

An Overview on Detection and Classification of Plant Diseases in Image Processing

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Abstract: *In this paper; heterogeneous plant diseases that are feasible and their apprehension using contrasting techniques have been discussed. These techniques include Otsu method, image compression, image cropping and image denoising including K means clustering to articulate the disease images. Neural networks including back propagation (BP) networks, radial basis function (RBF) neural networks, generalized regression networks (GRNNs) and probabilistic neural networks (PNNs) are also used to diagnose wheat and grape diseases. Cotton leaf diseases and rice plant disease using sobel operator, canny filter and feature extraction are passed down to recognize the disease. Many other diseases like orchid leaf disease, rubber tree leaf disease; apple fruit disease and chili plant disease can also be encountered using other approaches like fuzzy logic, Multi-class Support Vector Machine and Local Binary Pattern. A miniature explication on all the diseases and their detection has been given in this paper.*

Keywords: cotton leaf spot, Rice plant, Wheat and sugar beet diseases, Orchid leaf disease, Apple fruit diseases, Chili plant disease.

1. Introduction

India is an agricultural country where about 70% of the population depends on agriculture. Farmers can select suitable fruits and vegetable crops from a wide range. The cultivation of these crops for superlative yield and quality produce is highly specialized. The management should keep a close supervision of crops so that diseases do not affect the production. The image processing can be used in agricultural applications for following purposes:

- To find diseased leaf, stem and fruit.
- To check affected area by disease.
- To find shape of affected area.
- To identify color of affected area.
- To identify size and shape of fruits. Etc[7]

In case of plant disease is caused by plague which is any agent, these pests or diseases are present on the leaves, stem or fruits of the plants. These diseases occur naturally and their symptoms differ extremely. Crops face many traits/diseases, damage done by insect is one of the major trait/disease. Since, insecticides may be pernicious to some of the birds. So, they are not always proved to be profitable. They act as a major agent that damages natural animal food chains. Plant scientists should keep a track on the estimation of damaged plant by keeping an eye on percentage of affected area. Plant diseases can cause a huge reduction in quantity and degrades the quality of agricultural products. Some disease also infects other areas of the tree causing diseases of twigs, leaves, and branches. There are a variety of plant diseases in the world. Sometimes, it leads to contemplative harvest losses and even enforces food security.

The ability of disease diagnosis in earlier stage is very essential so that timely cure and control of such disease leads to decreasing dissatisfactory products. Timely recognition is useful for taking disease control measures, it lies on the visual identification by the agricultural technicians and requires high professional knowledge and

many professional as well as technical personnel. There is heterogeneity of characteristics of plant diseases and usage of many image processing and computer vision techniques for plant diagnosis problems.

The main purpose of this paper is to review some of the plant diseases which are proposed till date and the various techniques that have been used for their detection.

2. Some Leaf, Stem and Fruit Diseases

Plant leaves diseases are commonly measured by the ratio of lesion area and leaf area [1]. Image Acquisition and Image Segmentation is performed on the leaves in order to check the disease present in it. In image acquisition defiled leaves are arranged on a white background, such that the optical axis of digital camera is placed perpendicular to the leaf plane to hurl images present in the computer for future use. In image segmentation the image is deputed in different regions with unique implication. These regions do not intersect with each other, and each of the region should meet consistency conditions in specific regions [1]. Image segmentation includes leaf regional segmentation and lesion segmentation.

A. Different categories of cotton leaf spot diseases

The diseases identified on the cotton leaf spots are classified as Fusarium wilt, Verticillium wilt, Root rot Boll rot, Grey mildew; Circular dry brown lesions up to 10mm across may also be seen on the bolls. A alternata causes usually purple specks or small lesions with purple margins on leaves and bolls Leaf blight, Bacterial blight, Leaf curl[5]

Symptoms of Cotton Diseases:

Grey mildew (Areolate Mildew/ Dahiya) - Ramularia areola:

In this disease the lesions appear light to yellowish green on the upper surface and as the spot grows older the leaf

tissues turn yellowish brown. In addition to this a whitish frosty growth seems to appear on the under surface but sometimes on the upper surface also. The lesion turns reddish brown when the leaf becomes chlorotic and then defoliation takes place. Due to early and severe defoliation premature boll opening and immature lint takes place.

Bacterial blight (*Xanthomonas axonopodis* pv. *Malvacearum*):

In this an angular leaf spot appears on the under surface of leaves which consists of dark green, water soaked, angular lesions of 1 to 5mm. Its symptoms are mostly seen on the lower leaves than on the upper leaves. A dark green, water soaked greasy, circular lesion of 2 to 10 mm are present at the base of boll under the calyx crown and it prevents normal opening of the boll as the boll matures and the lesions dry out. This phase of symptom is called as Boll rot.

Leaf Curl virus disease - Gemini virus:

In this disease the initial symptom is presence of Small Vein Thickening (SVT) on the young upper leaves of plants. Later, upward curling of leaves occur due to the uneven growth of veinal tissues on the abaxial side of the leaves [5]. After that on the underside of the leaf formation of the cup shaped or leaf laminar outgrowth called enations take place. In case when plants are affected at an early stage the reduction of inter-nodal length which leads to stunting and reduced flowering/fruitletting is observed.

B. Rice plant diseases

Rice plant diseases consist of the following:

Brown Spot: In this disease small, circular and oval spots are fairly scattered on the leaves of the plant with gray center. Thus, rice leaves are infected with brown spots.

Rice Blast: In this disease small spindle shaped spots with brown border and gray center appears on the leaves. Diamond shaped spots are caused by fungal plague.

Bacterial Leaf Blight: In this disease lesions appear grayish white with wavy light brown margin and progresses downwards as well as water soaked stripes covers a large area of leaf blade.

These figures tells about the rice plant diseases explained above

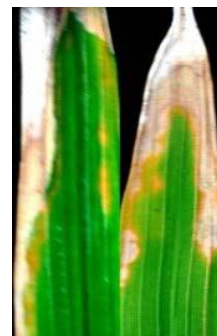
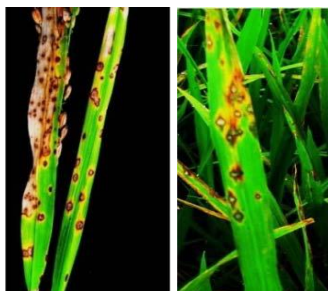


Figure 1[6]

C. Wheat and sugar beet diseases

The two common leaf diseases of wheat are wheat stripe rust and wheat leaf rust. The symptoms of these two diseases in wheat seedling are very similar and it is very difficult to distinguish between them[3]. Foliar disease of *Cercospora* leaf spot (CLS) in sugar beet is caused by the fungus *Cercospora beticola* which occurs world-wide and degrades the gross sugar yield resulting in less income for sugar factories and growers. This leads an essential driving force for early CLS detection and continuous disease quantization, to make timely and optimal *Cercospora* spray advisory for initial and subsequent fungicide sprays [4].

D. Orchid leaf disease

Orchid leaf diseases can be determined by looking at the parts of the leaf which has some abnormal appearance like black spots, yellowish parts of leaf. One can also check the texture of a leaf whether it is harder or softer than what it should be[8].

E. Rubber tree leaf diseases

Various rubber tree diseases are *Corynespora* Leaf Spot, Bird's Eye Spot and *Collectotrichum* Leaf Disease. All these three have a different symptom which helps in their detection. In *Corynespora* yellowish spots are seen on the rubber leaf. In Bird's eye spot disease dark brown spots appearing like eye is seen on the leaf and In *Collectotrichum* small holes are observed all over the leaf.

F. Apple fruit diseases

Three common apple fruit diseases are apple scab, apple rot and apple blotch[10].

Apple scabs are a gray or brown corky spot which means circular spots that appear on the apple.

Apple rot are infections that produce a slightly sunken, circular brown or black spots which may be covered by a red halo. Apple blotch is a fungal disease which appears on the surface of the fruit as dark brown, irregular or lobed edges.

G. Chili plant disease

There are two factors which can bring destruction to chili plant; living (biotic) and nonliving (abiotic) agents. Living agent does include insects, bacteria, fungi and viruses.

Nonliving agents include extremes of temperature, redundancy moisture, poor light, inadequate nutrients, poor soil pH and air pollutants. Diseased plants can have a variety of symptoms including aberrant leaf growth, color contortion, stunted growth, fossilize and flawed pods.

3. Related Work

In this the various techniques used for the classification of plant diseases are explained. Firstly the leaf region was splited by using Otsu method. In this HSI color system is used where H component is used to segment disease spot to reduce the disturbance of illumination changes and then disease spot regions were segmented using sobel operator to check disease spot edges. After that the quotient of disease spot and leaf areas are used to grade the plant disease.

For identifying grape and wheat diseases image compression, image cropping and image denoising including K means clustering was used to segment the disease images. Back propagation (BP) networks were used as the classifiers to identify grape diseases and wheat diseases, respectively[2]. The results showed that the identification of disease could be efficiently achieved by using BP networks. Another approach consist of neural networks including back propagation (BP) networks, radial basis function (RBF) neural networks, generalized regression networks (GRNNs) and probabilistic neural networks (PNNs) were used as the classifiers to identify wheat diseases and grape diseases[3]. Further, the results showed that by using these neural networks image recognition of these diseases based on reducing dimensions using PCA, acceptable fitting accuracies and prediction accuracies could be obtained. For the two kinds of wheat diseases, when image recognition was conducted based on PCA and BP networks the optimal recognition result was obtained.

A three stage framework is adopted to detect sugar beet leaf disease. First, a plant segmentation index of G-R is introduced to distinguish leaf parts from soil-contained background for automatic selection of initial sub templates; second, we adopt a robust template matching method called orientation code matching (OCM), which could not only realize the continuous and site-specific observation of disease development, but also shows its excellent robustness for non rigid plant object searching in scene illumination, foliar translation and small rotation; afterward, we employ a machine learning method of support vector machine (SVM) for robust and early disease classification by a color-based feature named two dimensional (2D) xy-color histogram, which has stable ability to classify disease against various illumination changes[4].

Cotton leaf disease detection is based on image RGB feature techniques which are used to identify the disease where the captured images are processed for enhancement first. After that color image segmentation is carried out to get disease spot that is the target regions.

Next acclimatize techniques like Sobel and Canny filter are used to analyze the edges, these elicitation edge

features are then used in allocation to analyze the disease spots. Finally, pest endorsement is given to the farmers to clinch their crop and deflate the yield loss.

Rice plant diseases can be detected by using the techniques like image enhancement, image segmentation, and feature extraction, where four features are extracted to identify the disease. These four are: first the fragment covered by the disease on the leaf; second the mean values for the R, G, and B of the disease; third the standard deviation of the R, G, and B of the disease and; last the mean values of the H, S and V of the disease.

Orchid leaf diseases detection system includes two parts image processing and fuzzy logic. The leaf image processing uses methods like gray scaling, threshold segmentation and noise removing. The centroid, area and number of diseased spots are collected from the image processing. All these data or numbers is then fed through the fuzzy logic system which includes fuzzification, fuzzy inference and defuzzification in order to get the output.

A database system of the rubber tree leaf diseases using Structured Query Language (MySQL) has been used. In this work, there are three selected diseases that can be identified using this database system which are *Corynespora* Leaf Spot, Bird's Eye Spot and *Collectotrichum* Leaf Disease[9]. Firstly, the input to the database system from each of these diseases based on Red, Green and Blue (RGB) color model from previous experiments has been taken. The purpose of this system is that it helps new users to recognize the types of rubber tree leaf diseases and also consists of data collection, stored, kept and arranged by the Database Management System. Therefore, by using the database system, the client can easily identify the diseases by comparing their records with the available information. While the advantage of this system is that it help new users to study the characteristics of the diseases without referring to the expertise since the information is consists of sample of images and its symptoms[9].

Another approach for apple fruit diseases is composed of the following main steps; first step includes K-Means clustering technique for image segmentation, the second step consist of art feature extraction from the segmented image, and lastly images are classified into one of the classes by using a Multi-class Support Vector Machine. Local Binary Pattern a simple yet very efficient operator which define local image pattern, and has reported impressive classification outcomes on representative texture databases[10]. In this method the use of clustering technique for the disease segmentation and Multi-class Support Vector Machine as a classifier for the automatic detection and classification of fruit diseases has been used.

Lastly, the effective way used in performing early detection of chili disease is done through leaf features inspection. Leaf image is captured and processed to identify the health status of each plant. Currently the chemicals are applied to the plants periodically without considering the requirement of each plant. In this technique the chemicals are only applied when the plants are detected to be effected with the diseases. The image

processing techniques have been used to perform hundreds of chili disease images. The plant chili disease detection through leaf image and data processing techniques is very essential and in expensive system especially for assisting farmers in keeping track on the big plantation area. The symptoms of the attacks are usually distinguished through the leaves, stems or fruit inspection[11].

4. Conclusion and Future Scope

This paper presents a variety of plant diseases including Grape and wheat disease, Sugar beet leaf disease, Cotton leaf disease, Rice plant disease, Orchid leaf disease, Rubber tree leaf disease, Apple fruit disease and chili plant disease. The symptoms, classification and detection of all these diseases have been depicted in peculiarity. Image segmentation is mainly performed on the leaves in order to check the disease present in it. The pathogens are basically responsible for the plant disease which destroys the leaf and stem of the plants. Back propagation (BP) networks, radial basis function (RBF) neural networks, generalized regression networks (GRNNs) and probabilistic neural networks (PNNs), image enhancement, image segmentation, feature extraction, fuzzy logic, Multi-class Support Vector Machine and Local Binary Pattern. are used as the techniques which helps in the detection of the plant diseases. Many plant diseases and different approaches for their detection are given in detail. In future many other techniques can be used. The combination of two or more techniques can also be used for the detection of plant diseases.

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