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Disease Detection Algorithm Based on Image Processing of Crops Leaf

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요 약

최근 IT 기술을 활용하여 농작물의 병충해 조기 진단에 관한 연구가 활발히 진행되고 있다. 본 논문은 카메라 센서를 통해 받아온 작물의 잎사귀 이미지를 분석하여 병충해를 조기에 감지할 수 있는 이미지 프로세싱 기법에 대해 논한다. 본 논문은 개선된 K 평균 클러스터링 방법을 활용하여 잎사귀 질병 감염 여부를 진단하는 알고리즘을 제안한다. 잎사귀 감염 분류 실험을 통해, 제안한 알고리즘이 정성적인 평가에서 더 좋은 성능을 나타낸 것으로 분석되었다.

■ 중심어 : 이미지 프로세싱, 잎사귀 질병, k-평균 클러스터링, 에지 검출

Abstract

Many Studies have been actively conducted on the early diagnosis of the crop pest utilizing IT technology. The purpose of the paper is to discuss on the image processing method capable of detecting the crop leaf pest prematurely by analyzing the image of the leaf received from the camera sensor. This paper proposes an algorithm of diagnosing leaf infection by utilizing an improved K means clustering method. Leaf infection grouping test showed that the proposed algorithm illustrated a better performance in the qualitative evaluation.

■ Keyword : Image Processing, Leaf Disease, K Means Clustering, Edge Detect

Ⅰ. Introduction

The disease control has been addressed rapidly as one of the most important and serious problem in crop farming. In particular, it is most important to detect the disease at an early stage without any special symptoms or signs. Disease detection takes a long time because it is done personally by most people. In addition, it is difficult to detect the disease at an early stage due to the limitations of the human senses of detecting. It requires a lot of effort and time, in the case of horticultural farmers to grow crops on a large scale, to directly check the status of every plant. Recent development of image sensor technology has allowed continuous and lasting monitoring of crops, and disease diagnose in combination with image processing. That is, it is possible to perform a plant observation by using the camera sensor, and to early determine the presence of the crop pest by the computer vision. This paper propose an improved image processing technique capable of detecting the leaf disease in the early stage by identifying the health condition of the plant via image of the leaves of the crop collected by the camera sensor. The improved K means clustering algorithm was specifically used to detect leaf disease.

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Ⅱ. Related Research

2.1 Image Processing Techniques for the Detection of Plant Diseases

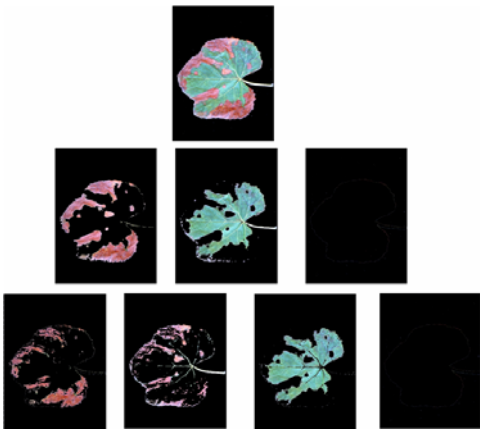
It is essential for a successful crop cultivation to identify leaves, stems and fruit of plants and to find an infection of infection. Leaf diseases of crops are determined by the area percentage of infected leaf [5]. Thus, the image analysis of the leaves of the crop may determine the infections. Leaf disease detection is done through the process of image obtaining, preprocessing, feature extraction, and identifying the symptoms of a bacterial disease. Types of crops include fruit crops, vegetable crops, economic crops and staple crops. A wide range of symptoms show in various parts depending on the type of disease, so diverse mechanisms also apply [3]. A first step of detecting a plant disease is an image pre-processing. It is the converting process of the obtained image into color space appropriate for processing the image or applying different filters to remove image noise. The second one is to extracts a region of interest by analyzing the features of the part to be detected. Representative feature extraction methods are block-wise, GLCM, GLRLM, DWT and PCA. Recently, methods using wavelet wave are also widely applicable [2, 4].

Principal component analysis can be used as data compression, face detection, and noise reduction because it can determine the distribution characteristics for a set of different data. K mean clustering algorithm is tying the similar data into K clusters [1].

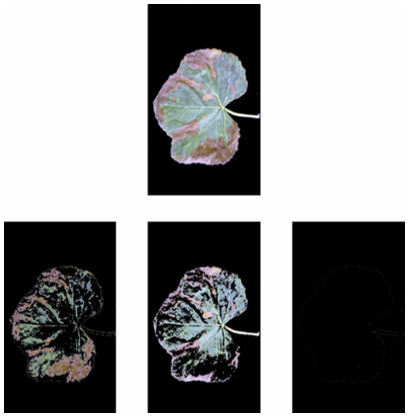
2.2 Considerations in Performing K Means Clustering

A few things to consider when performing K means clustering algorithm are as follows: First, they are the initial value of K and the median. Correct clustering cannot be occurred if the initial settings are incorrect. If the number of actual clusters is different from K, the center value of K is not a representative value of the physical cluster but meaningless data. <Figure 1> shows the case when the number of actual clusters is different from K value. In <Figure 1>, the original image is the color image consisting of the healthy part of the leaf, the infected part, and a black background. <Figure 2> is image where the color contrast of the original image <Figure 1> was lowered.

A valid cluster could not be classified with the K value if 3 because of obscure the boundaries between the cluster. In addition, there is a case of failure in the clustering due to the influence of light. To prevent this, the image pre-processing and color space change are required.



〈Figure 1〉 Clusters Changes According to the K Value

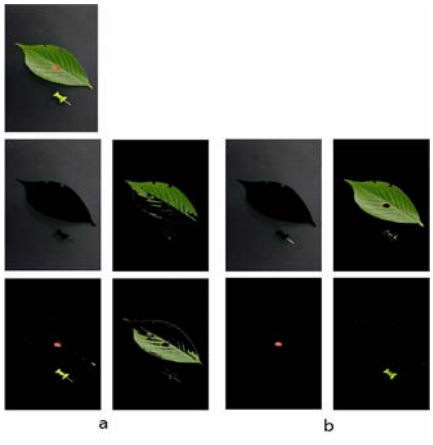


〈Figure 2〉 Clustering Incomplete Due to Low Contrast

Ⅲ. Algorithm Proposal

The proposed algorithm is performed in the following order: First, a pre-processing is carried out. Noise is removed by applying the median filter to RGB images. Various methods may be used in order to extract the leaf

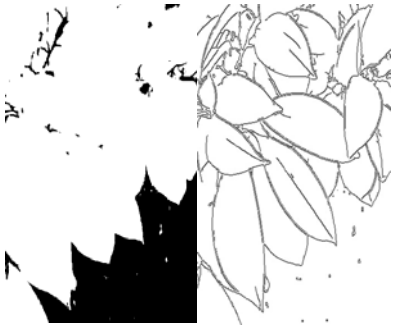
parts. There is a method of extract the green component after converting the RGB image into HSV color space. This method is not suitable because the stem or raw fruit can be detected with the leaf when they are green. K mean clustering was performed in this study in order to detect only the pure leaf. Typical K mean clustering divides the color cluster using R, G, and B values. For example, it can be used to divide a healthy portion from the infected parts of the leaves. However, proper clustering does not result with the same color family. This is the case when the stems and fruit are taken at the same time as well as when the influence of light is large. One leaf can be divided into two clusters in the worst case. This is due to the influence of light to increase the R, G and B values as a whole. In this paper, therefore $|RB|$, $|GR|$ and $|GB|$ values were used in place of R, G and B values. R, G and B values may increase as a whole, but the values of the difference between each other are substantially constant. All may be recognized as a cluster except when it is white due to full reflection of light, or black because of a shadow. <Figure 3> (a) shows the image when the conventional K mean clustering was used. <Figure 3> (b) shows the result when the suggested K mean clustering was used.



〈Figure 3〉 The Result Image of Applying the Existing Methods and Proposed Methods

The proposed method converts it to HSV color space first, to analyze the H component and identify the color distribution of the image. The color distribution is aligned and the percentage is taken into account to set the value of K. A single pixel of the corresponding pixels in each of the color distribution is set as the center value. When the K value was set and the K mean clustering method is performed, it is divided into leaf clusters and other clusters. The rest, except for leaf clusters are removed before performing the following procedures:

Detection of leaf area is followed by the extraction of the individual leaves. This process utilizes a Figure edge image of the original image. Canny edge is an edge detection technique that shows a little slow, but the exact contours of the objects in one line. When the edge detection is completed, the leaf area is binarized and merged with the edge image. The combined image is the individually classified leaf image. <Figure 4> shows the leaf clump and edge image.



〈Figure 4〉 Leaf Area and the Edge Image

Next, feature point extraction and matching are processed. SIFT and SURF are examples of several feature extraction techniques. This paper extracted feature points using SIFT. Samples of the corresponding plant leaf are prepared before using for the feature extraction. Feature extraction shows that the edge portions of the leaves are matched. <Figure 5> shows the feature extraction and matching result. A leaf is extracted over the corresponding edge using edge tracking techniques (ISBF). A various sized leaf images can be obtained after all of the above procedures are conducted. A hole in the resulting images can be considered to be a sign of unhealthy leaf. Therefore, infected leaves can be classified by classifying the images according to the results of the existing holes.

〈Figure 5〉 Image Applying the SIFT Methods

Ⅳ. Conclusion

Crop pest is important because it has direct effects on the quality and yield of the crop. It is the reason why it requires a lot of effort to find a pest in the early stage for large-scale farmers. In this paper, an algorithm was suggested for diagnosing the health of a leaf by utilizing RGB images obtained from image cameras in the monitoring environment. The improved K mean clustering showed better results than the traditional K means clustering in order to extract the leaves among number of objects within the image. In addition, the feature point extraction, matching, and edge tracing steps were proposed as the individual classifying process. This paper proposed an initial stage of the crop leaf health diagnosis. The final determination algorithm needs to be implemented properly to meet the leaf detection.

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