Computer Image Processing System Based on Feature Extraction Technology

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Abstract. This article studies the methods of computer image acquisition, processing and recognition. The study found that the images collected from the computer image processing system often have blurring phenomenon. For this reason, the paper proposes a wavelet transform feature extraction algorithm based on colour images, which can separate the image and the background without greying the colour image. Through experimental research, it is found that this method can efficiently and quickly solve the problem of automatic image registration.

1. Introduction
Today's social information is growing rapidly in an explosive manner, and the types are increasing. How to obtain the required information from massive data has become increasingly important. Colour is an important attribute of an image, it usually has a certain stability to the geometric deformation of the image; texture is usually defined as a certain local property of the image, which is a quantitative description of the spatial information distribution of the image [1].

In the three basic low-level image content of colour, texture, and shape, texture features are very important. Although this algorithm has high accuracy in retrieving texture images, the Gray-level co-occurrence matrices generated are generally sparse matrices, which leads to a lot of redundancy in eigenvalue calculations [2]. The image classification part proposed in this paper adopts the feature algorithm based on wavelet transform, and finally realizes the computer image classification.

2. Wavelet transform feature extraction algorithm for dynamic blurred images
Figure 1 is a general model of image degradation, which is universal for most degradation processes. In the model, the degradation process is modelled as a system (or operator) \( h(x, y) \). The expression is as follows:

\[
g(x, y) = H[f(x, y)] + n(x, y)
\]
There are many classification methods of image restoration technology, so under the conditions of a given model, image restoration technology can be divided into two categories: unconstrained and constrained. The degraded image \( g(x, y) \) is convolved with the restoration filter \( m(x, y) \) to obtain the restored image \( f'(x, y) \).

\[
n = g - Hf
\]  

(2)

The inverse filtering method belongs to unconstrained restoration; Wiener filtering belongs to constrained restoration. \( T \) is the length of acquisition time. The actually acquired blurred image \( g(x, y) \) caused by motion is:

\[
g(x, y) = \int_0^T f[x-x(t), y-y(t)]dt + n(x, y)
\]  

(3)

This is a basic model of dynamic blurred images. Let us first consider the situation where there is no noise. We set the noise \( n(x, y) = 0 \), and the Fourier transform obtained from the formula (3) is:

\[
G(u, v) = \int_{-\infty}^{\infty} \int_{-\infty}^{\infty} g(x, y)e^{-j2\pi(ux+vy)}dxdy
\]  

(4)

Changing the order of integration can be expressed as:

\[
G(u, v) = \int_0^T \left[ \int_{-\infty}^{\infty} \int_{-\infty}^{\infty} f[x-x_0(t), y-y_0(t)]e^{-j2\pi(ux+vy)}dxdy \right]dt
\]  

(5)

The integral term in the outer brackets is the Fourier transform of the permutation function \( f[x-x_0(t), y-y_0(t)] \). If the motion of the image is a uniform linear motion in the direction of \( x \) and \( y \), and the rate is \( (v_x, v_y) \), then \( (x_0(t), y_0(t))=(at/T, bt/T) \). The degradation function is a key step for image restoration. After understanding the degradation function, two restoration methods can be used to restore the dynamic blurred image caused by uniform linear motion.

### 3. Filter processing of binary image after denoising and separation

After the filtering operation of the crop line, there will be some granular point noise in the binary image. If it is not removed, it will have an impact on the image retrieval calculation. Therefore, it is
necessary to denoise the binary image after image separation [3]. When removing noise, the methods of true colour image, Gray image and binary image are not the same. The noise removal of binary image mostly adopts the method of removing noise points. In this experiment, two denoising methods are used to filter out the noise of the binary image.

3.1. Mathematical morphology method to filter out binary image noise

Mathematical morphology is a mathematical method for analysing geometric shapes and structures. It is based on set algebra and is the science of quantitatively describing geometric structures using set theory. The following are the expression formulas for corrosion, expansion and opening operations:

\[
A \oplus B = \left\{ z \mid (\hat{B})_z \cap A \neq \emptyset \right\}
\]

(6)

For the sets \( A \) and \( B \) in \( z^2 \), use \( B \) to corrode \( A \), which is defined as

\[
A \ominus B = \left\{ z \mid (B)_z \subseteq A \right\}
\]

(7)

Use the structural element \( B \) to open the set \( A \), that is, first use \( B \) to corrode \( A \), and then expand the result of \( B \), which is expressed as:

\[
A \circ B = (A \ominus B) \oplus B
\]

(8)

The image obtained after binary processing contains many isolated noise points. We can use the open operation in mathematical morphology to remove the residual isolated noise points in the binary image, and only keep the image we are interested in smoothing [4]. As shown in Figure 2, the open operation of mathematical morphology removes the particle noise in the image, but there will still be a little residual noise that has not been processed. Therefore, the experimental system did not choose mathematical morphology as a method of de-manipulation of binary images.

![Figure 2. Using mathematical morphology to remove image noise](image_url)
3.2. Scan line algorithm filters out binary image noise
Due to the consideration of the efficiency of image denoising processing, this paper adopts the scan line algorithm to remove the noise of the binary image. If the area is less than R, then immediately clear and delete related resources [5]. The algorithm avoids repeated detection by detecting line by line, and can fill in quickly, so as to meet the real-time requirements in noise processing. Figure 3 shows the image after the binary image noise is removed by the scan line algorithm.

Figure 3. Scan line algorithm to remove image noise

3.3. Computer image area and centre of gravity location feature acquisition
Define the area of the target in the binary image as \( A \) and the size of the target \( b(x, y) \) as \( M \times N \).
For the binary image \( b(x, y) = 1 \), its area \( A \) can be found by counting the number of pixels belonging to this pattern.

Calculation of area centre:

\[
A = \sum_{x=0}^{M-1} \sum_{y=0}^{N-1} b(x, y)
\]

(9)

Calculation of the regional centre of gravity: Since the image always occupies a certain position, usually more than a single pixel, the precise position of the image is generally determined by the centre of gravity and then the operation is performed. The regional centre of gravity is a global descriptor, and the coordinates of the regional centre of gravity are calculated based on all the points belonging to the region:

\[
m = \frac{1}{MN} \sum_{x=1}^{M} \sum_{y=1}^{N} xb(x, y)
\]

(10)

\[
n = \frac{1}{MN} \sum_{y=1}^{N} \sum_{x=1}^{M} yb(x, y)
\]

(11)
4. Image processing and detection experiment design
The paper uses Java to design and develop an image retrieval system. The system consists of image reprocessing, feature extraction, feature matching, display and other modules. The system block diagram is shown in Figure 4. The test image library used is composed of 100 real-colour images downloaded from the Internet, including 6 groups of related images: modern villas, roses, blue sky, woods, sunset, and zebras.

![Image Retrieval System Block Diagram](image)

**Figure 4.** Block diagram of image retrieval system

For comparison, the block-accumulated histogram method, the Mallat algorithm of classical wavelet analysis, and the Gray-level co-occurrence moment method are also tested. Among them, the block strategy and weight of block accumulation co-occurrence moment method and block Mallat algorithm are the same as block lifting wavelet. Here we select the first 12 images that are the closest to the example image for investigation [6]. The main frequency of the computer's CPU is 2.94GHz, and the memory is 512MB. Table 1 shows the experimental results of extracting colour features using three methods: block accumulation histogram, block Mallat algorithm and block lifting wavelet. Table 2 shows the experimental results of using Gray-level co-occurrence moment method and lifting wavelet method to extract texture features.

| Method                          | Recall rate (%) | Precision rate (%) | Query time (seconds) |
|--------------------------------|-----------------|--------------------|----------------------|
| Block lifting wavelet          | 75.00           | 62.50              | 9.825                |
| Block cumulative histogram     | 71.66           | 59.72              | 7.989                |
| Blocked Mallat algorithm       | 75.00           | 62.50              | 17.215               |

**Table 1.** Experimental results of image retrieval based on colour features

| Method                                        | Recall rate (%) | Precision rate (%) | Query time (seconds) |
|-----------------------------------------------|-----------------|--------------------|----------------------|
| Lifting wavelet                               | 73.33           | 61.11              | 10.119               |
| Gray-level co-occurrence moment               | 73.33           | 61.11              | 12.846               |

**Table 2.** Experimental results of image retrieval based on texture features

It can be seen from Table 1 that the recall rate of the block-boosted wavelet is 4.66 percentage points higher than that of the block-accumulated histogram. Compared with the classic wavelet analysis Mallat algorithm, the query time used by the Mallat algorithm is 1.752 times that of the boosted wavelet algorithm. It can be seen from Table 2 that the recall and precision of the method of extracting texture features by lifting wavelet is no less than that of the classic Gray-level co-
occurrence moment method, and the average query time is shortened by about 1/ compared with the Gray-level co-occurrence moment method. 6.

5. Conclusion
This paper first studies the extraction method of image colour and texture features based on the lifting wavelet transform domain, and proposes a colour feature extraction method based on a binary algorithm. This method divides the image into several according to the degree of human eye attention to different areas of the image. In the area block, the colour features of the low frequency sub bands of the wavelet decomposition of the HSI component of each block are extracted. Experiments confirm that the algorithm proposed in this paper improves the retrieval accuracy of computer images.

References
[1] Echegaray, S., Bakr, S., Rubin, D. L., & Napel, S. Quantitative Image Feature Engine (QIFE): an open-source, modular engine for 3D quantitative feature extraction from volumetric medical images. Journal of digital imaging, 31(4) (2018) 403-414.
[2] Liu, L., Li, C. F., Lei, Y. M., Yin, J. Y., & Zhao, J. J. Feature extraction for hyperspectral remote sensing image using weighted PCA-ICA. Arabian Journal of Geosciences, 10(14) (2017)1-10.
[3] Yildiz, K. Identification of wool and mohair fibres with texture feature extraction and deep learning. IET Image Processing, 14(2) (2019) 348-353.
[4] Zhu, H., Xu, Y., Cheng, Y., Liu, H., & Zhao, Y. Landform classification based on optimal texture feature extraction from DEM data in Shandong Hilly Area, China. Frontiers of Earth Science, 13(3) (2019) 641-655.
[5] Damayanti, F., Herawati, S., Ayu, F. M., & Rachmad, A. Indonesian license plate recognition based on area feature extraction. Telkomnika, 17(2) (2019) 620-627.
[6] Budiman, F., & Sugiarto, E. Image Feature Extraction of Numbers and Letters Using Matrix Segmentation. Научная визуализация, 12(1) (2020) 120-131.