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The Research on the Feature Extraction of Sunflower Leaf Rust Characteristics Based on Color and Texture Feature

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***Abstract*—In order to accurately identify and control the disease of sunflower, using the computer image processing technology to made a research on the common sunflower rust in the production. Will be collected under natural light conditions sunflower leaf disease image preprocessing, comparing of several common colorimetric system to HSI color characteristic parameters as a research field, and using color histograms distinguish lesions and normal leaf blades, and then after texture feature extraction and in-depth research on sunflower leaf diseases for a more accurate identification of diagnosis.**

Keywords—Sunflower Leaf diseases; Image preprocessing; Feature extraction; Disease recognition

I. INTRODUCTION

In order to improve the yield and quality of crops, as early as the 1980s the foreign began the study of crop images to identify disease diagnosis. For different optical filtering and spectral reflectance characteristics impact on the disease recognition, Yuataka Sasaki et al (1999) use Genetic algorithm to research cucumber anthracnose diagnostic recognition, and in 2003 by using of the genetic algorithms for multiple shapes of cucumber lesion images characteristic parameters were optimized, ultimately found a method can accurately and effectively identify different shape characteristic parameters of cucumber diseases [1] . Mohammad Sammany et al (2006) use genetic algorithms optimizing neural networks structure and parameters [2] , and its application to the study of crop diseases recognition diagnosis, getting a good recognition effect. Then to reduce the number of input feature vector and improve operational efficiency, adding a rough set technology, thereby shortening the time of disease diagnosis. Boese et al (2008) use eelgrass disease leaf pseudo-color image to calculate the lesion area, by a large number of experiments show that this method greatly improves the recognition rate of a variety of pests and diseases [3] .

In China, Mao Hanping (2001) mainly byextracting the color of tomato leaf nutrient deficiency, texture feature, establishing the trigeminal tree pattern recognition framework, and add fuzzy K-nearest neighbor method to identify the type of nutrient deficiency on the basis of the framework. Then they designed tomato nutrient deficiency identification system based on neural network technology and the correct recognition rate over 85% [4] . Hu Chunhua and Li Pingping et al (2004) analyzed and compared to normal cucumber leaves and iron deficiency, magnesium deficiency, nitrogen deficiency of cucumber leaf color feature of the color images are in RGB, HSV color space, etc., and give a different image characteristic for nutrient deficiency , the study found that using the relative difference between the percentage of the HSV color space H (hue) histogram, you can effectively determine the range of nutrient deficiency sick leaves [5] . Mao Wenhua, Chen Hong et al (2008) in a color image HSI color model, using S and H component histogram extracted lesion area after segmentation threshold, the color characteristics of different lesion was found as a basis to distinguish different diseases [6] .

II. RESEARCH PROGRAM

A. Equipment and Disease Image Acquisition

Image processing technology used MATLAB7.0 as a development language. Collection equipment consists of a CCD camera (to ensure the lesion blade has the best optical effect) and a metal tripod head photographic, under the field of natural light conditions, taking automatic exposure mode, shooting obtain sunflower growing leaf diseases images to JPG format incoming computer.

B. Image Preprocessing

Sunflower leaf disease image acquisition under natural conditions, in the process of collection and transmission, and may be affected by external factors cause image blur, degraded, affecting the accuracy of the subsequent identification of sunflower diseases. Therefore, follow-up work prior to disease diagnosis, first we must make the image enhancement and ensure easy to obtain the ideal image of sunflower diseases identified. As the threshold of this design is difficult to determined, so we use Otsu method automatically strike threshold in the process of image segmentation and Sobel operator for edge detection of image segmentation further.

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C. *Color Feature Extraction and Research*

The most direct visual features is color to describe the sunflower leaf diseases, color space use a mathematical method to visualize represented the color, the common color space is RGB, HSI, XYZ and so on. In the study of crop disease images mainly adopts RGB and HSI color model, sunflower disease leaf images collected in the natural environment which easily influenced by other external factors such as light (i.e, more sensitive to brightness), and each component of the RGB color model is closely related to the brightness(i.e, change image brightness R,G, B three-component also changed), thus it can be seen, the color characteristics of plant disease image can not be accurately expressed by the RGB color space . Compared with the RGB color model, HSI color model is more consistent with human visual characteristics, not only to avoid the influence of light and collection methods for diseases of different sample images, but can effectively reduce the loss of image color information of disease, and better reflect the lesion color characteristics, so this study will convert the image from the disease RGB color space to the HSI color space conversion is completed, extracting the three color components of HSI models as the main object of study for distinguish the different color characteristics of sunflower leaf lesions.

The HSI color space and the RGB color space is only the same quantity of two different representations, there are some conversion relations between them. If an RGB color image formats exist, to convert the image format to HSI conversion formula is as follows:

$$H=\begin{cases}\theta,(B\le G)\\ 360-\theta,(B>G)\end{cases} \qquad (1\text{–}1)$$

Here

$$\theta=\arccos\left\{\frac{\frac{1}{2}\left[(R-G)+(R-B)\right]}{\left[(R-G)^2+(R-G)(G-B)\right]^{1/2}}\right\} \qquad (1\text{–}2)$$

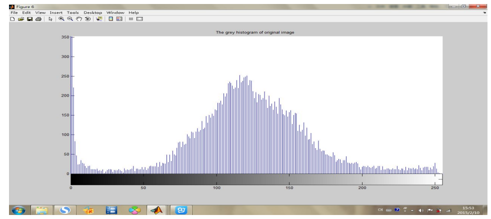
The saturation component is given by:

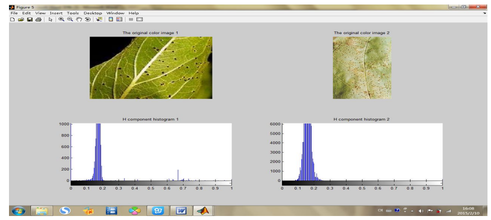
$$S=1-\frac{3}{(R+G+B)}\left[\min(R,G,B)\right] \qquad (1\text{–}3)$$

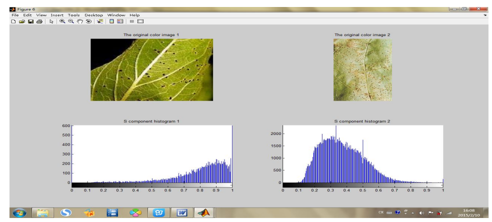
The last intensity component is:

$$I=\frac{1}{3}(R+G+B) \qquad (1\text{–}4)$$

Selected two sunflower leaf rust image color feature parameter comparison, by comparing H,S,I,the mean distribution of the three components, for the three color components and sunflower rust diagnostic studies ,shown in Fig.1.


Gray histogram of Leaves


H component histogram comparison


S component histogram comparison

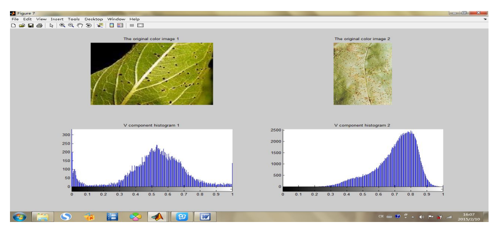

V componen histogram comparison

Figure. 1 Gray histogram of Leaves and H, S, V Comparison of each component

After checked the information and repeated experiments, we determined by the H component as a standard of color characteristic parameters, to measure the similarity. With a "y", "n" to judge whether they contain the disease, shown in Fig.2

Figure.2 color characteristic parameters determined whether they contain disease

D. Texture Feature Extraction and Research

The statistical method and the structure method are two main method to describe texture characterization. As the sunflower leaf texture is formed under the natural living environment, its texture on the individual pixels no rules to follow, but within an area pixel gathering will reflect regularity, which is a quasi-regular texture, not suitable for the method of use structure to describe. Therefore, this paper GLCM(Gray-level Co-occurrence Matrix) sunflower leaf spots texture analysis, comparative analysis to extract the best texture parameters as discrimination based on sunflower leaf texture recognition of different diseases.

As GLCM texture features can not be directly used to describe the image, so the statistics use the matrix condition, commonly used are the following:

1) Angular second moment (energy): reflects the image grey distribution uniformity and texture fineness.

$$ASM = \sum_{i=0}^{L-1}\sum_{j=0}^{L-1} P^2(i.j) \tag{1–5}$$

2) Moment of inertia (contrast): reflects the groove depth of sharpness and texture of an image.

$$ASM = \sum_{i=0}^{L-1}\sum_{j=0}^{L-1} P^2(i.j) \tag{1–6}$$

3) Relevance: reflects local gray image correlation.

$$COR = \frac{\sum_{i=0}^{L-1}\sum_{j=0}^{L-1} ij\overline{P}_{\delta}{}^2(i,j)\mu_1\mu_2}{\delta_1^2\delta_2^2} \tag{1–7}$$

Where μ_1、 μ_2、 δ_1^2 and δ_2^2 are defined as follows:

$$\mu_1 = \sum_{i=0}^{L-1} i\sum_{j=0}^{L-1}\overline{P}_{\delta}(i,j) \qquad \mu_2 = \sum_{i=0}^{L-1} j\sum_{j=0}^{L-1}\overline{P}_{\delta}(i,j)$$

$$\delta_1^2 = \sum_{i=0}^{L-1}(i-\mu_1)^2\sum_{j=0}^{L-1}\overline{P}_{\delta}(i,j) \quad \delta_2^2 = \sum_{j=0}^{L-1}(j-\mu_2)^2\sum_{i=0}^{L-1}\overline{P}_{\delta}(i,j) \tag{1–8}$$

4) Entropy is a measure of the amount of information of images having, expressed or complexity of the non-uniform grayscale image texture.

$$f_4 = -\sum_{i=0}^{L-1}\sum_{j=0}^{L-1}\overline{p}_{\delta}{}^2(i,j)\lg\overline{p}_{\delta}(i,j) \tag{1–9}$$

5) Local uniformity (inverse gap): reflects texture homogeneity measure of how much local variation in texture.

$$L = \sum_{i=0}^{L-1}\sum_{j=0}^{L-1}\frac{P(i,j)}{1+(i-j)^2} \tag{1–10}$$

The sunflower rust images are analysised and displayed as texture parameters. Study diseases were at a distance d = 1 and angle were 0o, 45o, 90o, 135o characteristic of GLCM features, and extracted from their horns, contrast, correlation, entropy, energy deficit a total of 20 statistic parameters for experimental research and analysis, shown in Fig.3.

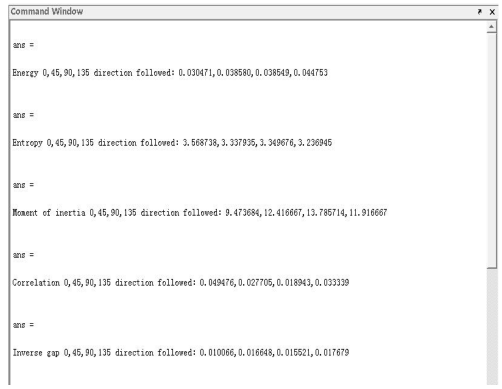


Figure 3. The texture feature parameters scope of sunflower leaf rust

E. Disease Recognition

Using the method of texture features to rust leaf graph parametric analysis, determining the approximate range of the containing rust texture parameter, for identification. The experiment recognition rate of 66.7%. While not all of the rust can be correctly identified, there are some errors, but you can better identify the disease leaf on the whole.

III. CONCLYSION

The study combined with biometric color, texture and other lesions when presented sunflower leaf disease, using advanced digital image processing technology to diagnose diseases of sunflower leaf identification; and MATLAB as a platform to achieve a sunflower leaf diseases image preprocessing lesion feature extraction and disease diagnosis, sunflower leaf rust eventually be identified. Concluded in the course of the study:

(1)Image preprocessing of sunflower leaf diseases. This article on the neighborhood after filtering, median filtering and vector median filtering method after a comparative analysis, median filtering method derived denoising better, it retains the original lesion useful information and the images are not blurred in the process. Using Otsu method automatically strike thresholds sunflower leaf lesion when the lesion segmentation segmentation and adopt edge detection method for fine segmentation.

(2)Lesion characteristics of sunflower leaf extract. Using color and texture features of disease, after multiple comparison test characterization elect six characteristic parameters (11 value) as the basis for the identification of different diseases. The results showed that six characteristic parameters chosen better able to represent the characteristics of sunflower leaf diseases.

(3)Identification of sunflower leaf diseases.By color,texture features obtained if they contain sunflower leaf rust.

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