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# Plant Leaf Contour Extraction

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## Abstract

**Plant leaf contour extraction technology is an important part of the field of plant image recognition. As plant image recognition plays an increasingly important role in scientific research and production, plant leaf image contour extraction technology will also usher in a period of development opportunities. Related research More and more abundant. We usually use a camera to take photos and then the staff identify the plant species. The identification of a large number of plant images has brought tremendous pressure to plant identification and classification personnel. If computer-aided processing and processing of plant images can be used, the objectivity and efficiency of classification will be greatly improved[1]. In this paper, the camera is often used to take photos of plants first, then go through grayscale, morphological processing, noise processing, edge detection, etc., and finally obtain the ideal leaf image through contour extraction.**

## Keywords

**Plant Leaves; Grayscale; Morphological Processing; Edge Detection; Contour Extraction.**

## 1. Introduction

The identification of plant species is the cornerstone of the work of protecting the ecological environment, but now the identification of plant species is mainly carried out by humans, the identification rate is relatively low and time-consuming, and the work efficiency is very low. The identification of plants requires considerable professional knowledge and a considerable accumulation of knowledge of plant species. In some cases, it is difficult for plant experts to accurately identify the types of plants. With the help of artificial intelligence, the computer can identify plants through pictures, and to identify a plant we will no longer have to go through a lot of information, we can directly use the computer to identify by obtaining pictures[2]. This is of great significance to the study of plants, so the extraction of the outline of plants is of great significance to the identification and research of plant species.

## 2. The process of extracting plant leaf contours

The leaves of different types of plants are very different, but the characteristics and textures of the leaves of the same species are very similar, including their shapes, textures, edges, etc. Therefore, we can use the characteristics of plant leaf images to identify and classify plant species. To achieve leaf contour extraction, it is first necessary to process multiple images of one or more types of plant leaves, and then extract features, which are sample features. The extracted features are classified to form a training set and a test set, and this sample set is used to complete the identification of plant leaves. Therefore, the key technology of plant leaf contour extraction based on leaf image features includes three parts: image acquisition, image preprocessing and image contour extraction[3]. The image preprocessing stage is to perform a series of grayscale, corrosion, expansion, noise removal, edge detection and other preprocessing operations on the original image according to the needs of the

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image during the later training of the leaves. The contour extraction conditions can be used as the final standard. Figure 1 shows the basic flow chart of herb leaf identification.

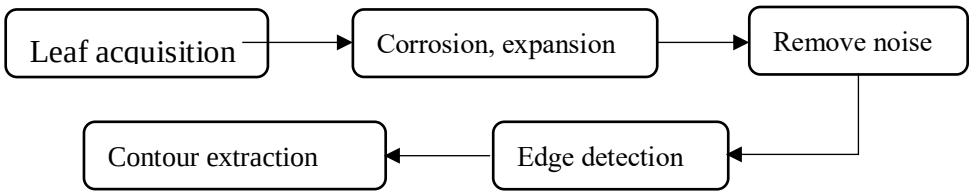


Figure 1 Flow chart of leaf contour extraction

## 3. Obtaining leaves

We use the camera to obtain the leaf image. The leaf image obtained by the camera can ensure the validity of the leaf veins, leaf color and other information, and retain the complete leaf pattern information to a large extent, but the external light is difficult to maintain when the image is obtained. The obvious difference in light and darkness brings difficulties to contour extraction, but a series of image processing can meet the requirements. This article focuses on extracting leaf contour features. There are no strict requirements on leaf veins and other texture information and color information. The use of a camera to collect leaf samples meets the standard of leaf image.

## 4. Pretreatment of plant leaves

Image preprocessing is a series of operations that need to be performed on plant leaves before contour extraction, including image grayscale, morphological processing, noise removal, edge detection and other processing. Its main purpose is to eliminate the influence of noise in the original image and useless information in the image, and to retain the leaf image containing the main features. The data set we collected is obtained by directly photographing plant leaves[4]. Affected by other factors such as lighting conditions and motion distortion, the quality of the acquired image is relatively poor and there will be a certain amount of noise. Therefore, we need to pre-process the plant leaves obtained by shooting[5]. First, extract the color characteristics of the herb leaves, and then preprocess the leaves to obtain the grayscale image and the binary contour image of the plant leaves. We take ginkgo leaves as an example for pretreatment, the original picture is shown in Figure 2.

Figure 2 Ginkgo leaves map

### 4.1 Graying processing

There are many pixels in the plant image, and the color of each pixel is determined by the proportion of the three primary colors of red, green, and blue. These three primary colors can be synthesized into any color. The plant leaf image contains a lot of color information, and the leaf image contains more colors. The brightness and darkness of the background often interfere with various features in the leaf image when taking pictures, which is not conducive to the feature extraction and analysis of the target

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image[6]. Therefore, color images are generally converted into grayscale images, which can greatly reduce the storage space of the image, and effectively reduce the noise of the image, make the characteristics of plant leaves clearer, and help better image contour extraction. Commonly used gray scale methods include component method, maximum value method, average method and weighted average method. Here, the weighted average method is used for calculation. According to the special importance of the R, G, and B components in the image, the appropriate weights are given to the three components of each pixel, and the R, G, and B are equal to the weighted average of their values. This average The value is the gray value of the pixel, and the algorithm is Y=(WrR+WgG+WbB)/3[7]. Among them, Wr, Wg, and Wb are the weights of the three colors of red, green and blue respectively. Since the sensitivity of human vision to these three colors is green, red, and blue in descending order, according to the different sensitivity of human eyes to these three colors, the three components of each pixel in the image are assigned With different weights, the sum of the weighted average of the three components is calculated as the gray value of the pixel. The gray-scale image obtained in this way is more reasonable and more in line with human visual experience[8]. Therefore, the weighted average method is better than other methods in processing effect, Y=0.183R+0.614G+0.062B+15.

### 4.2 Morphological processing

After gray-scale, the image of some leaves may have protrusions and depressions in the background. In order to avoid the influence on the subsequent extraction of leaf contours, it is necessary to perform morphological processing on the leaf image to remove noise and fill in the gaps. The basic operations of morphology mainly include corrosion and expansion. Among them, the erosion operation is to reduce or eliminate the pixels with high gray value in the edge of the image, so that the boundary shrinks inward. During the traversal process, the useless elements smaller than the structural elements are eliminated to eliminate the useless boundary points of the target object in the image. The expansion operation has the opposite effect of corrosion. It repairs the depressions on the boundary that are smaller than the structural elements, and fills in the boundary points on the edge of the image to expand the purpose. The border of the image. The sequence of execution of expansion and corrosion can form two different morphological operations: the process of first expansion and then corrosion is called closed operation; the process of first corrosion and then expansion is called open operation[9]. The closed operation and the open operation have different functions in the blade image processing. Because the closed operation can fill in small vacancies in the object, connect adjacent objects, and smooth the boundary. At the same time, the closed operation will not significantly change the area of the blade; while the open operation can eliminate small objects and smooth the boundaries of larger objects[10]. Significantly change the area of the leaves. So we use the open operation to fill the recesses in the leaf area of the binary leaf image. The morphologically processed image is shown in Figure 3.

Figure 3 Corrosion and expansion diagram

### 4.3 Remove noise

In the process of image collection, the quality of the captured images is not ideal and there is a lot of noise due to uneven lighting or interference around plant leaves. We need to reduce the noise of the leaf image after morphological processing. The noise of the leaf image is removed by noise reduction, and at the same time, it is necessary to ensure that the key information of the leaf in the image is not

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damaged, and the image contour extraction is not affected. Commonly used methods of noise reduction include mean filtering, median filtering and Gaussian filtering[11].

Median filtering is non-linear filtering. Its basic principle is to replace the pixel value of a point in the digital image with the median value of each point in a neighborhood of that point, so that the surrounding pixel values are close to the true value to eliminate noise points. , Is a classic method of smoothing noise.

Mean filtering is also called linear filtering, and the main method it uses is neighborhood averaging. Mean filtering has inherent defects. It cannot protect image details well. It also destroys the key information of the image while denoising the image, which makes the image blurry and cannot meet our requirements[12].

Gaussian filtering is a linear smoothing filter suitable for eliminating Gaussian noise. Gaussian filtering is the weighted average process of the entire image. The value of each pixel is obtained by weighted average of itself and other pixel values in the neighborhood. Compared with the mean filter and median filter, the smoothing effect of Gaussian filter is softer, and the edge preservation is better[13]. So we choose Gaussian filtering to reduce the noise of the leaf image, the formula is shown in Figure 4.

$$G(x,y) = \frac{1}{2\pi\sigma^2} e^{-\frac{x^2+y^2}{2\sigma^2}}$$

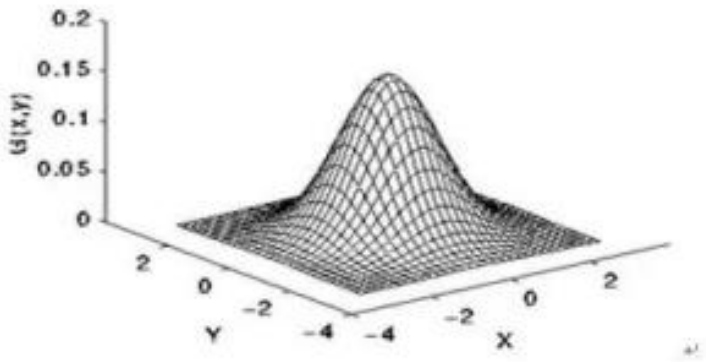


Figure 4 Gauss formula diagram

## 5. Edge detection

After the above series of processing, the leaf image has become an image that only includes the leaf area and background. At this time, the edge of the leaf area can be easily obtained by using the edge detection method. The purpose of edge detection is to detect points with significant changes in attributes in digital images, including depth discontinuities, surface direction discontinuities, and changes in color brightness and darkness. Commonly used edge detection operators include Roberts operator, Prewitt operator, Sobel operator, etc.

The detection result of Roberts operator is still relatively ideal. The image after noise reduction processing has continuous contour edges and relatively clear edge contours. Sobel and Prewitt operators can detect relatively smooth and regular leaf contours, but shadowed contours will also be detected. Such contour information will interfere with subsequent chain code operations on contour edges[14].

By comparing the performance of various commonly used edge detection operators, the blade profile to be obtained should retain the edge corners and edge lines as much as possible, and the more obvious the boundary, the better[15]. Because the image is processed by noise reduction, the Roberts edge detection operator with high positioning accuracy, fine detection edge, and fast detection speed is selected. The process of edge detection is shown in Figure 5.

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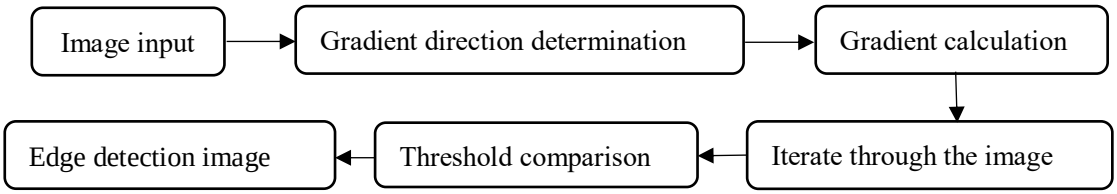
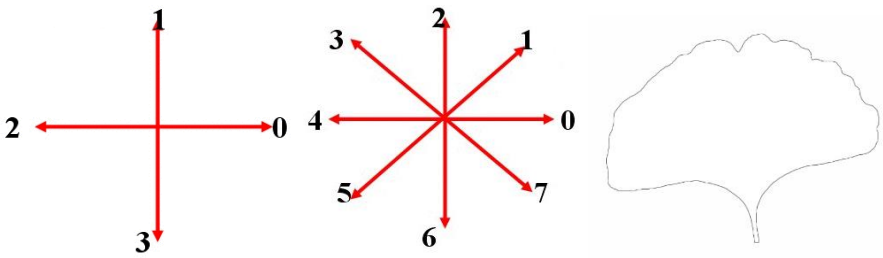



Figure 5 Flow chart of edge detection

## 6. Contour extraction

After the plant leaves undergo gray-scale processing, morphological processing, filter noise reduction and edge detection, the ideal image of the plant leaf image is obtained. If we perform contour extraction processing on the image of the entire blade, not only the effect is poor, it will also greatly affect the processing speed of the computer, and it will occupy the storage space of the computer and delay a lot of time[16]. Since the shape features of the leaves are all included in the outline of the leaves, the extraction of the shape features only requires the outline information of the plant leaves, so that the type of the plant can be identified.

Extracting the shape features of the plant leaf image is based on the chain code of the leaf contour, and the chain code method is used to obtain the contour of the herb leaf. Chain codes are divided into four-way chain codes and eight-way chain codes. Four-way chain codes use 0, 1, 2, 3 to indicate directions, and eight-way chain codes use 0, 1, 2, 3, 4, 5, 6, and 7 to indicate directions. direction[17]. The idea of chain code is to start from a pixel on the image boundary and traverse along the boundary of the image in a certain direction. Each step of the traversal is coded according to the chain code value corresponding to its direction, until the traversal back to the starting point. Coordinates and chain codes can represent the outline of the target image[18]. The four-way chain code and eight-way chain code direction symbols and the contour extraction results are shown in Figure 6(a)(b)(c).




a b c

Figure 6 Chain code and contour extraction diagram

## 7. Conclusion

After acquiring the image of the plant leaves and the gray-scale processing, the background of the image becomes more obvious, and then the image is corroded and expanded to make the missing or incomplete parts of the leaf image more perfect, and then go through Gaussian The filter removes Gaussian noise and makes the image clearer. Finally, the edge detection removes the irrelevant parts of the blade and retains those important parts. Finally, the contour extraction can obtain the required image. This is of great help to the researcher's manual identification. Improving the identification efficiency of plant species has great practicability.

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