# Research on Preprocessing Algorithm of Two-Camera Face Recognition Attendance Image Based on Artificial Intelligence

Lin-lin Tian[1], Wan-li Teng[1], and Hai-hong Bian[2,3](✉)

[1] School of Information and Control, Shenyang Institute of Technology, Shenyang 113122, China
tianlinlin1258@tom.com
[2] Nanjing Institute of Technology, Nanjing 211167, China
11q201801@163.com
[3] Jiangsu Collaborative Innovation Center for Smart Distribution Network, Nanjing 211167, China

**Abstract.** The traditional double-camera face recognition attendance image preprocessing algorithm can not distinguish the target from the complex background. In order to solve this problem, an artificial intelligence based double-camera face recognition attendance image preprocessing algorithm is proposed. First, artificial intelligence technology is used to extract the features of face recognition attendance image, and then spatial denoising algorithm is used to remove the noise of face recognition attendance image. On this basis, multi-channel texture weighting algorithm is used to realize the double-camera face recognition attendance image preprocessing. Therefore, a double-camera face recognition image preprocessing algorithm based on artificial intelligence is completed. In the experiment, the infrared image of the face is tested to see whether the evaluation factors obtained by the two algorithms can distinguish the target from the complex background. Experimental results show that the algorithm has a short computing time and can distinguish targets in complex background in a short time.

**Keywords:** Two camera face recognition · Image preprocessing · Artificial intelligence technology · Noise reduction processing

## 1 Introduction

The initial face recognition method is based on geometric features. The core idea of this kind of method is: first detect and extract the main face parts such as eyes, nose and mouth, and then integrate the geometric distribution relationship and mutual parameter ratio of these parts for face recognition [1]. Typical algorithms include semi-automatic face recognition attendance image preprocessing algorithm and profile algorithm. Face recognition based on geometric features of attendance image preprocessing algorithm, light and attitude interference resistance is weak, and geometric features of the face information is less than the overall face features. Therefore, currently, the commonly used methods are to extract the features of the whole face image, then conduct the


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operations of reducing and classifying, and finally get the face recognition results. In order to enhance the interference resistance of illumination and attitude, a face recognition algorithm based on artificial intelligence was proposed.

The double-camera face recognition attendance image preprocessing algorithm based on artificial intelligence has the support of perfect statistical theory. They treat face samples as random vectors and use statistical methods to extract and classify faces. On this basis, extract the features of each face image, string the gray value of all pixels into a high-dimensional vector, and then remove the noise of double-camera face feature recognition attendance image through principal component analysis, so as to realize attendance image preprocessing. Based on artificial intelligence dual camera face recognition attendance image preprocessing algorithm specific implementation process is as follows.

## 2 Artificial Intelligence Dual Camera Face Feature Recognition Attendance Image Feature Extraction

Using the principle of artificial intelligence technology to extract double camera face feature recognition attendance image features. Artificial intelligence technology has the function of data classification and dimensionality reduction. Its essence is to create a coordinate system in the data space and project the data into the new coordinate space respectively. It can effectively remove the correlation degree between different types of data vectors, effectively realize data classification, and at the same time, it can also remove some coordinate system composed of data redundancy, so as to compress the data and reduce the dimension of feature space.

Complete artificial intelligence technology double camera face recognition attendance image feature extraction steps are as follows:

The first step is to normalize the face database and obtain the feature matrix $X$ based on the data. Each column of the matrix represents an feature vector.

The second step is to find the autocorrelation matrix $R = E[X^T X]$ of the characteristic matrix $X$.

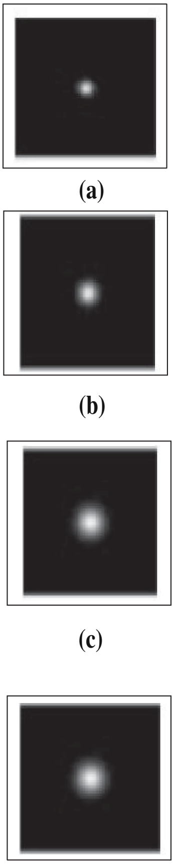
The third step is to solve the eigenequation and obtain the eigenvalue and eigenvector from the correlation matrix $R$. The eigenvalue obtained constitutes a diagonal autocorrelation matrix, which is a diagonal matrix, so each element is the autocorrelation coefficient of the transformation matrix. The eigenvector should be linearly independent and normalized [2].

The fourth step is to obtain the transformation matrix by treating the eigenvectors as column vectors.$\phi = (\phi_1, \phi_2, \ldots, \phi_n)$.

The fifth step is to obtain the transformation features by calculating $\alpha = \phi^T X$. Since the autocorrelation matrix of the new features is a diagonal matrix, it is linearly independent [3].

The sixth step is to select the features with larger eigenvalues for the application of classification. This is because the eigenvalue is a measure of variance, and the larger its value is, the more relevant the data is, and the larger the value range is [4].

Step 7: take 5 different scales $v = (0, 1, 2, 3, 4)$ and 8 different directions $\mu = (0, 1, 2, 3, 4)$ to get 6 different Gabor nuclei. Double-camera face recognition attendance image Gabor features, as shown in Fig. 1:



(a)

(b)

(c)

(d)

**Fig. 1.** Gabor features of double-camera face recognition attendance image

Complete Gabor features of human faces were obtained by using the Gabor nucleus.

## 3 Dual Camera Face Feature Recognition Attendance Image Noise Removal

The quality degradation of double-camera face feature recognition attendance image is often affected by some random errors, which is called noise [5]. Noise may occur in the process of generating, transmitting, converting, receiving and processing video images. For example, when a camera is used to obtain a video image, both the light level and the temperature change of the sensor are the main factors that produce image noise. In the transmission process, the image is interfered by the atmospheric environment, electromagnetic multiple number and other transmission channels, which will also introduce image noise [6]. Noise will reduce the image quality, which will make the subsequent image analysis and understanding difficult, and seriously affect the user's visual experience. For this reason, the noise reduction processing of face recognition attendance image with dual camera is proposed.

According to the design requirements of video image preprocessing system, a fast and efficient spatial noise reduction algorithm is most suitable. A fast adaptive gaussian noise reduction algorithm is proposed, which is described as follows:

For pixel $\mu_{|i,j\rangle}$ to be processed, take its surrounding filtering neighborhood $R_{|i,j\rangle}$, as shown in Fig. 2:

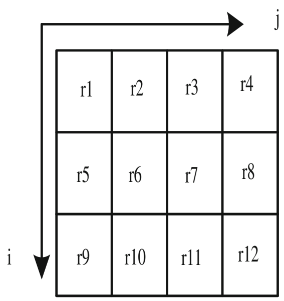



**Fig. 2.** The domain template for the pixels to be processed

Determine whether the pixel to be processed is polluted by gaussian noise through standard deviation $std - dev$, and define the formula:

$$std - dev = \left| \mu_{|i,j\rangle} - w - mean \right| \tag{1}$$

Where, $w - mean$ represents the grayscale weighted mean of pixels in the neighborhood set, and $\mu_{|i,j\rangle}$ represents the weight of 4. Here, the weight is set as 2 to facilitate hardware calculation and processing [7].

At the same time, sobel operator is introduced to detect the edge texture information of the image in order to protect the detail texture of the image from being excessively smooth during noise reduction [8]. And the final filtering mode is determined accordingly. The operator detection template of the four squares is shown in Fig. 3.

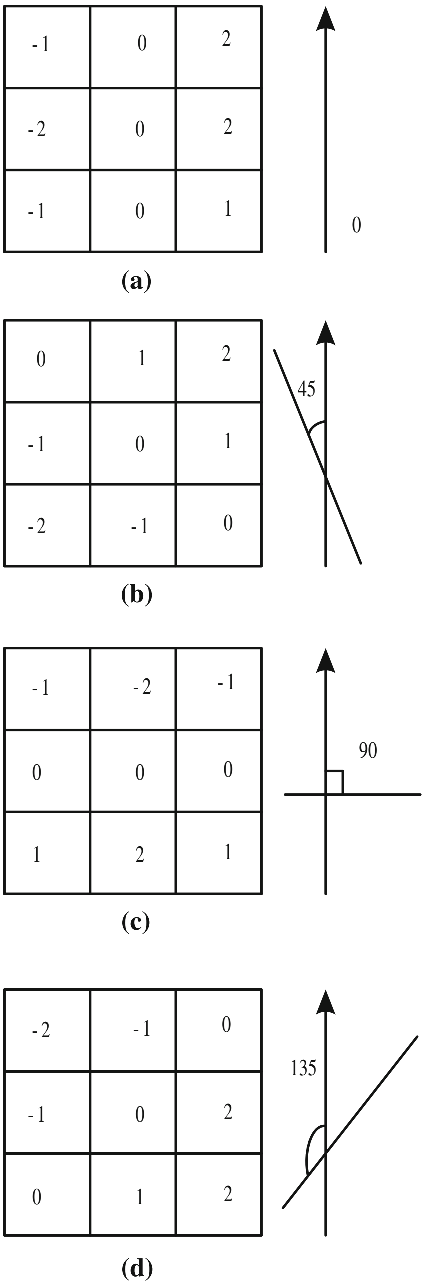



**Fig. 3.** Sobel operator detection template

The template is convolved with the neighborhood template of the pixel to be processed. After the calculation of standard deviation $std - dev$ and the representation of max-edge by the most human edge information, the paper first determines whether the processed pixels are polluted by noise by comparing $std - dev$ with the noise threshold NTH [9]. If $std - dev <$ NTH, it means that the pixel point is not polluted and its gray level is guaranteed to remain unchanged. If $std - dev >$ NTH, it means that the pixel point is judged as a noise point. For noise points, if the corresponding max-edge is greater than or equal to the edge judgment threshold NTH, it indicates that the noise point is located at the image details, and then the noise point is replaced and interpolated according to the edge direction.

The noise removal process of double-camera face feature recognition attendance image is as follows (Fig. 4):

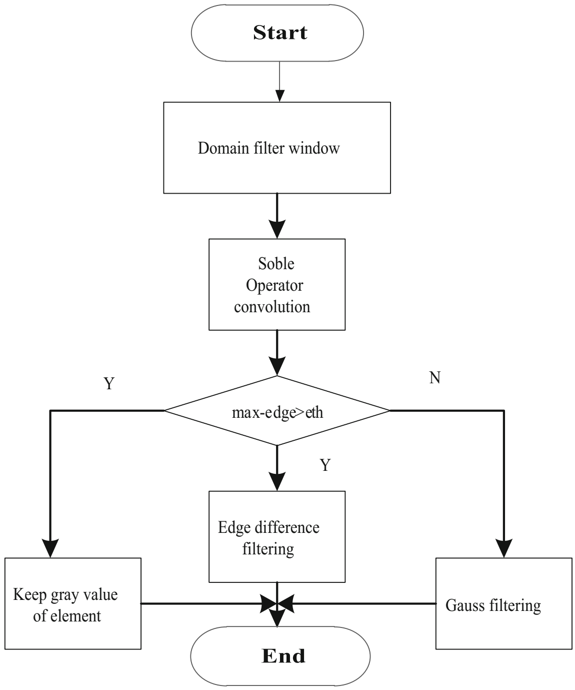



**Fig. 4.** Noise removal process of double-camera face feature recognition attendance image

In the concrete implementation, the solution of $std - dev$ and the convolution calculation of max-edge can be processed in parallel, so as to improve the processing speed of the whole algorithm process.

# 4 Dual Camera Face Feature Recognition Attendance Image Preprocessing

In order to further improve the suppression effect of noise reduction algorithm on high-concentration impulse noise, a fast and efficient algorithm based on decision theory was proposed [10]. The algorithm principle is as follows:

For neighborhood filtering window, first of all gray levels of pixels in the window to ascending, row from left to right, on this basis, the gray values of all pixels from top to bottom of sequence alignment, and finally, based on the results of the procession sorted, gray levels of pixels on the diagonal to ascending diagonal arrangement, the whole process as shown in the figure below (Fig. 5).

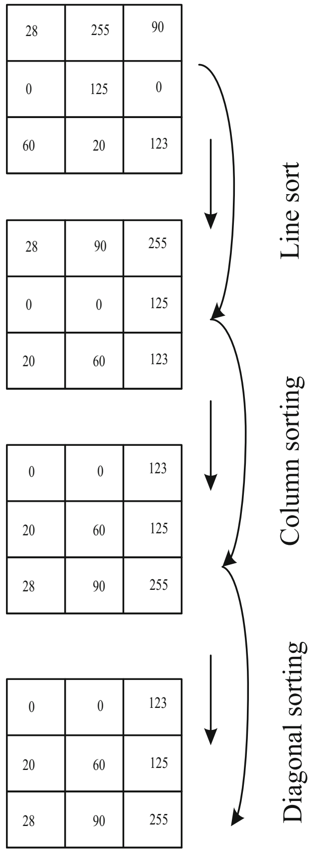



**Fig. 5.** Sequence flow of impulse noise suppression

It can be seen that the gray value of the pixel in the window is minimum value $p_{\min}$, the gray value of the last pixel is maximum value $p_{\max}$, and the gray value of the center point of the filter window is maximum value $p_{med}$. If the pixel $\mu_{|i,j\rangle}$ to be processed meets $p_{\min} < \mu_{|i,j\rangle} < p_{\max}$, it can be determined that $\mu_{|i,j\rangle}$ is not polluted by impulse noise and its gray value remains unchanged. Otherwise, $\mu_{|i,j\rangle}$ is the noise point. If $\mu_{|i,j\rangle}$ is polluted by noise, it satisfies $p_{\min} < \mu_{|i,j\rangle} < p_{\max}$, then the median $p_{med}$ of the table neighborhood filter window is not polluted by noise, and the gray value of the pixel to be processed is replaced by this median. Finally, in the case of noise points, the gray value of the neighborhood pixel to the left of the median value is used to replace the pixel to be processed.

The artificial intelligence based two-camera face recognition attendance image prediction and processing algorithm also has a good processing effect for the image polluted by high concentration pulse noise, and only a few pulse noise points remain in the processed image.

Image preprocessing can improve the image signal-to-noise ratio transmitted to the main processor and reduce the amount of data stored and processed, so it is of great significance. According to the principle of target detection, this chapter will use multi-channel texture weighting algorithm to realize the double-camera face recognition attendance image preprocessing algorithm based on artificial intelligence, and analyze and compare these algorithms.

Image contrast and signal-to-noise ratio are two commonly used indicators to evaluate the excellent preprocessing, which are defined as follows:

$$contrast = (g_t - g_d) \tag{2}$$

Where, *contrast* represents the contrast before and after the image, and $g_t$ is the average gray value of the target. $g_d$ refers to the average grayscale size of the background.

Preprocessing time is another important parameter of preprocessing performance, which is defined as: $T = t_2 - t_1$, $t_1$ is the system time of image processing, $t_2$ is the time after image processing.

In image preprocessing, the performance parameter used to indicate the ability of spatial filter to suppress background clutter is absolute mean square error, which is defined as follows:

$$MSE = \frac{1}{m \times n} \sum \left( Y_{ij} - X_{ij} \right) \tag{3}$$

Among them, $X_{ij}$ is the original initial image, $Y_{ij}$ is the output image, and *MSE* is the smaller, the better the filter performance.

After obtaining the two commonly used indexes to evaluate the excellent preprocessing, in order to avoid the complex and time-consuming process of solving the sparse representation coefficient of the image in the overcomplete dictionary, the image after solving the column vectorization and the atom of the overcomplete dictionary with the same vectorization were transformed into vector projection, and the algorithm principle was simpler. After first use significant processing as a filter for image preprocessing module, by setting up a reasonable threshold to realize image binarization, and extract the image block is in the original image as the interest area, and then USES the two-dimensional gaussian model generation sample image, and then construct super perfect target dictionary, with columns to quantify the interested region after image block with a list of vectorization atom in turn do vector projection and calculation of the normalized projection coefficient, using the projection coefficient of background and target on the atoms have bigger difference, can set a threshold to distinguish. The ROI blocks larger than the threshold were used to enhance the image gray scale compared with the original image, while those smaller than the threshold were used to suppress the image gray scale. The final image could quickly detect the target.

If the infrared image is $I(i,j)$, the significance image is $S(i,j)$:

$$\begin{aligned} A(f) &= \alpha(fft[I(i,j)]) \\ p(f) &= \phi(fft[I(i,j)]) \\ L(f) &= \log(A(f)) \end{aligned} \tag{4}$$

In the above formula, $\phi$, $\alpha$ respectively represent the phase and modulus of complex Numbers, log represents convolution, *fft* represents Fourier transform and its inverse transformation, and $A(f)$ represents mean.

According to the above formula, the calculation amount of the algorithm in this paper is small and the real-time performance is high. Figure 1 shows the image containing the infrared small target and the result image of significant domain detection. In contrast image 2, only one target is included, and the contrast between the target and the background is very low. Also, after the detection of the significance domain, some areas with sharp changes in the noise background are also detected as the significance domain. In Fig. 6, in addition to the two dim targets, a dark interference is artificially added to the upper right of the image, and the infrared small target is processed after the processing of the significant domain.

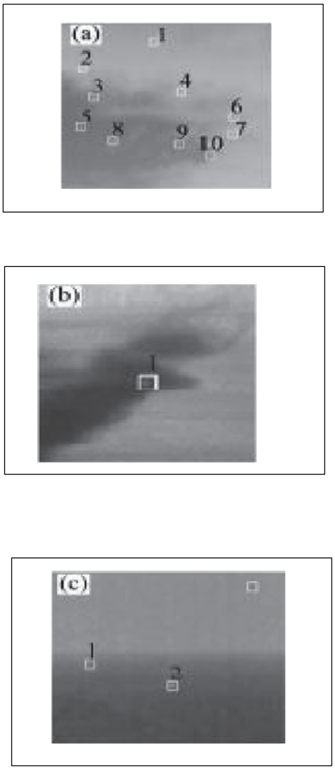



**Fig. 6.** Pre-processing results of infrared small target image and corresponding image significant domain

In order to obtain the optimal solution of infrared small target, it is necessary to know the optimization and the optimal solution of norm. Considering the matrix $A \in B$, an underdetermined linear system with an equation of $A\mathrm{x} = b$ is defined. If the system still has many unknown equations, case 1 is that the system has no solution. The other case is that if $b$ is in the space extended by the matrix $A$ column vectors, the equation has an infinite number of solutions. To avoid the case of no solution, the $A$ matrix can be determined as full rank. If the signal is a single frame image, matrix $A$ represents the corresponding compression or other domain transformation operations, and a relatively small amount of information $b$ is obtained. If we want to get the original signal from information $b$, we should look for the more excellent solution sets in the infinite solution sets of x.

By defining constraints to narrow the scope of the solution, one of the methods is to adopt the normalized method, which estimates the characteristics of x by defining a $j(\mathrm{x})$ function. Generic optimal solution problem $\{p_j\}$ is defined as follows:

$$\{p_j\} : \min j(x) subect = Ax \tag{5}$$

In the above equation, $p_j$ defines the least two norm problem for the most commonly used Euclidean mean square norm $j(x)$, $\{p_2\}$ problem and has a unique solution $x$. Lagrange factor is used to define Lagrange equation:

$$L = \|X\| + \lambda(Ax - b) \tag{6}$$

In Eq. (6), $\|X\|$ is the Lagrangian factor. Take the derivative of both sides of the above equation with respect to $x$.

The above $\{p_2\}$ problem is widely used in engineering field. The $\|X\|$ solution is simple and has closed form and uniqueness. Therefore, $\{p_2\}$ problem should be widely applied in signal and image processing field, but it does not mean that $\{p_2\}$ has the universality of solving the optimal solution in all problems. On the contrary, most of the time, researchers and engineers will be misled by the mathematical simplicity of the optimal solution, which is not conducive to the selection of the optimal $j(x)$.

Considering the optimal solution of other such norm and the problem of sparse tendency of norm, this paper gives a detailed introduction and further supplementary explanation. Considering other problems such as the optimal solution of $\{p_j\}$ norm of $p < 1$ and the sparsity trend of $\{p_2\}$ norm, this paper gives a more detailed introduction and further supplementary explanation. However, it should be pointed out that the norm problem of $\{p_2\}$ is very different from that of $\{p_j\}$ on the surface, but actually it is completely the opposite. In addition, the reverse recovery signal is computationally intensive and time consuming, which is not conducive to practical applications.

Therefore, a double-camera face recognition image preprocessing algorithm based on artificial intelligence is completed.

## 5 Experimental Analysis

In order to prove the performance and robustness of the proposed double-camera face recognition attendance image preprocessing algorithm based on artificial intelligence, we have done experiments on face recognition attendance image. At the same time, we compare the existing two better algorithms. One is the traditional algorithm, the other is based on artificial intelligence dual camera face recognition attendance image preprocessing algorithm (Fig. 7).

## 5.1 Experimental Procedures

Experimental process:

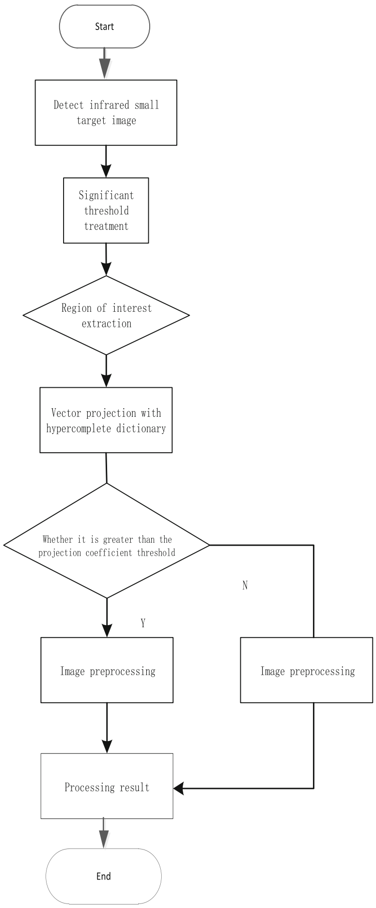



**Fig. 7.** Experimental process

First, the tested face recognition attendance image was processed in significant domain, and the region of interest of 8 * 8 size in the figure was extracted according to the binarization results. Through gaussian gray model GIM, atoms of 8 * 8 sizes are generated, 30 different target center positions are set, and 19404 infrared small target samples are generated. Therefore, an ultra-complete infrared small target dictionary of 64 $\times$ 19404 dimension is formed. Then, according to the vector projection method, the projection coefficient of each ROI in the overcomplete dictionary was calculated. The threshold was set as 0.79, and the threshold was judged according to the normalized vector projection coefficient. The gray value of ROI greater than the threshold was enhanced, and the enhancement factor was 1.2. The inhibitory factor less than gray inhibition was 0.37, and the inhibitory factor for background of non-interested region was 0.17. Finally, all regions are integrated to obtain a normalized gray distribution after image preprocessing algorithm.

### 5.2 The Experimental Results

The detection results of the traditional algorithm and the double-camera face recognition attendance image preprocessing algorithm based on artificial intelligence are as follows:

**Table 1.** Detection results of double-camera face recognition attendance image preprocessing algorithm based on artificial intelligence

| Detection algorithm | Evaluation factor | Calculation results |
|---|---|---|
| Chart (a) | SCRG | 1.6542 |
| | BSF | 1.6542 |
| | Time consuming | 1.5121 |
| Chart (b) | SCRG | 1.6452 |
| | BSF | 1.6421 |
| | Time consuming | 1.6745 |

**Table 2.** Traditional algorithm detection results

| Detection algorithm | Evaluation factor | Calculation results |
|---|---|---|
| Chart (a) | SCRG | 1.2316 |
| | BSF | 1.3264 |
| | Time consuming | 0.1326 |
| Chart (b) | SCRG | 1.0321 |
| | BSF | 1.2361 |
| | Time consuming | 1.2636 |

Face images contain strong clutter and noise. According to Table 1 and Table 2, the algorithm in this paper has a higher value than the traditional algorithm. This fact also proves that this method is more effective than other methods in such bad conditions. Although this algorithm will be more time-consuming than other methods, it is acceptable to some extent.

## 6 Conclusion

In view of the problems existing in the traditional algorithms, this paper proposes a double-camera face recognition image preprocessing algorithm based on artificial intelligence. First extract the face is the attendance image image features, and then remove the image noise, the realization of double camera face recognition attendance image preprocessing. Therefore, the research on the pre-processing algorithm of attendance image based on the artificial intelligence of dual camera face recognition is completed. Because this study only preprocesses the attendance image, but does not consider the problem of unclear recognition when employees wear glasses, so in the future, we will further study the two camera face recognition attendance system based on artificial intelligence.

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