Advanced Science and Technology Letters
Vol.79 (IST 2014), pp.44-48
http://dx.doi.org/10.14257/astl.214.79.09

Study of Rice Disease Spots Segmentation

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Abstract. Image identification technique is a newly emerge corn disease diagnosis. Disease and background can be isolated base on the image segmentation. The accuracy of the identification result has important impact on corn quality and yield. Plant disease often appears in leaves. In this study, an image extraction algorithm of rice leaf which is based on green component and use the threshold of grey-scale image methods has been proposed. According to the color characteristics of rice diseases, we use RGB color space technology to identity disease spot. The segmentation results show that this paper proposed segmentation method not only has good effect but also can be easily implemented but has good accuracy.

Keywords: image segmentation, rice disease, green component

1 Introduction

Rice is an important food crops. The epidemics of rice diseases could lead to severe losses and affect food security and agricultural production. In order to control rice diseases effectively, accurate and timely detection measures of rice diseases should be taken out.

Traditionally, farmers recognize the rice disease condition by manual methods, such as the guide books, their experiences, and experts. However, errors may occur during the process of identifying diseases. Misidentification usually leads to some inadequate control treatment, such as untimely and indiscriminate use of pesticides. With the development of precision agriculture, Computer technologies can overcome the impact of these factors and has been widely used in the studies on crop diseases. Many different methods are proposed for disease spots segmentation [1-3]. Thresholding is also a widely used segmentation technology [4-6]. Although the existing methods achieved effective segmentation results, their computations were complex.

In this paper, we are using color feature of rice diseases image, and proposed a new segmentation algorithm based on green component features and threshold of grey-scale methods. The algorithm can be well segment disease region and the surroundings.

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ISSN: 2287-1233 ASTL

2 Materials and Methods

2.1 System Platform and Materials

The samples of rice leaves in this study were collected from the trial base of China National Rice Research Institute of Fuyang City in Zhejiang Province [7]. The images were captured using Nikon D80 digital camera, as illustrated in the rice disease images in Fig. 1(a). More than 300 color images were sampled.

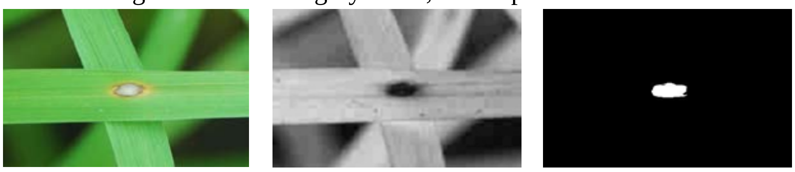
2.2 Gray-level transformation

The first step, which is familiar to almost all image processing plant detection algorithms, is the gray-level transformation. Its purpose in this study is to enhance contrast between background and disease area. This can be achieved in an RGB color space. The well-known color indices applied in this paper as the following:

$$2G - R - B \quad . \tag{1}$$

Where R , G and B are the actual pixel values from the agronomic images based on RGB color space.

The gray-scale image is shown in Fig. 1(b). As can be expected, according to the process of emphasizing the green value, the background has a higher gray value, while the disease region has a lower gray value, which presented dark.



(a) (b) (c)

Fig. 1 Process of rice disease segmentation: (a) original image, (b) grey-scale image, (c) result of disease segmentation

2.3 Rice disease segmentation

To overcome the above mentioned shortcoming of the Otsu's method, this paper proposes another algorithm based on a self-adaptation threshold. The gray-scale image was segmented with the threshold calculated as the following steps:

Step 1: The average value of the median filtering gray-scale image (t) was calculated as follows:

$$t = \frac{\sum_{i=0}^{m-1}\sum_{j=0}^{n-1} pixel(i,j)}{m \times n} \quad . \tag{2}$$

Where m is the width of the image and n is the height of the image, $pixel(i,j)$ is grey value of $point(i,j)$ in the grey-scale image, limit to [0,255].

Step 2: The standard deviation value of the median filtering gray-scale image (s) was obtained by equations 3:

$$s = \sqrt{\frac{\sum_{i=0}^{m-1}\sum_{j=0}^{n-1}[t - pixel(i,j)]^2}{m \times n}} \tag{3}$$

where s is the standard deviation value of grey-scale image.

Step 3: After a large statistical experiment for lots of images, the self-adaptation threshold was calculated as:

$$T = floor(t - 6 \times s) \quad . \tag{4}$$

After the threshold T was confirmed, the gray-scale image was converted into the binary image with the threshold T . However, the segmentation result only based on the threshold is still not ideal. Then we analyzed from a new point view of color features in original image. We found that the component G in color image is higher than 150 in disease spots. To clear image, the segmented images were negated. The pixel of grey-scale image which with a lower value than T and the component G in color image with a higher value than 150 was set to white, representing the disease region. On the contrary, the pixel was set to black, representing the surroundings. The component value G here 150 was based on experimentally obtained.

In the rice disease region, some holes might be found, so it could be filled. If some noises were still retained in the image, they would be removed by comparing noises area with the threshold value T . The threshold T determination based only on the pixel value in the gray-scale image, but not being set manually.

The gray-scale image in Figure 1(b) was segmented with the new threshold, and the study result is shown in Figure 1(c). The result implies that the proposed algorithm can get ideal segmentation results.

2.4 Segmentation Results Evaluation

In order to test the efficiency of the proposed algorithm which by grey-level 2G-R-B and the adaptive threshold, contrast with other experiments had been computed on the basis of the average values of features and adjacent regions [8]. Test data are shown in Table 1. The comparison between two regions R_j and R_k is calculated as following:

$$c_{jk} = \frac{|f_j - f_k|}{|f_j + f_k|} \quad . \tag{5}$$

Where f_j and f_k is the average gray level of each area. R_j represents disease area, R_k is the background region.

This is seemed to be which has a maximum accurate rate value between zero and one will be the best method. Based on the comparisons by Table 1, it is visibly known that, under the same experimental conditions, the accurate rate of proposed algorithm is about 92%.

Table 1. Contrast data of different methods

Method	2G-R-B	2g-r-b	1.262g-0.884r-0.311b
Otsu	41.67%	25.89%	23.93%
Proposed method	92.96%	64.48%	84.63%

3 Results and discussion

The proposed methods were applied on 300 infected rice disease images. Sample of acquisition images is shown in Fig. 1(a). From the Fig.1 (a) displayed, the rice disease image mainly consists of disease area and the surroundings due to the image was obtained in the RGB color model. The infected area and the rest region have great difference in color, so color was considered as the feature. The method emphasize G used to enhancing the comparison of background and target. A new adaptive threshold was calculated by the mean and standard variance of a gray image. Then combine with the green component in color images to segment disease. The new method this study proposed was satisfactory in detecting the disease region of the rice in Fig. 1(c).To measure the effectiveness of the proposed algorithm, a contrast study was carried out with the grey-level transformation and Otsu's methods. The result is visible in Tab.1

4. Conclusion

In this paper, an algorithm was completed to rice diseases segmentation. The method $2G-R-B$ grey-level transformation applied provides adequate contrast for disease region and background. The new threshold calculation could overcome the Otsu shortage.

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