi, Geetika [10] proposed a system which uses WEKA tool for learn comparison of various classification techniques. Clinical data is used as an input to the system. The main aim of this proposed system is to investigate performance of different methods of classification for given input data. Navie bayes, J48, rule jrip, Logistic, and Bayes Network algorithms are used. After implementation it is found that Bayes Network is efficient one.

Mrinal Kumar, Tathagata Hazra, Dr. Sanjaya Shankar Tripathy [11] proposed system that is much more concern about the wheat leaf disease detection by using image processing technique. Author decided to implement image processing techniques for plant disease detection because agriculture is the back bone of the country and still farmer awareness regarding these diseases is less hence this proposed system tries to overcome the situation. Image processing includes steps like image acquisition then image pre-processing and then feature extraction. In the end proposed system also apply a classifier know as neural network.

Simona E. Grigorescu, Nicolai Petkov, and Peter Kruizinga [12] proposed system compares texture features based on local power spectrum. Local power spectrum are obtained by Gabor filters and are compared. Fisher criterion and the classification result comparison are two methods used to compare distinct feature vector clusters for different textures. Gabor energy, grating cell and complex moments operator features are considered in this paper.

Table 1 Related work.

Paper	Description	Analysis
R.Ramya , et. al. [1]	It proposes a cumulative study of various classifiers present in WEKA machine learning tool for plant disease detection using plant leaf image analysis. The features from images are extracted using color and texture based filters. For classification random forest, Zero R, Neive bays and SVM algorithms are used to predict the result.	Only color and texture filters do not appropriately find the disease in plant leaf using image processing. This paper is selected because various classifiers are considered and voting is done for them. Based on than result is predicted.
S. Avinash .et.al.[2]	This system proposed solution for lung cancer detection using image processing technique. Watershed segmentation algorithm is combined with color and texture filters to improve the accuracy of detection. It uses Gabor filter followed by watershed algorithm and then masking technique to correctly map the area.	This technique does not use any classification algorithm for detection. Also dataset is lung cancer specific is used
Vijai Singh, et. al.[3]	It proposes a technique for Detection of plant leaf diseases using image segmentation and soft computing techniques. Plant leaf is monitored. For labeling the correct disease it uses image processing and machine learning technique. Segmentation algorithm is used for feature extraction whereas for classification it uses SVM classifier.	Accuracy is not so good of this approach hence hybrid approach of multiple classification algorithms like neive bays, fuzzy logic should used is proposed for future work.
Bhavini J.[4]	In this system hybrid approach for Apple Fruit Diseases Detection is proposed. For color and texture feature extraction it uses combination of algorithms such as: GCH+ Gabor, GCH+LTP, Gabor+LTP, Gabor+CLBP+LTP, etc.	After extraction of features random forest classification algorithm is used to correctly label the disease. Disease detection accuracy level is proved to great level.
Shivangi Gupta[5]	It proposed a comparative analysis of various classification algorithms. The test is conducted on various datasets downloaded from UCI repository and accuracy of classification is calculated for each classifier. WEKA tool is used for comparative analysis of classification Algorithms.	Different classifier algorithms generates different results for same dataset. Comparative study of best suitable classifier is discussed with respect to the dataset.
Smita Naikwadi, Niket Amoda [6]	It proposed system that automatically detect and classified diseases of plant leaf. Image processing techniques are used for this. Image segmentation as well as OTSU method is used. In this proposed system the mostly green pixels are masked by calculating threshold values with the help of OTSU method. The part with zeors Red , Blue and green value and present on the border of leaves is removed. Hence remaining part left is considered as a affected area and analyzed.	OTSU Technique is not commendable for images under hazardous conditions. Accuracy hampers. Accuracy needs to be improved
Mr. N.S. Bharti [7]	It proposes a study on Detection and Classification of Plant Diseases. It detects the plant diseases using in phases:1 :feature Extraction 2: Masking and 3: Classification. For feature extraction it uses segmentation. And Find the green part of image. In masking phase it uses Ostu's method to mask green pixel. After masking the green pixel, the pixels having zero RGB value and pixels on leaf boundaries are removed. Then ANN classification algorithm is used and disease label is extracted.	This is improved version of [6]. Accuracy level is increased as ANN classification algorithm is used for label extraction.
R. Ravikumar[8]	It present a system that work on identification of the sugarcane plant leaf disease. It uses Feed Forward Artificial Neural Network technique and K-means algorithm. This technique uses Feed Forward Artificial Neural Network using Multilayer Perceptron (MLP) and Simple K	New technique i.e. Feed Forward Artificial Neural Network using Multilayer Perceptron (MLP) is used here. Sugarcane plant leaf images are used as dataset.

	means algorithm.	
Milos Ilic[9]	It proposes a technique for early fruit disease detection. This is disease prediction system. It uses previous plant disease data with various other parameters. For disease prediction it uses mathematical regression methods. This helps to suggest important chemical protection for plants.	Early fruit disease detection means disease prevention approach is adopted and mathematical regression methods. Regression is studied which generally helps for predictions.
Meenakshi, Geetika [10]	It proposed a system which uses WEKA tool for learn comparison of various classification techniques. Clinical data is used as an input to the system. The main aim of this proposed system is to investigate performance of different methods of classification for given input data. Navie bayes, J48, rule jrip, Logistic, and Bayes Network algorithms are used.	After implementation it is found that Bayes Network is efficient one. Using WEKA software classification algorithms are studied.
Mrinal Kumar, Tathagata Hazra, Dr. Sanjaya Shankar Tripathy [11]	It proposed system that is much more concern about the wheat leaf disease detection by using image processing technique. Image processing includes steps like image acquisition then image pre-processing and then feature extraction. In the end proposed system also apply a classifier know as neural network.	Neural netowork classifier is studied in this paper which is effective as far as efficiency improvement is concern.
Simona E. Grigorescu, Nicolai Petkov, and Peter Kruizinga [12]	It proposed system compares texture features based on local power spectrum. Local power spectrums are obtained by Gabor filters and are compared. Fisher criterion and the classification result comparison are two methods used to compare distinct feature vector clusters for different textures. Gabor energy, grating cell and complex moments operator features are considered in this paper.	Here Gabor filters is used along with Gabor energy, grating cell and complex moments operator features to improve accuracy of the result.

III. ANALYSIS AND PROBLEM FORMULATION

Lot of machine learning techniques and image processing techniques are applied for disease detection and identification. These techniques are studied independently. To improve the system accuracy ensemble approach can be useful.

System should automatically detect the plant is suffering from disease or not. The disease should be correctly labeled by analyzing the plant leaf using image processing and machine learning techniques.

IV. PROPOSED METHODOLOGY

A. Architecture

Following figure shows the architecture of the system. The system takes training and testing images as an input to the system. The input dataset contains affected as well as normal plant leaf images. The system processes the image by applying feature extraction. For feature extraction texture analysis and image segmentation techniques are used. The extracted features are input to the classification technique.

Three types of classifier are used:

1. SVM classifier
2. Naive bays
3. Random Forest Classifier

The collective results of these thee classifier generates the final result called as label for each classification record in test dataset. The label notifies that image is affected or not. The collective result of more than one classification technique improves the accuracy of label prediction for test dataset.

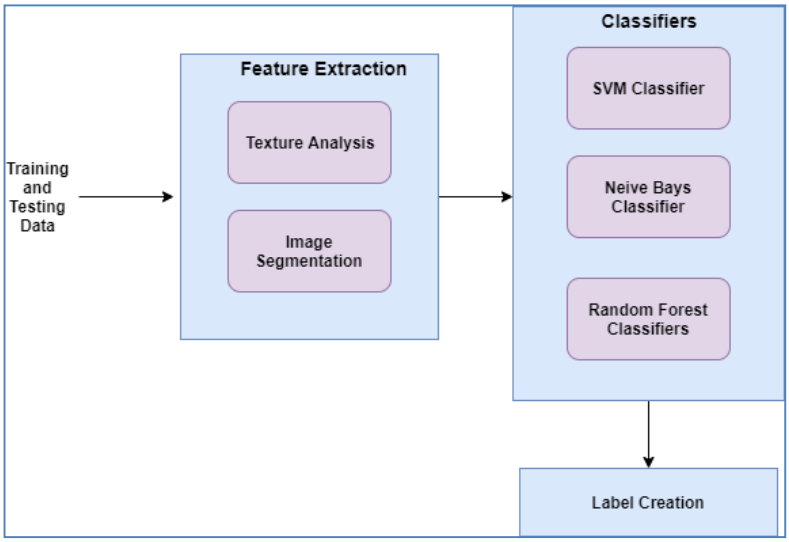

Fig.1. System Architecture

B. System Working:

The proposed system contains following modules:

1. Feature Extraction:

Before applying the feature selection algorithms the image is resized and compressed to reduce the extra processing overhead.

In feature extraction color and texture based feature selection algorithms are applied on training dataset and on test image. The combination of color and texture filter algorithm is: gabor + LBP.

After color and texture feature extraction watershed segmentation algorithm is used. This separates the affected part of leaf. The feature extraction technique on training dataset is applied at ones and features of all images are extracted and saved with disease label. This saved data is used for classification training process.

1. Gabor Filter:

This is linear filter for texture analysis. It checks for specific frequency contents in the localized image region in specific direction. Mathematically it can be represented as:

$$g(x, y, \lambda, \theta, \Psi, \sigma, \Upsilon) = \exp\left(-\frac{x'^2+\Upsilon^2 y'^2}{2\sigma^2}\right) \exp\left(i(2\pi\frac{x'}{\lambda}+\Psi)\right) \qquad (1.1)$$

where,

λ = Wavelength of the sinusoidal component.

Θ =orientation of the normal to the parallel stripes of Gabor function.

Υ =spatial aspect ratio and specifies the ellipticity of the support of Gabor function.

Ψ = phase offset of the sinusoidal function.

σ =sigma/standard deviation of the Gaussian envelope

$x' = x.\cos\theta + y.\sin\theta$

$y' = x.\sin\theta + y.\sin\theta$

2. LBP

Local Binary Pattern is a texture filter. It is used for classification of images. It can be calculated as:

a) Divide the image in 16*16 blocks

b) For each pixel its neighboring 8 pixels are compared

c) If center pixel value > neighbors then

Value = 1

Else

Value =0

d) Compute the histogram based on the value

e) Normalize the histogram

3. Watershed:

It is a segmentation method. It partitioned the image in multiple small pieces based on its properties. It works on grey scale image. It visualizes the image as topographic surface. High intensity pixels are treated as peaks whereas low intensity area is valleys. The watershed algorithm tries to fill valleys with water until all peaks are under water. To fill the valley section local minima of the image is used.

4. Classifier Training:

The SVM, Naive Bays and Random forest classifiers are used collectively to define a disease label. The feature extraction information of affected plant leaf is provided to these classifiers for training.

5. Classifier Testing:

The test image features are provided to these classifiers to extract correct label. A collective voting is conducted based on the result of each classifier and a summary label is generated based results of all classifiers.

V. CONCLUSIONS

In this paper, various existing systems for plant disease detection are studied. For automatic plant disease detection image processing and data mining techniques are used. Using image processing technique the features can be extracted of plant leaf or plant fruit. Based on the extracted features data mining technique conclude that plant is affected or not. In the posed system, the plant leaf image features are extracted using image segmentation and texture analysis algorithm. The extracted features are compared with the training dataset with machine learning algorithms such as: SVM, Naive Bays and Random forest. The collective result of classification algorithm achieves the accuracy in detection. In future system will work on automated plant disease detection using live hardware support.

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