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RESEARCH ARTICLE

A FEASIBILITY STUDY OF IMAGE PROCESSING TECHNIQUES FOR PREDICTION OF CORN PLANT LEAF DISEASE

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ABSTRACT

In this review, we present a comprehensive and critical survey on image-based plant leaf disease prediction techniques. Diseases in plants cause major production and economic losses in agricultural industry worldwide. Monitoring of health and detection of diseases in plants and trees is critical for sustainable agriculture. To the best of our knowledge, there is no sensor commercially available for real-time assessment of health conditions in trees. Currently, scouting is most widely used mechanism for monitoring stress in trees, which is an expensive, labor-intensive, and time-consuming process. Molecular techniques such as polymerase chain reaction are used for the identification of plant diseases that require detailed sampling and processing procedure. Early information on crop health and disease detection can facilitate the control of diseases through proper management strategies such as vector control through pesticide applications, fungicide applications, and disease-specific chemical applications; and can improve productivity. The aim of this research is to propose and evaluate a framework for detection of plant leaf diseases. Studies show that relying on pure naked-eye observation of experts to detect such diseases can be prohibitively expensive, especially in developing countries.

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INTRODUCTION

Plant diseases have turned into a nightmare as it can cause significant reduction in both quality and quantity of agricultural products (Shen Weizheng, 2008), thus negatively influence the countries that primarily depend on agriculture in its economy (Prasad Babu, 2010). Consequently, detection of plant diseases is an essential research topic as it may prove useful in monitoring large fields of crops, and thus automatically detect the symptoms of diseases as soon as they appear on plant leafs. Monitoring crops for to detecting diseases plays a key role in successful cultivation (Prasad Babu, 2010 and Weizheng, 2008). The naked eye observation of experts is the main approach adopted in practice (Shen Weizheng, 2008). However, this requires continuous monitoring of experts which might be prohibitively expensive in large farms. Further, in some developing countries, farmers may have to go long distances to contact experts, this makes consulting experts to very expensive and time consuming (Prasad Babu, 2010). Therefore; looking for a fast, automatic, less expensive and accurate method to detect plant disease cases is of great realistic significance (Prasad Babu, 2010). Studies show that image processing can successfully be used as a disease detection mechanism (Shen Weizheng, 2008).

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System Model

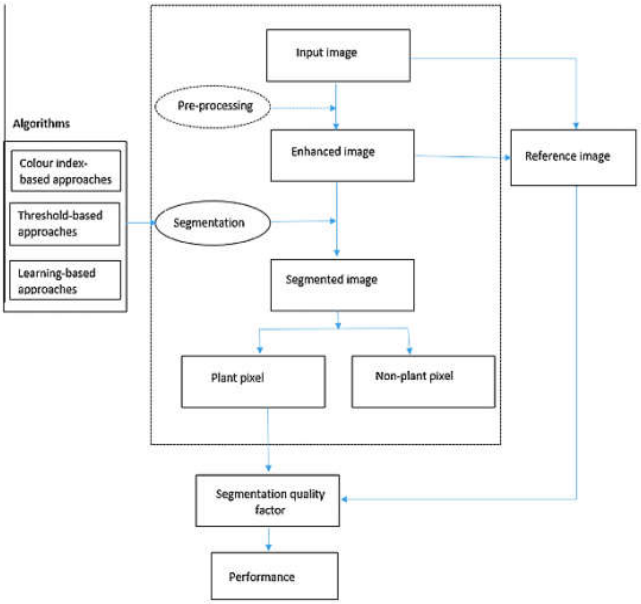

Figure 1. General scheme for segmentation and its evaluation

In this survey, we focus on recent studies that consider image processing techniques that used for plant extraction and segmentation under various field conditions and consider their performance. Fig. 1 shows a block diagram of a general scheme for segmentation, including a broad framework for evaluation of segmentation algorithms. This typically includes a pre-processing stage, followed by the core segmentation stage, which can be done using a variety of approaches (indicated by the ‘‘Algorithms” box on the left hand side of Fig. 1). Evaluation is typically carried out by comparing the output of the segmentation algorithm with a reference image that is treated as a ‘‘gold standard”, and by using a suitable performance or quality metric.

Previous Work

Extensive research has been conducted to explore various methods for automated identification of plant diseases. The disease can manifest in various parts of the plant such as roots, stem, fruit or leaves. As stated before, this work concentrates particularly on leaves. Dheeb Al Bashish *et al*. (Dheeb Al Bashish, 2010), Discussed a methodology for recognition of plant diseases present on leaves and stem. The proposed work is composed of K-Means segmentation technique and the segmented images are classified using neural network. The classification showed an average accuracy of 93%. The study by Di Cui *et al*. (Di Cui, 2010), involves image processing of multispectral images for identifying rust on soybean plant and its spread percentage. The algorithm uses two parameters for disease diagnosis; ratio of infected area (RIA) and rust color index (RCI).The results obtained from 32 collected leaves suggest that this method can effectively detect rust severities. Similar work is done by YouwenTian and Lin Zhang (Youwen Tian, 2012), on cucumber downy mildew disease using hyperspectral imaging. Similar review of various techniques is described by Sindhuja Sankaran *et al*. (Sindhuja Sankaran, 2010). This paper presents different imaging techniques that can be used for image acquisition such as Fluorescence spectroscopy, hyperspectral imaging, visible and infrared spectroscopy etc.

Rong Zhou *et al*. (Rong Zhou, 2013), discussed a technique for robust and early recognition of leaf spot in sugar beet. The algorithm uses hybrid techniques of template matching and support vector machine (SVM). The proposed method uses color based features for segmentation and SVM classifier. The paper by Juan F. Molina *et al*. (Juan, 2014), presents a computer vision prototype strategy for detection of infections on tomato crops. The algorithm uses color based classification and neural networks. The work by Monika Jhuria *et al*. (Monika Jhuria, 2013), involves monitoring diseases in apple and grapes and classifying them using artificial neural network (ANN). The diseases are classified into their respective classes based on three main features, namely, texture, color and morphology. Murali Krishnan *et al*. (Murali Krishnan, 2013), describes an algorithm that identifies the infected plant areas by using K-Means clustering and extracting the region of interest (ROI). David G. Lowe (David G. Lowe, 2004). describes the scale invariant technique for finding the feature points known as keypoints from the image for feature matching purpose. The different views of an object or scene are accurately matched using SIFT algorithm. The features extracted are scale invarient, rotation, 3D viewpoint and illumination.

Based on the above mentioned work and by the results obtained from the previous work, we put forward a new technique used for identification and classification of plant diseases that can overcome the disadvantages of the previous work. Our proposed work can be applied to the images that can be captured under varying illumination conditions, non-uniform background and varying viewpoint.

Techniques

In this section, we consider the general flow of the various steps that are being performed in order to achieve the desired result. The proposed approach consists of four main steps: image acquisition of leaves, extraction of leaves from complex background, statistical analysis and disease classification.

The general flow of the disease detection system is illustrated in Figure 2.

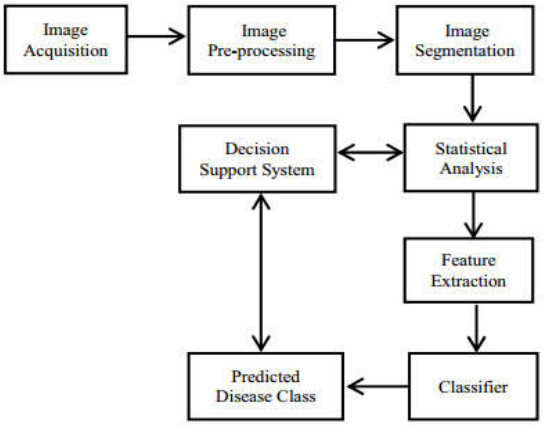

Figure 2. Block diagram of disease detection system

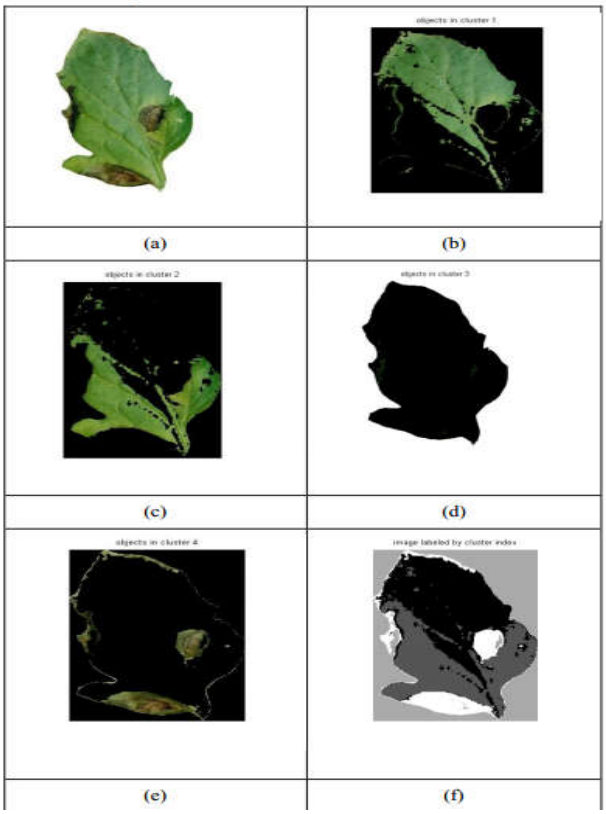

Figure 3. Example of the output of K-Means clustering for a leaf that is infected with early scorch disease. (a)The infected leaf picture. (b, c, d, e) the pixels of the 1st,2nd,3rd and 4thcluster, respectively.(f) a single gray-scale image with the pixel colour based on cluster index

Dheeb Al Bashish *et al*. (Dheeb Al Bashish, 2010), used technique composed of K-Means segmentation technique and the segmented images are classified using neural network for recognition of plant diseases present on leaves and stem. K-means clustering is used to partition the leaf image into four clusters in which one or more clusters contain the disease in case when the leaf is infected by more than one disease. K-means uses squared Euclidean distances. In our experiments, the K-means clustering is set to use squared Euclidean distances. An example of the output of K-Means clustering for a leaf infected with early scorch disease is shown in Figure 3.

Conclusion

The paper is suggesting that the image processing technique of digital image serves the useful role in the more cultivation of the corn. Image processing techniques like segmentation, median filtering and k-mean clustering helps to find the prediction of the disease in the corn plant leaf.

Future scope

This paper and research will help in the field of agriculture, not only for the corn plants but also in the other plants if minor changes done in the algorithm and the input database.

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