Visual recognition system of cherry picking robot based on Lab color model

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Abstract. This paper designs a visual recognition system suitable for cherry picking. First, the system deals with the image using the vector median filter. And then it extracts a channel of Lab color model to divide the cherries and the background. The cherry contour was successfully fitted by the least square method, and the centroid and radius of the cherry were extracted. Finally, the cherry was successfully extracted.

1. Introductions
As the nutritional value of cherry is higher, the market demand for cherry is bigger and bigger, and there is more cherry planting area. So, cherry picking becomes an urgent problem to solve. Cherry picking robots have become a market demand because of the benefits of using robots for picking cherries. The picking robot has been developing rapidly in China for over a decade. In the literature of picking strawberries [1], it is proposed to mark the area of strawberry and then use Hough to recognize. In the literature of picking tomato [2], the local maximum value method and random ring transform detection circle algorithm are proposed to extract the target, and then the algorithm of surf algorithm is used to the target matching algorithm. In the literature of picking litchi [3], firstly, in order to improve the efficiency of the algorithm, the traditional Otsu algorithm is improved. Then, the improved Otsu algorithm is used to coarse segment and fine segment the target color image background, fruit stalk and fruit respectively. In the literature of picking kiwi fruit [4], the contour curve of a kiwi fruit was fitted by ellipse Hough transform, and the separation of adjacent fruits was achieved. In the literature of picking apples [5], a hybrid color space recognition method based on R / B value and V value is proposed. The literature of picking grapes presents a new method of picking points based on improved clustering image segmentation and point-line minimum distance constraint [6]. The literature of picking eggplant adopts automatic threshold method to segment EXG gray image [7].

With the deepening of artificial intelligence [8-14], the research of cherry picking visual system is more and more [15-17].

2. Visual recognition system

2.1. Vector median filter
For cherry color images, vector median filter is used [18]. The method is to represent any point in an image with the component of RGB. If you assume that a window has $m$ vectors, the median vector algorithm for this window is as follows [18].

1. If the direct distance from one vector in the window to another vector is $L_{ij}$, then

$$L_i = \sum_{j=1}^{m} \| X_i - X_j \|$$

2. By looking for the smallest value in $L_{ij}$, it is denoted as $L_{\text{min}}$.
3. The vector values corresponding to the $L_{\text{min}}$ are the vector median values of the filter window. The cherry image is processed by vector median filtering, as shown in figure 1.

![Figure 1. Image is processed by vector median filtering.](image)

As you can see from Figure 1, the background noise of the image is removed a lot, and the cherry color is bright.

2.2. $L a b$ color model
Lab color space was released in 1976, and it has L, a, b, which are 3 elements of the color space [19-22]. L represents brightness, a component means color range from dark green to gray to bright pink, and b component also indicates color range from bright blue to gray to yellow. The advantage of Lab is that it contains all the colors of RGB and can show the same color as the naked eye. It is wider than the RGB color and the CMYK color pattern. And it makes up for the uneven distribution of RGB color patterns and CMYK color patterns.

The image is processed by the $L a b$ color model a channel, as shown in Figure 2

![Figure 2: The image is processed by the $L a b$ color model a channel to extract the contour.](image)

The morphological operations and canny operator operations are performed on the obtained images [17], as shown in Figure 3.
2.3. Least square fitting circle

The least squares method [23] finds the matched function by minimizing the sum of the error squares. It is characterized by its sensitivity to noise and the simplicity of the algorithm. It can detect the center of the circle and the radius even if it is affected by noise.

As you can see from Figure 4, the contour of the cherry image is successfully fitted by the least squares method, and the radius and center of the image are found.
3. Conclusions
First of all, we apply color vector median filtering to remove the noise of the image. Then, through Lab color model a channel processing, we successfully extracted the color features of cherry images, and separated the cherry images from the background. Then morphological operations are performed to remove the external noise of cherry and canny operator is used to extract the contour of cherry image. Finally, by using the features of the round shape of cherry images, the circle contours are successfully fitted by the least square fitting circle, and the cherry radius and centroid are successfully found. Finally, cherry images are successfully recognized.

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