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APPLICATION OF OTSU SEGMENTATION ALGORITHM BASED ON SIMILARITY IMPROVEMENT IN FABRIC DEFECTS

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ABSTRACT

In order to improve the segmentation result of fabric defect image, an Otsu segmentation algorithm based on similarity improvement is proposed. Firstly, by comparing the median filtering and Gaussian filtering, the average filtering with better filtering effect is used to filter the fabric defect image, which reduces the influence of noise on the segmentation result, and effectively suppresses the interference of the background texture of the fabric defect image; Then, by the histogram analysis of the fabric defect image, for the classical Otsu segmentation algorithm has no better segmentation result of the single-peak type fabric defect image, the threshold is adjusted by calculating the similarity between the segmented defect image and the original defect image, enhancing the ability of the Otsu segmentation algorithm to adapt the single-peak type images. Experiments show that the Otsu segmentation algorithm based on the similarity improvement has better segmentation results for the single-peak type fabric defect image, and can also obtain better segmentation results for the bimodal type fabric defect image, which has certain reference value in the fabric defect research.

KEYWORDS

similarity, Otsu segmentation method, mean filtering, fabric defect, histogram single, peak

INTRODUCTION

There are many types of fabric defects, such as weft, hair spots and hole-drawing, discriminating the type of fabric defects has always been an in-depth study of the textile industry. The discrimination of the type of defect is affected by many factors, among which the texture of the fabric and the background pattern of the fabric have great affection. Nowadays, the detection of defects in China is mainly done by human eyes, it is high that the false detection rate and the missed detection rate with human eyes, and the high temperature, high noise and cotton dust of the cloth inspection workshop are very harmful to the body of the cloth inspection workers. Therefore, the automatic identification technology of the defects is studied, it has profound significance to the textile industry [1]. At present, the detection of fabric defects is mainly carried out by wavelet transform, neural network, gray level co-occurrence matrix method and Fourier transform method [2], but the threshold segmentation algorithm is simple and classic, has high scalability and can be combined with various algorithms, therefore it has research value.

Image threshold segmentation refers to segmenting a desired target from the image by selecting a certain gray level, and processing it into a binary image to highlight the target region [3]. Threshold segmentation algorithms mainly include Otsu method, improved Otsu method, local threshold segmentation algorithm, and image maximum entropy threshold method[4]. The threshold segmentation algorithm can also be extended from one dimension to two dimensions to obtain better segmentation results[5], Renzhong Li et al conducted related research.
A grayscale image, if corresponding to each gray value, counts the number of pixels basing on the gray value, and then draws the pixel number-gray value pattern, which is the gray matter histogram of the image, referred to as the histogram [6]. Through the histogram, the distribution of the gray value of the image can be seen clearly, which is convenient for analysis and research.

When the histogram shows a peak fluctuation, we call it a single peak type image; when it presents two peak fluctuations, we call it a double peak type image; when it presents multiple peak fluctuations, we call it a multimodal type image. The traditional Otsu segmentation method automatically determines the threshold according to the variance between classes, which has a good segmentation effect for the bimodal type image, but it is incapable for the single modal type image[7].

THE PROBLEM OF THE TRADITIONAL OTSU SEGMENT ATION METHOD

The processing of the traditional Otsu method

Firstly, the gray image of the fabric defect image in the experiment is processed to facilitate filtering and segmentation in the subsequent experiment.

Secondly, the histogram analysis of the gray defect image of the fabric is performed to observe the distribution characteristics of the histogram. The histogram can be used to visually see the distribution of the pixel values of the fabric defect image, which has certain reference value for the selection of the threshold.

Some of the fabric defect image histograms are generally single-peak type, and some are generally bimodal; from the histogram curve with roughness, it can be seen that the fabric defect image has noise influence.

The traditional Otsu segmentation algorithm can't distinguish the defect from the background texture well for the single-peak type fabric defect image, and the image segmentation result of the double-peak type fabric is also lacking.

EXPERIMENTAL RESEARC

Data source

The data used in this paper is from the XUELANG AI Challenge Vision Computational Aided Quality Test Database. The database contains a variety of defect images, such as hole, freckle and latitude. This paper selects some screenshots of the defect image with obvious effect, intercept size is 256 × 256 pixels.

Experimental process

Firstly, grayscale processing is performed on the image of the intercepted fabric to facilitate subsequent experiments. Secondly, the histogram is equalized on the grayscale image to equalize the brightness of the image, and then the grayscale image is filtered to eliminate the influence of noise on the segmentation result. Three filtering methods, median filtering, Gaussian filtering and mean filtering, are selected to filter the fabric defect images respectively.

Mean filtering is relatively effective, so this paper uses mean filtering as the de-noising algorithm in the preprocessing stage.

Finally, the Otsu segmentation based on the similarity improvement is performed on the image after preprocessing, and the experimental results are obtained.

Otsu segmentation algorithm based on similarity improvement

Given two images a and b, the similarity of the two images can be found according to the following formula:

$$SSIM(a,b) = \frac{(2\mu_a\mu_b + c_1)(2\sigma_{ab} + c_2)}{(\mu_a^2 + \mu_b^2 + c_1)(\sigma_a^2 + \sigma_b^2 + c_2)}$$

Where, μ is the average, σ^2 is the variance, and σ the covariance,c $1=(k\_1\ L)^2$,$c_2=(k^2\ L)^2$ is the constant used to maintain stability, L is the

dynamic range of the pixel value, $k_1 = 0.01$, and $k_2 = 0.03$. The range of similarity is from -1 to 1, the closer to 1, the higher similarity between the two images.

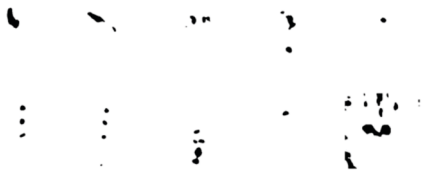

Figure 1.The segmentation result of algorithm in this paper

EXPERIMENTAL RESULTS AND ANALYSIS

The Otsu segmentation algorithm based on the similarity calculation can realize the threshold automatic adjustment of the single-peak type fabric defect image.

It can be seen from Fig. 1 that the Otsu segmentation method based on the similarity improvement has better segmentation results for the single-peak type fabric defect image, and also has better segmentation results for the multi-peak type fabric defect image.

IN CONCLUSION

For the image of the collected fabric, firstly, the size of the experiment needs to be intercepted, and the grayscale processing is performed; then the histogram equalization of the gray defect image of the fabric is improved to better the illumination imbalance problem in the process of collecting the image of the defect, which is convenient for the follow-up experiment; the mean value filtering of fabric defect gray image is performed to eliminate the influence of Gaussian noise and suppress the interference of fabric background texture; finally, the preprocessed image is segmented by Otsu segmentation algorithm based on similarity improvement. Experimental results show that the Otsu algorithm based on the similarity improvement not only has a better segmentation result for the unicycle type fabric defect image, but also has a certain improvement on the bimodal type fabric defect image segmentation result, but the Otsu algorithm based on the similarity improvement lacks certain practicability, it can't be directly applied to the automated processing of fabric defect detection, further research is needed.

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