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Clothing Style Recognition Method Based on Digital Image Processing

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Abstract: *The use of digital image processing technology to identify clothing styles from clothing images has broad application potential in clothing consumption analysis, auxiliary clothing design and identity recognition. In the current clothing style recognition field for feature extraction and classification of clothing contours, the main methods are extreme learning machine classification based on wavelet Fourier descriptor, and Euclidean distance classification based on fusion features. However, these methods also have some shortcomings. Currently, there is still no effective method to extract features and classify clothing contours. In order to solve this problem, this paper is based on the SVM classification method of Fourier contour description features. The contour curvature characteristic point in the figure can be described as the bending characteristic of the clothing contour curve, and its calculation is simple and intuitive, which improves the judgment effect of the similarity performance of the Hausdorff distance. This paper constructs a multi-resolution framework of the new image, uses edge detection algorithms to obtain the edges of each level of resolution image, and expands them into narrow edge bands, and combines the point distribution model with the edge narrow bands obtained by edge detection to perform multi-resolution image ASM search for. This paper proposes an image fusion algorithm based on algebraic multigrid and adaptive block. Because the coarse grid extracted by the algebraic multi-grid method can extract the detailed information of the image to a certain extent, the original image can be reconstructed from the grid data. Experimental research shows that from the overall recognition rate of various clothing styles, the Fourier descriptor has a high recognition rate for each clothing, and the stability of multiple experiments is also good.*

Keywords: *Digital Image Processing, Clothing Style Recognition, Edge Extraction, Contour Curvature Feature Points*

1. Introduction

With the improvement of people's living standards, the pursuit of human clothing has also undergone major changes. Clothing has transformed from the basic necessities of life to cover the body and avoid shame into the signs of fashion and identity. Therefore, improving people's satisfaction with clothing through technological innovation has become a current development trend.

Nowadays, the research on the recognition method of digital image processing is welcomed by the majority of scientific researchers. For example, Ma mainly studies the simulation of concave-convex carving on different fabrics with cartoon characters such as Hello Kitty as direct patterns. Both vivid characters and fabrics with different materials and textures have undergone a spectral reconstruction process to integrate the beneficial characteristics of both parties. This article also combines image processing technology with computer simulation technology, and sets cartoon elements as one of the popular culture labels. Its application in clothing is consistent with modern fashion trends, so it has had a profound impact in this field [1]. Malkani proposed a new hairiness detection method based on video microscope combined with image processing technology, and used MOTIC SME-140 video microscope to capture yarn images and then processed them. Carry out gray scale conversion, image segmentation, morphological opening and image thinning processing in turn [2]. Manikandan discussed the relationship between clothing elongation and fabric tension. Digital image processing technology is used to obtain images of clothes and measure the elongation of fabrics. The research uses digital image processing techniques, such as image binary conversion, noise point deletion, smoothing of fringe edges and measurement of fringe width [3]. Surendra introduced a method of generating two-view images for comparison through image data acquisition, a method of reconstructing 3D review and

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processing technology using a special image correction algorithm, that is, the acquired image data is corrected first, and then processed with other images The method is combined to adjust the gray reference line and contrast of the image. Compared with the conventional image processing, it greatly improves the image quality method of the inspection system based on Cobalt-60 [4].

In the domestic research on clothing style recognition methods based on digital image processing, Zou recognizes specific clothing styles by learning texture features from clothing images, and can classify different clothing styles through extension. Tests show that the algorithm is effective in distinguishing specific clothing styles and correctly classifying [5]. Cao proposed a sparse coding method to explore clothing elements for style recognition. The texture-based sparse code is connected with the color feature to recognize the clothing style through the support vector machine (SVM) model. A series of experiments were carried out to analyze the characteristic attributes for clothing recognition [6]. Yang detects clothing regions by fusing superpixel segmentation, saliency detection and Gaussian Mixture Model (GMM). For the evaluation, a data set for clothing style recognition was collected, which included 5 styles and 14 fashion attributes. A large number of experiments have shown that the proposed framework has a promising ability to recognize clothing styles [7].

In this article, we use the rough reconstruction effect extracted from algebraic multiplexing to express features that can effectively improve contrast and improve object recognition. From clothing recognition to multi-group object recognition, some practical research has been conducted. The results show that the features extracted from the coarse grid can significantly improve the feature contrast and target recognition rate. In the object recognition of a single object, by learning and training support vector machines, combined with appropriate image features and image description methods, good recognition results can be achieved.

2. Research on Clothing Style Recognition Method Based on Digital Image Processing

2.1 Digital Image Processing Technology

Generally, an image is the distribution of light intensity, which is a function of spatial coordinates x, y, z (for example, f(x, y, z)). If it is a color image, the value of each point will also reflect the color change, expressed as f (x, y, z, λ). In is the wavelength of light. For simulated images, f (x, y, z) is a non-zero continuous function, and it is finite, that is, 0 <f (x, y, z) <∞.

The two-dimensional (p+q) order moment of the digital image (x, y) of size $M \times N$ is defined as:

$$m_{pq} = \sum_{x=0}^{M-1} \sum_{y=0}^{N-1} x^p y^q f(x,y) \quad (1)$$

Where p= 0,1,2,3… and q= 0,1,2,3… are both integers. The corresponding (p+q) order center distance is defined as:

$$\mu_{pq} = \sum_{x=0}^{M-1} \sum_{y=0}^{N-1} (x-\bar{x})^p (y-\bar{y})^q f(x,y) \quad (2)$$

Where $\bar{x} = \frac{m_{10}}{m_{00}}$ and $\bar{y} = \frac{m_{10}}{m_{00}}$. Define the normalized central moment of (p+q) order as $\eta_{pq} = \frac{\mu_{pq}}{\mu_{pq}^{\gamma}}$, where γ= (p+q)/2 + 1.

The image digitization process is completed in two steps: sampling and quantization. The process of image analysis in space is called sampling. The selected points become sampling points, and these points are also called pixels. The function value at the sampling point is called the sampling value. In other words, the finite sampling points in space are used to replace continuous infinite coordinate values. The shorter the sampling interval, the finer the image, the more points in the image, and the larger the sampling data [8-9]. The minimum number of sampling points must meet certain restrictions, that is, the spatial frequency used in the horizontal direction is greater than the cutoff frequency of the image in the horizontal direction, and the spatial frequency used in the vertical direction is also greater than the cutoff frequency.From these samples, a specific method can be used to completely reconstruct the original image, which is the two-dimensional sampling theorem.

(2) SVM

SVM is essentially a two-class algorithm, but it can also be extended to a multi-class classifier. Common methods include one-to-one and one-to-many.

Limiting the gray value of a pixel to an integer is called quantization. The result of quantization is all the color data contained in the image. Quantization determines the range of values used to represent

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each point after the image is sampled. This value range determines the total number of colors that can be used in the image. Generally, the maximum gray level of a pixel is converted to an integer power. Quantification is divided into unified quantification and non-uniform quantification [10-11]. Uniform quantization refers to simple quantization performed at equal intervals on the gray scale. Non-uniform quantization uses long intervals for low pixel frequency parts, and short intervals for high frequency parts. The larger the size, the higher the image quality and the higher the storage requirements[12-13].

2.2 Histogram Balance Processing

The histogram equation is an important method to improve the image. The histogram has the following properties:

(1) The histogram is the statistical result of the gray-scale time of each pixel in the image. It only reflects the display time of different gray values in the image, and does not reflect the location of a specific gray. In other words, it only contains the probability of a specific gray pixel in the image, not its location information [14-15].

(2) Each image has a unique histogram, but different images may have the same histogram. There is a very one-to-one relationship between the image and the histogram.

(3) Since the histogram is obtained by counting the pixels with the same gray value, the sum of the histogram of each sub-region of the image is equal to.

$$Center_0(i) = i\left(\frac{\max(I)}{k+1}\right) \quad (i = 1,2,\ldots,k) \tag{3}$$

Where max(I)——The maximum gray value of gray image.

2.3 Image Segmentation Method Based on Local Statistical Features

This paper proposes an image segmentation method, which divides the image into three parts according to formula (4): black (0), white (255) and gray (100), and considers that text can only appear in black and white areas.

$$SR(x,y) = \begin{cases} 255 & I(x,y) > T_+(x,y) \\ 0 & I(x,y) > T_-(x,y) \\ 100 & other \end{cases} \tag{4}$$

$$T_\pm(x,y) = Mean(x,y,W_B) \pm offset \tag{5}$$

Where SR(x,y) —— segmentation result;

$T_\pm(x,y)$——the threshold at I(x,y);

$Mean(x,y,W_B)$——The mean value in the field centered on I(x,y), the field size is W_n;

offset ——Normal number, so that some pixels are divided into gray layer.

The identifier text discussed in this article can only appear in the white layer, so formula (4) is modified, and the modified formula is given by formula (6).

$$SR(x,y) = \begin{cases} 255 & I(x,y) > T_+(x,y) \\ 0 & I(x,y) > T_+(x,y) \end{cases} \tag{6}$$

$$T_+(x,y) = Mean(x,y,W_B) \pm offset \tag{7}$$

The meaning of each variable in the formula is the same as formula (4).

This article uses formula (8) to calculate the offset value.

$$offset = k * std_1 \tag{8}$$

Where k —— constant term;

std_1 ——The standard deviation of the gray value of the gray image I.

2.4 Research on Image Fusion Algorithm

Fusion algorithms usually combine features such as mean, entropy, standard deviation, and mean

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image gradient. This article mainly analyzes and studies pixel image fusion. The main pixel fusion methods include gray-weighted average fusion method, minimum fusion method selection, principal component analysis (PCA) fusion method, pyramid decomposition fusion method and waveform fusion method [16-17]. Among them, the choice of PCA fusion method and minimum fusion method are typical examples of weighted average method, and methods such as ripple decomposition are typical examples of decomposition pyramid fusion method.

(1) Gray average weighted average algorithm

The weighted average gray level fusion algorithm is a more direct and simple algorithm in the fusion algorithm, and it is an extension of the weighted average imitation method to a single image. And the weight coefficient usually satisfies the summation state. The weighted fusion method can improve the signal-to-noise ratio of the fused image, but it will weaken the image contrast. This figure shows the weighted average effect of the fused image. The expression of the weighted average fusion algorithm is:

$$I(x, y) = \phi_a I_a(x, y) + \phi_b I_b(x, y) \tag{9}$$

Among them, ϕ_a and ϕ_b are weighting coefficients, and the sum is generally set to 1.

(2) PCA method

PCA fusion is to convert PCA into multiple input images, and the calculation type is expressed as:

$$I(x, y) = \phi_a I_a(x, y) + \phi_b I_b(x, y) \tag{10}$$

Where ϕ_a and ϕ_b are the coefficients of each input image.

(3) Wavelet fusion method

Wavelet transform technology has many excellent features that other time-space-frequency domains do not have, such as close support and a small amount of data. In the decomposition of image waves, the edges have large contrast transformations in the image, such as contours, light rays and peripheral contours. By fusing the wavelengths of different source images, the obvious target can be maintained, and the applicability is high [18-19]. The main step to complete it is to perform waveform transformation on each original image, the expression is:

$$l(x, y) = W^{-1}(\phi\left(W\left(I_A(x, y)\right), W\left(I_B(x, y)\right)\right)) \tag{11}$$

Where W is the wavelet forward transform, W^{-1} is the wavelet inverse transform, and ϕ(.) is the fusion rule function.

(4) Image quality evaluation

For image processing or image communication systems, the main body of information is the image, and an important indicator of this system is image quality. The concept of image quality includes two aspects: one is the fidelity of the image, that is, the degree of deviation of the image from the original standard image is evaluated. The second is image understanding, which refers to the ability of images to provide information to people or machines [20-21].

1) Subjective evaluation of images

Subjective image evaluation is the personal observation of the image, the subjective evaluation of the image quality, and then the average score for the evaluation result. The image quality currently being evaluated is related to the characteristics of the observer and the observation conditions. In order to ensure that the subjective evaluation is statistically meaningful, when selecting observers, not only untrained "external" observers must be considered, but also "expert" observers with certain experience in image technology.

2) Objective evaluation of images

Although subjective quality assessment is the most effective method, in some specific research cases or due to limited experimental conditions, we also hope to have an objective description of image quality. This is a commonly used fidelity indicator. The quantitative expression of color image fidelity is a very complex problem [22-23]. Currently, the most widely used application is the quantitative expression of the fidelity of black and white images. A wise measurement method should be consistent with subjective test results and should be simple and easy to use.

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2.5 Electronic Position Interferes with Image Processing

(1) Improve the interpolation edge image

When performing image enhancement tasks, first cross the gray values of all pixels in the image to obtain the maximum and minimum gray values, and then cross all the pixels in the image again. For each pixel, calculate according to equation (12) to create a new image:

$$I'(x,y) = (I(x,y) - I_{min}) \times \frac{255}{I_{max}-I_{min}} \tag{12}$$

In the above formula, I(x, y) represents the gray value in each pixel of the original image, I_{max} represents the maximum gray value of all pixels in the image, and I_{min} represents the minimum gray value of all pixels in the image. In the enhanced image, clear interference fringes are observed.

(2) Media filtering

The result of calculating the average filter is related to the size of the selected filter window. When a smaller filter window is selected, detailed image characteristics can be better preserved. At the same time, multiple filter edits must be performed to obtain better filter effects. When a larger filter window is selected, the detailed image characteristics will disappear. No matter how big the filter window is, the average filter will produce a blur effect. This paper uses a 3×3 filter window to compare the influence of the filter medium on the positional image [24-25]. It can be found that the particle noise points in the original image are partially eliminated and the image becomes blurred.

2.6 Method Based on Target Model

(1) Shape normalization

Since the model-based method is based on the statistical value of the shape vector, we need to normalize the shape vector obtained from the training sample image to eliminate the target objects caused by different distances, angles and invisible interference in the training set images. They are caused by external factors such as variable speed changes, so it is possible to directly compare key points with the same serial number in each shape. In short, it aligns all shapes with the same coordinate system through translation, zoom and rotation functions without changing the appearance and shape of each sample. The Procrustes method can be used to align two shape vectors. Cooks modified the traditional Procrustes to allow him to adjust the form of a set of training sets.

(2) Calculate PDM statistical parameters

Each sample shape vector is regarded as a two-dimensional vector, and then the sample set is a vector set in a two-dimensional vector space. Due to the limitation of the actual shape of the object, the shape vector of the target object can only exist in the subdomain of the 2n-dimensional vector. In ASM, this subdivision is called the "real shape domain". The shape of each vector generated in ASD is similar to the shape in the training set.

(3) Search for images

By fundamentally transforming the average shape of the PDM model and inserting the original shape into the new image, a suitable original shape is obtained for searching pictures.

1) Calculate the local features of the shape of the training set

In order to optimize the shape of the corresponding image in the most ideal position, you can consider moving the position of the key point to the contour in the image. This step is not unique. This article achieves this goal by adjusting the model's normal pixel limit distribution during the process of moving the model to the strongest image limit. Another commonly used method is to calculate local features for each key point of the training set. In the iterative process, the local capabilities of the key points of the matching model are calculated, and the local feature differences between the corresponding model and the corresponding key points of the education set are found. The smallest image position to obtain the best new position of the key points of the model.

2) Calculate the local features of the key points of each model

After covering the original model in the image, by comparing the pixel points in the specific neighborhood of the key points of the matching model with the local features of the corresponding key points in the training set, start to calculate the ideal new position of each key point to be moved with

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the shortest distance Is the new position where the model will move. Take the i-th key point of the model as an example to illustrate the method of calculating the local features of the key points of the model.

3. Experimental Research on Clothing Style Recognition Method Based on Digital Image Processing

3.1 Application and Data Collection of SVM Classifier

According to the format of this article, the application of SVM classification described by Fourier is as follows:

(1) First, pre-edit the clothing image in the sample library and sample area to obtain the clothing outline. Then extract the Fourier feature description vector of the clothing contour.

(2) 40% of the feature vectors are used as the test set. The number of styles is consistent with the overall proportions. In addition to the feature vector, the test set and training set also contain this feature.

(3) According to the above-mentioned well-trained SVM classification model, the test suite feature vector and its category label are used.

(4) Randomly select 60% of the samples as the training set, and the remaining 40% as the total test. The number of each style matches the overall ratio.

3.2 Image Expression

(1) Collect all the attribute point vectors into one, and use the algorithm to merge visual vocabulary with similar concepts to create a vocabulary containing vocabulary.

(2) Calculate the number of times each word in the word list appears in the image, thereby representing the image as a dimensional vector. By taking points close to the edge points and performing interpolation based on the gray levels of these points, the unknown parameters contained in the interpolation basis function are obtained, and then the function is obtained to obtain the first derivative, and then the first derivative is zero. The zero point coordinates of the first derivative are calculated so that the end points of the sub-pixels can be located. This is because the zero point of the first derivative of the function is the maximum value of the function, and the gray value of the image at the extreme positions changes more.

3.3 Get Images

The recognition system is designed to individually select existing photos for recognition, or to perform batch recognition of images in a designated folder, or to use real-time image capture cameras for recognition. When selecting a camera for real-time recognition, you must first select the camera and parameters, such as the resolution and color depth of the photo. For the identification object in this article, the resolution is 640×480 and the bit width is 24.

4. Experimental Research and Analysis of Clothing Style Recognition Method Based on Digital Image Processing

4.1 Comparison of Other Contour Feature Extraction Techniques

Using the above-mentioned SVM training and testing, the extracted four kinds of clothing contour features are used to compare the actual style and the predicted style of the sample in the sample library to obtain the recognition accuracy of the whole and each style.

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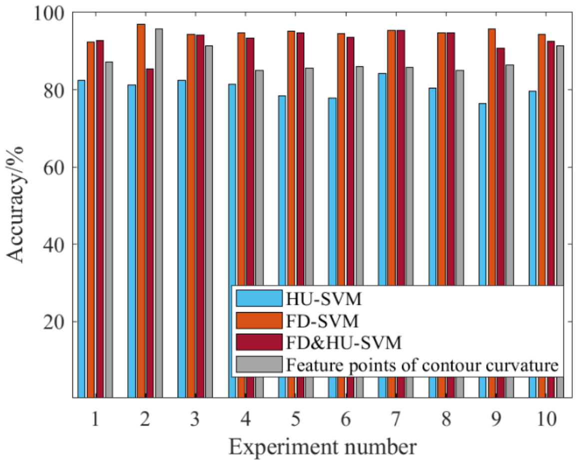

Figure 1: Overall recognition results of different feature extraction technologies

On the whole, the overall recognition results of different feature extraction technologies are shown in Figure 1. It can be clearly seen from the figure that the classification accuracy of each feature is relatively stable, and the difference in accuracy of each feature is also obvious. The average classification accuracy of 10 experiments are: Fourier descriptor is the highest, 94.8%; fusion features are the next, 93.8%; contour curvature feature points and Hu invariant moments are relatively low, 86.3% and 81.2 respectively. It takes about 3.8 milliseconds to identify the four characteristics of a sample.

From the perspective of various styles, the average recognition results of different feature extraction techniques in 5 experiments are shown in Table 1. It can be seen from the table that the recognition rate of short-sleeved T-shirts, shorts and trousers is generally high, especially the contour curvature feature points can reach 100% accuracy; the recognition of long-sleeved shirts, coats and suit tops The rate is relatively low, because these three styles have similar contour shapes, and the details of the collar, placket and hem are not described enough, which needs to be further strengthened. Looking at each style as a whole, the Fourier descriptor has a very good recognition rate for each style. High, and the stability of multiple experiments is also good.

Table 1: Fourier descriptor's recognition rate analysis of each style

Test set style	Accuracy (%)			
	Feature points of contour curvature	Hu moment invariants	Fourier descriptor	Fusion feature
Shirt	75.3	43.1	92.6	91,5
Coat	75.4	64.35	89.36	84.37
Suit	77.37	67.34	87.45	91.47
Shorts	97.4	99.3	95.38	100
Recognition rate	100	98.5	99.6	100

Based on the above experimental results, the following conclusions can be drawn: Among the four clothing contour shape feature description methods, combining the overall recognition rate and the recognition rate of each style, the Fourier descriptor still has the strongest ability to characterize clothing styles; the integration of Hu remains unchanged Although the fusion features of moments and Fourier descriptors have reached a relatively high accuracy rate, they are slightly lower than a single Fourier descriptor. Analysis shows that although feature fusion increases the range of feature representation, it fails to eliminate participation in fusion. The difference between the features of, caused a slight decline in the characterization ability; when identifying styles with obvious shape characteristics such as short-sleeved T-shirts, shorts and trousers, the contour curvature feature points have the best description ability.

4.2 Horizontal Comparison Experiment Results

Select a test image, and on the basis of retaining the pixel area of the search object that matches the shape of the model, manually process the image, add extra texture or remove unnecessary edge environment, and construct the same resolution, the edge ratio gradually decreases A small test image set, horizontal comparison of the search results of the three methods.

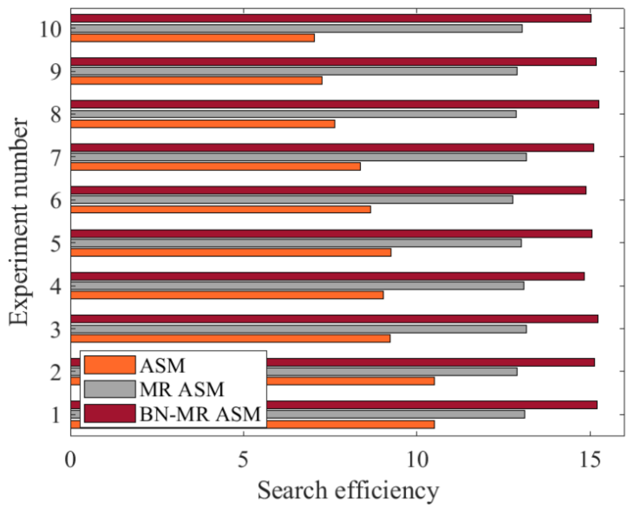

Figure 2: The overall search efficiency of traditional ASM, MRASM, and BN-MRASM

It can be seen from the horizontal comparison result in Figure 2 that when the image resolution is the same and the edge ratio is different, the running time of the traditional ASM and MRASM is relatively stable, indicating that the execution efficiency of these two methods generally only depends on the image size. The number of edge pixels in the image is irrelevant. The running time of BN-MRASM gradually decreases with the decrease of the edge ratio, indicating that the execution efficiency of BN-MRASM is not only related to the overall size of the image, but also greatly affected by the number of edge pixels in the image. On the other hand, on the whole, under different edge ratios, the time required to construct the image pyramid and calculate the edge pixels is relatively stable. This is because the implementation of these two steps requires traversing all pixels of the image. Point is calculated, so the calculation time only depends on the image size.

Use Gaussian filtering to construct 4 layers of resolution on the test image. The sampling step is 2 (for the convenience of comparison, the images of each resolution are displayed in the same size). a is the 0th layer (original image, resolution 544x948), b is the first layer (1 Gaussian blur, 1 drop, resolution 272x474), c is the second layer (2 Gaussian blur, 2 drop, resolution 136x237), d is the third layer (3 Gaussian blur, 3 downsampling, resolution 68x119).

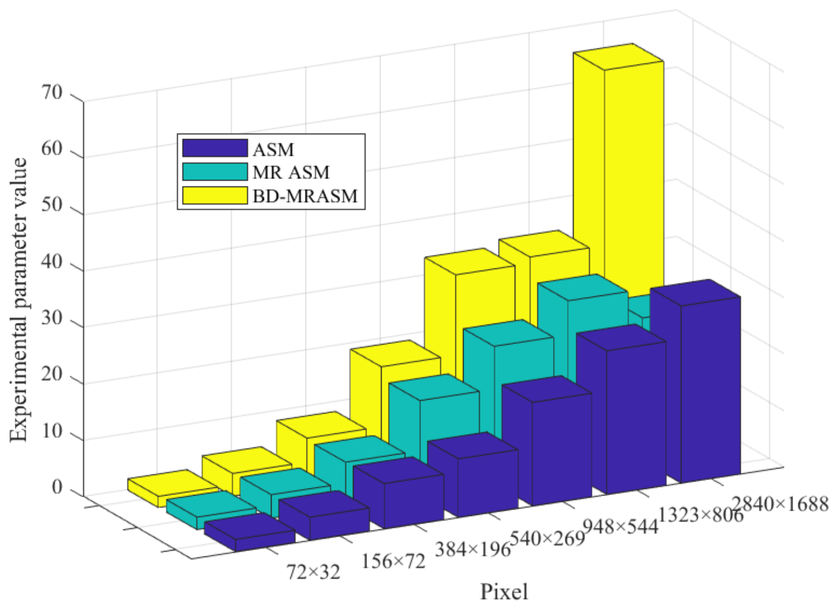

Figure 3: Search efficiency of traditional ASM, MRASM, and BN-MRASM

It can be seen from the longitudinal comparison results in Figure 3 that as the resolution of the search image increases, the total search time of the traditional ASM has a greater increase in the running time than the other two methods. This is because, compared with the other two algorithms, traditional ASM only needs to directly calculate the local texture features of the key points of the training set to perform image search; on this basis, MRASM based on the resolution framework takes more time to build an image pyramid; BN-MRASM, which combines edge detection and multi-resolution framework, further increases the time to calculate the edge pixels of each layer of resolution image.

4.3 Research on Feature Expression Based on Coarse Grid

Coarse grids can extract more detailed features. We verify the effectiveness of this method through experiments on characteristic clothing. We use 10 pictures in the clothing database, use the traditional PCA method for clothing recognition, and use Euclidean distance for the distance. A set of data uses the original clothing picture, and a set of data uses the clothing picture reconstructed from the first layer of coarse grid data as input. The effectiveness of the feature is proved through comparative analysis. The result is shown in Figure 4. What you get is the distance between the input image and other images in the picture sequence.

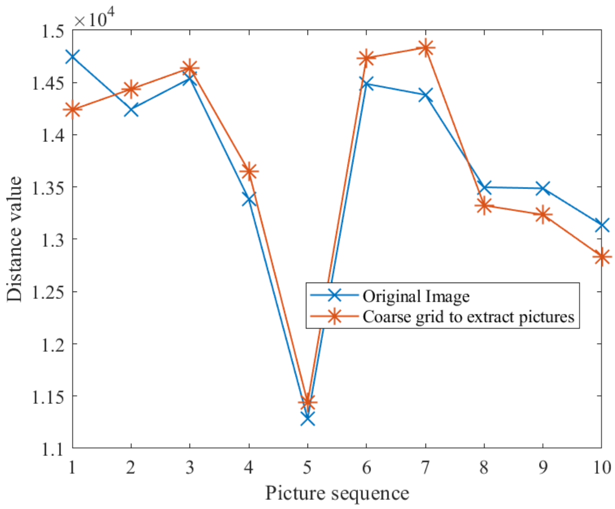

Figure 4: Comparison of the distance between the original image and the image sequence extracted from the coarse grid

Through the analysis of the results, a total of 10 pictures were analyzed, of which pictures (except the pictures) were reconstructed after being extracted by the coarse grid, which can effectively improve the standard deviation of the distance between the sample and the sample in the library, increase the contrast, and can perform more effectively. Object recognition. We will continue to verify the effectiveness of this method in subsequent multi-group object recognition.

5. Conclusions

This work does some research on clothing recognition. This work uses the rough grid reconstruction results extracted from algebraic multiple grids to express features, which can effectively improve the contrast of the corresponding features and improve the recognition ability. From some classic clothing recognition to multi-group object recognition, some practical research has been conducted. The results show that the effect of coarse grid reconstruction can significantly improve the target recognition rate. Aiming at the "bag of words" model, this paper proposes an expression based on the "bag of words" model graph. This paper proposes a solution method based on the energy function and proposes some principles for feature selection.

This article mainly simulates and analyzes standard methods, improves some classic algorithms and obtains some results. This paper proposes a dual method based on the estimation of the number of foreground pixels, and has achieved a good dual effect. Based on the characteristics of object recognition, this paper improves the existing edge-based binary algorithm and has achieved good results. In this article, noise will inevitably be introduced in the process of capturing and acquiring images. Therefore, before processing and analyzing the image, filtering processing must be performed to eliminate noise. By studying a variety of filtering methods, comparing and analyzing the filtered image and the original image, we know that the anisotropic diffusion filtering process has a small change in the gray tip value after filtering, which is very similar to the original image. At the same time, edge information will not be lost.

In order to improve the search efficiency of the ASM algorithm, this article first introduces a multi-analysis framework. Since the shape of the target object is perceived as the edge of the image by perception, limiting the search range to the edge of the image will not have a significant impact on the search accuracy, and significantly reduces the amount of calculation and improves the search efficiency.

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