

Research on Measurement Method of Plant Leaf Area Based on Gait Analysis and Digital Image Processing

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ABSTRACT. Plant leaf area is an important index for studying plant physiology and biochemistry, genetic breeding and crop cultivation techniques. To establish a convenient, rapid and accurate method for leaf area determination. The characteristics of existing methods for measuring plant leaf area are analyzed, and a digital image processing method for gait analysis is proposed to obtain leaf image. Based on this principle, a new method for fast acquisition of plant leaf image and accurate measurement of leaf area using digital camera is presented. Digital image processing technology, including template matching, sub-pixel and motion estimation technology, is used to identify and track the movement of markers. Using the corrected image to calculate the blade area, the measurement accuracy is improved. Studies have shown that digital image processing can accurately determine plant leaf area, which has the advantages of time saving and labor saving. Therefore, this method is worthy of promotion and application in the determination of plant leaf area. Provide reference for the development of plant leaf area measurement and blade image processing integration software..

KEYWORDS:GAIT ANALYSIS; DIGITAL IMAGE; PLANT LEAF AREA

1. Introduction

Leaf is an important photosynthetic organ and the main way of transpiration. The size of leaf area is very important for plant growth and development, crop yield and cultivation management [1]. Collecting a large number of functional leaves from plants for destructive measurement, which more or less caused a certain degree of damage to plants, and then affected the continuity of agricultural experiments [2].

Establishing a convenient, rapid and accurate method for measuring leaf area is helpful for adjusting population structure and making full use of light and heat resources to guide plant cultivation density and rational fertilization. Leaf area directly affects crop yield to a certain extent. Accurate measurement of leaf area is the premise of studying leaf area [3]. Since the area and the pixel of the entire image area, that is, the scan frame area, are known, it is known that the image of the blade in the scanned image can be calculated by the ratio of the scanning blade area. Leaf area determination is the basis for studying photosynthesis and material production of plants, and it is also the primary problem to be solved by studying physiological and biochemical indicators related to plant leaf area [4]. To this end, three different methods are applied (digital image processing) to highlight useful information in the image according to specific needs, while weakening or removing some unwanted information to improve image quality while ensuring the main optical axis of the camera. The blade plane is vertical, which greatly increases the difficulty of image collection of plant leaves, and the size of plant leaves is also limited to a certain range, especially for the picking measurement of leaf area [5].

Instead of fixing the area of each pixel, the area of a known area reference object located on the same plane with the same leaf is used as the reference area. Because the reference object is on the same plane as the plant leaf. Draw a box of known length and width on white paper. The lines should be clear so that the digital camera can clearly distinguish [6] after taking a photograph. The pretreatment process includes brightness, contrast adjustment and smoothing filtering of the image. Adjustment of brightness and contrast can make image features obvious and easy to recognize [7]. Although gait features have the advantage of no hindrance to movement, it is necessary to label the negatives manually one by one, and then input the coordinates of key points into the computer through digitizer [8]. In the determination of leaf area, although there are many methods to choose from, the methods vary in accuracy, ease of operation, level of equipment, cost, working environment, and condition requirements. Will affect the researcher's choice of measurement methods [9]. The rectangular area is used as the known reference area, and the image is geometrically corrected by extracting the vertices of the rectangular frame in the extracted image and the known actual vertex coordinates of the rectangle. Scan the acquired digital image application software for format conversion, binarization, vectorization, and the like. Influenced by the scanning quality of the platform scanner and the color depth of the scanning blade, the RGB values will be different at different positions of the background area and the leaf image area and the boundary between the leaf image and the background area in the scanned image. Therefore, the use of different tolerances and the separation of the blade image from the background will have a certain degree of influence on the number of pixel image pixels [10].

2. Materials And Methods

Edge detection is the most important basis in image analysis fields such as shape extraction of target area, so the accuracy of image processing software to obtain leaf

range depends on the degree of leaf edge detection. Only the blades are photographed or scanned to obtain digital images; then, in the software environment, batch processing can be carried out, and the coordinates of the landmarks in each image can be identified through image processing. With the coordinates of the landmarks, the kinematic parameters in the gait can be calculated, which greatly saves processing time. The error correction model is established and the correction formula of leaf area measurement based on smart phone azimuth sensor is proposed to correct the distorted image and improve the measurement accuracy. The number of pixels in the selected leaf image is close to the actual number of pixels, and the variation between different plants is very small. It can be applied to plants with large differences in leaf size, shape and color. In the case of a certain tolerance, the background color of the inverse selection method is only affected by the scanning quality, and the colors are relatively consistent. The number of selected leaf image pixels is closer to the actual situation. The results measured by different methods are significantly different, and the measurement results of the smaller area of the blade are larger, and the accuracy increases with the increase of the leaf area. However, it is not suitable for the surface with wrinkled leaves to be determined by digital image processing. The influence of the blade image selection method on the number of pixels is shown in Table 1. There is a slight difference in the number of pixels of the selected blade image by the positive selection method.

Table 1 The influence of blade image selection on the number of pixels

	Standard deviation	Coefficient of variation
Direct election	0.12	0.05
Reverse election	0.09	0.38

In order to measure the leaf area of various plants with different shapes and sizes, it is necessary to make a handheld standard table suitable for measurement according to the shape and size of plant leaves. A plane image in a computer is a group of pixels arranged in a network. The number of pixels per unit length is the resolution of the image. When shooting the image, the digital camera should be as far away from the measured blade as possible. The zoom function of the digital camera can make the image of the measured blade as large as possible, which is equivalent to shooting at the longest focal length, and the error will be effectively reduced. Marker recognition is the most important part of the whole system, because all the analysis is based on marker coordinates. After edge detection, the binary processing of digital image is carried out. By setting a threshold and taking the threshold as the threshold, the pixels of multi-gray level image are divided into two parts, that is, the set of pixels larger than the threshold and the set of pixels smaller than the threshold. If other software can be used to perform gait analysis on the obtained image, it is not necessary to consider the influence of tolerance and blade image selection on the number of pixels. Thereby, a large error is generated, the similarity of the pixel color channel and the threshold segmentation of the blade region obtained by the adaptive method, and the shadow portion pixels are separated to improve the measurement accuracy. Not affected by factors such as blade shape,

size, and thickness. Therefore, the application of digital image method to determine leaf area has broad application prospects in agriculture and forestry.

The actual area of a single pixel in a digital image is calculated according to the total number of pixels in the digital image and the size of the digital image set during scanning. Different selection thresholds significantly affect the measured values, so selecting the appropriate threshold size is the premise to maintain the accuracy and accuracy of the determination. The error increases with the increase of selection threshold. The approximate polygon of blade contour is extracted and divided into several sub-contours. The sub-contours between the whole blade and the damaged blade are automatically registered according to the shape criterion. Then the pixels of the blade image and the whole image area are counted by the histogram in the image menu, and the area of the unit pixel is calculated by the ratio of the scanning frame area to the whole image area. Then, the number of pixels in the blade image is multiplied by the area of the unit pixel to calculate the area of all kinds of scanned blades. When measuring with leaf area meter, it is found that the smoother the blade is, the smaller the thickness is, the higher the measuring accuracy is. The resolution of digital image processing system is one pixel. In fact, because of the continuity of the image, gait recognition can be used to achieve the accuracy below one pixel. Therefore, under the real area where each pixel point is known, the area of the blade can be found by calculating the number of pixels of the blade in the image. Multiple leaves can be measured at a time, and one leaf can also be determined. However, this method cannot measure a single area of a plurality of leaves at a time, and only the total area can be determined. At the same time, the boundary of the captured image is located on the rectangular standard area board. If the automatic processing is not met, the image is manually preprocessed, and the excess part is cut off before the automatic analysis and calculation.

3.Result Analysis and Discussion

Image processing method can be applied to almost all blades, and is not affected by the shape, size, thickness and other factors of the blade. Therefore, the matching search area does not need to be carried out in the whole image. Using the results of the previous image recognition to determine the search area of the current image can greatly reduce the computational complexity and improve the computational speed. When the difference between the area of reference object and the area of measured leaf is large, a slight error in extracting the image of reference object will cause a larger error in the area of measured leaf and affect the measurement accuracy. When the threshold value is 0% automatically, the influence on the measured values of different is very little. Click on the properties of the vectorized image to view the information contained in the vectorized image, such as polygon (blade outline) area, perimeter, and attributes. It has reference value for accurate determination of leaf area by digital image method.

Each pixel represents the real area and the number of pixels occupied by the image to calculate the area of the image. At present, the most advanced leaf area meter is to fix the area value represented by each pixel, that is, to sample after the

object distance is strictly fixed. Therefore, it is not applicable in systems with high real-time requirements. Usually, the chroma of an object is determined by the light absorption and reflection characteristics of the material that constitutes the object, and the brightness is obviously affected by the illumination and the angle of view, so it is more reliable to segment the image according to the chroma. Moreover, the spherical marking points in the field of view are circular in any angle, unlike the planar marking points, they will be deformed with the change of viewing angle. The digital image processing technology can determine the leaf area for almost all the leaves, and is not affected by the shape, size, thickness and other factors of the blade. It can realize non-destructive measurement. The image of the blade image and the scanning resolution obtained under different scanning resolutions are clear. The quantitative relationship. At the same scanning resolution, the difference in pixel of the scanned image of the leaves of different plants of the same area is extremely small. The relationship between the scanning resolution and the number of pixels of the scanning blade image is shown in Figure 1. However, when the data is measured, the measurement speed of the former is significantly larger than that of the latter. Therefore, in order to reduce the error, the digital image is analyzed according to the actual processing method and parameter setting.

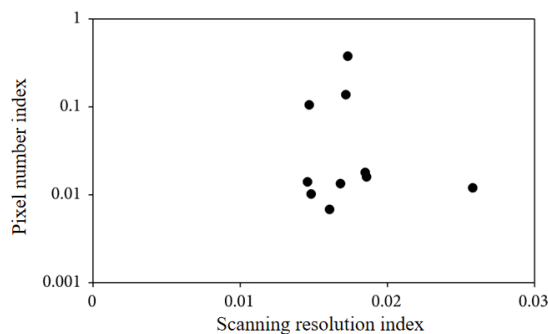


Figure. 1 The Relation between Scanning Resolution and the Number of Pixels in Scanning Blade Image

Mean value and variation coefficient of measured data are higher than those of fixed light intensity threshold correction and binarization, but there is little difference between fixed light intensity threshold correction and binarization. Image is an intermediate file, which is a necessary step before removal analysis. At the same time, data processing is automatically completed by computer, which avoids the influence and noise of human factors and reduces the labor intensity of operators. The blade digital image obtained by scanning is an image in a certain background. To obtain the pixels of the blade image, the blade contour selection must be separated from the background. In addition, the gray-scale digital image obtained by scanning can better reflect the external characteristics of original plant leaves, such as color, shape of leaf margin, etc. Each pixel is regarded as a point on the

coordinate, has a two-dimensional feature, traverses from the start point to the end point, and determines the attribution of the pixel according to the threshold. The ordinate change of the mark point is not very smooth, and the abscissa is relatively stable. It will not change until it starts to leave the ground, which is the step part of the abscissa curve, so we use the abscissa of the marker point as the basis for judgment.

4. Conclusion

In this paper, the measurement method of plant leaf area based on digital image processing based on gait analysis is studied. Computing process is automatically completed by computer. Complex functions can be achieved by setting and modifying attributes. Basic operations are similar to those described above. Expected purposes can be achieved by attributes, methods and events. Real-time, fast and accurate area measurement of various blades of different shapes and sizes in vivo or after harvesting can be carried out, and the original image of the measured blades can be retained. The size of leaf area is calculated by calculating the fractional proportion of leaf pixels under gait recognition. The data is measured and analyzed, and these results are superimposed on the true influence information of the subject, giving a more intuitive judgment. Especially for the treatment of irregular blades and incomplete leaves, the measurement results are more accurate and reliable. The leaf image is selected and separated, and then calculated to obtain the desired result. The data required for the test cannot be saved by this software. The digital image processing method is very suitable for plant leaf area measurement, and can realize rapid and batch operation and design. Software specifically designed for plant leaf area determination and with data retention capabilities will be of great significance.

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