Research on image processing based on pattern recognition

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Abstract. Image processing is to transform the image into digital matrix by mathematical formula, then store the data in the computer, and enhance the source bitmap by computer, including gray-scale processing, median filtering and binarization. Then the image is cut, including contour edge processing, seed filling and so on. In this paper, the image is recognized and processed based on pattern recognition, and then a pre classifier is designed to build a system model of fruit intelligent classification. After the fruit is taken by industrial camera, the corresponding image processing and feature value extraction are carried out. Then the extracted eigenvalues are used for classification. Through this method to achieve a variety of fruit classification effect.

1. Introduction

The essence of the mode is to distinguish the type of the mode and the expression of the clear mode, then input the digital signal into the computer, and judge the category of the mode by the computer[1]. Five problems must be solved in pattern recognition: digitalization of pattern, selection of pattern characteristics, expression of feature, expression of pattern class and determination of decision mode. Because the fruit can be distinguished and its characteristics can be defined by pattern recognition, the fruit can be classified into a certain category by the features identified by pattern recognition, which can meet the requirements of the system for fruit classification. At the same time, the accuracy of classification by pattern recognition is higher and the time of classification is shorter. After comprehensive analysis, this paper uses pattern recognition to classify fruits intelligently.

2. Image acquisition and preprocessing

Image enhancement is the first step in image processing. Generally, image recognition can only be carried out after image eigenvalue enhancement. When the image is taken, the data of the intake image is often missing, which leads to the reduction of the image. For example, to extract the shape and size of the image, the image edge missing can’t meet the requirements, so image enhancement is needed. Image enhancement is to enhance the image taken and the required features, and reduce the unnecessary features, so that the computer can read and process the image. Because the environment of the captured image is unknown, the image is processed by linear gray level before eigenvalue extraction. In the darker environment, the gray level of the image will be very low. What the human eye observes is a blurred, layered image. In order to solve the problem of restoring degree of the captured image, the single-valued linear function can be used to expand each element in the image.
After gray transformation of source bitmap, the gray range of original image $f(m, n)$ changes from $(a, b)$ to $(c, d)$ of image $g(m, n)$. The relationship between $F(m, n)$ and $G(m, n)$ is as follows:

$$
g(m, n) = \begin{cases} 
  c & f(m, n) < a \\
  c + \frac{c-d}{b-a} (f - a) & a < f(m, n) < b \\
  d & f(m, n) > b
\end{cases}
$$

![Figure 1. Original image](image1.png)

![Figure 2. Gray level processing result graph](image2.png)

3. Binary processing

Noise, target object and target background together constitute an image. If we want to extract the object directly from the image, we must weaken the influence of background and noise. So we set a threshold $T$ to divide the image into two parts: the part greater than the threshold $T$ and the part less than the threshold $T$. If the part greater than the threshold $T$ is set to white, the part less than the threshold $T$ is set to black. Correspondingly, if the part greater than the threshold $T$ is set to black, the part less than the threshold $T$ is set to white. Because the image is only segmented by a threshold $T$, there will be obvious defects in image details and the image display is not accurate. Local binarization is just to improve this defect. The way to realize local binarization is to divide the whole image into innumerable small windows according to certain rules. By setting a threshold, the elements in one window of innumerable small windows are divided into two parts, which are greater than and less than the threshold, and then binarized.

![Figure 3. Binary Result Graph](image3.png)
4. Image Segmentation

Image segmentation is a process and method to segment the captured image into innumerable unique parts and extract the required features\(^4\). In image processing, we often only need to extract a part of the image characteristics, they are often special in the graphics, there is a certain range of areas. In order to recognize and analyze the target more accurately, we need to cut the specific area and extract the required features\(^5\).

\[
\bigcup_{i=1}^{n} R_i = R \quad (2)
\]

\[
I = 1, 2, \ldots, N, \quad P(R_i) = \text{TRUE} \quad (3)
\]

\[
i \neq j, P(R_i \cup R_j) = \text{False} \quad (4)
\]

\[
i = 1, 2, \ldots, N, \quad R_i \text{ is a connected region} \quad (5)
\]

5. Corrosion Extraction

When a binary segmentation image is obtained after threshold segmentation of the processed image, there are holes in the image center due to the loss of data when it is cut, and there are bumps and pits around the image, which affect the accuracy of the perimeter and area to be extracted\(^6\). Therefore, in order to make image data more reliable, before extracting fruit morphological features, it is necessary to corrode the binary image in order to reduce the error caused by this kind of noise. The method used is quadratic square operation. The valid data show that the square root operation can effectively improve the accuracy of Fruit Morphological characteristics, so it can improve the classification accuracy of fruit. Suppose there is a foreground object in the original image, traversing every pixel of the original image, then aiming at the currently traversing pixel with the central point of the structural element, and then taking the minimum value of all the pixels in the corresponding area of the original image covered by the current structural element, replacing the current pixel value with the minimum value. The effect of corrosion seems to be to make the foreground object shrink in a circle. For some small connections in the foreground object, if the structural elements are equal in size, they will be disconnected.

![Figure 4. Image Segmentation Result Graph](image1)

![Figure 5. Image Segmentation Result Graph](image2)
6. Eigenvalue extraction

After image enhancement, gray level change and binarization, the image will be further processed, that is, image analysis. By inputting the processed image data which can be read by the host computer into the computer, the information needed in the image is transformed into digital features, and the information of the image is expressed by digital features, thus the image is recognized. Because the upper computer can only read digital signals, but can’t read analog signal, so in order to process image through the upper computer, some mathematical algorithms must be used to transform the features of the image into signals that the upper computer can read and analyse\(^6\). In this way, the computer can process graphics and become image recognition. In order to make the computer recognize the image, the first step is to extract the eigenvalues of the image. The eigenvalue of an image is the intrinsic property that distinguishes the image from other images. It can be divided into natural features that can be observed and human features that can be observed only through calculation. Natural features include: color, brightness, contour, texture. Human characteristics include spectrum, histogram.

7. Classifier settings

Artificial neurons can be regarded as a non-linear threshold device, and input multiple values to the artificial neurons at the same time, and ultimately only output one result. Here X1, X2,...,Xn denotes its n inputs, W1, W2,..., Wn denotes the weights. \(\sum WiXi A\) is the activation value.

\[
O = f(\sum WiXi - \theta)
\]

Among them, O represents the output value; theta represents the threshold value of the artificial neuron, and if the activation value of input \(\sum WiXi A\) is greater than the threshold value, the artificial neuron begins to work.

When neural networks are used in pattern recognition, input neurons are used to input eigenvectors of patterns or patterns. Generally speaking, neural network pattern recognition is divided into two stages: recognition and training. There are many kinds of models of artificial neural network, among which feedforward neural network is often used in neural network system because of its simple...
structure, short training time and quick response. Feedforward neural network system is more suitable in the following two situations: 1. Input value is eigenvector; 2. BP network. Each input node represents a target feature, and the corresponding classification result is the network output value. According to the number of nodes, it can be divided into multi-output and single-output.

In this experiment, a single output model is used for classification. There is no middle layer in the network system. A single output model is used to construct a classifier to classify fruits twice. The first one is to extract the perimeter of fruit and classify the fruit into three grades: small, middle and big. After extracting the eigenvalues into the computer, the system automatically reads the eigenvalues and directly outputs the corresponding grades of fruits. The second is to extract the color of fruit and then further classify the fruit into two categories: qualified color saturation and unqualified color saturation. When the color saturation of fruit is qualified, the output is 1, and when the color saturation is unqualified, the output is 0. The quality of fruit was accurately judged by two classifications.[3]

8. Simulation analysis
The following is the final result of image capturing, gray processing, binarization, image segmentation and corrosion processing using Matlab. The final image features are fed into a pre-set classifier, and the image is classified by the classifier.

9. Conclusion
This paper introduces the basic method of fruit intelligent classification system based on pattern recognition and the simulation of image processing results by using MATLAB[7]. It mainly creates a
simple fruit intelligent classification system through pattern recognition and image processing. It takes images under the same conditions, and then extracts them through image enhancement, image segmentation and image eigenvalue extraction. The eigenvalues are sent to the classifier for judgment, and the final judgment results are output. This method is used to achieve the purpose of intelligent classification of fruits.

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