Research of Ticket Detection and Correction Algorithm Based on Regional Segmentation

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Abstract: In order to solve the problem of low speed and accuracy during the ticket image information recognition, which is due to uncertain direction of ticket image, a new algorithm based on region segmentation was proposed to detect and correct the ticket image direction in this paper. In the algorithm, based on the analysis of ticket image, divide the ticket image split into subregions and demarcate it, combine with the histogram statistics of the calibrated region, then find out the difference of eigenvalues between different calibrated regions, determine the direction of the calibrated region, and judge the direction of the ticket image. On this basis, the image geometric transformation is used to correct the direction of the ticket image. The experimental results show that the correct rectification rate of the algorithm is 98.02%, and the algorithm is simple and easy to hardware implementation. It can improve the efficiency of the ticket recognition algorithm.

1. Introduction

With the increasing penetration of artificial intelligence to the railway service department, passenger ticket checking is the key link to verify the passenger identity and the intelligence degree of the ticket checking is also progressively advancing. In view of the intake of ticket face image in the intelligent recognition process, considering the arbitrariness of each passenger in the direction of the ticket, there is a positive image and a backward image in the image of the system, which is not consistent with the direction of the ticket. It is bound to increase the difficulty of the work in the image recognition link, so it is intelligent. Before the other link, we should correct the ticket image.

In view of the research of image rectification, a variety of image direction detection and correction algorithms have been proposed. For example, Fan-feng Ceng and others proposed the use of projection technology to locate text symbols, according to the use of punctuation habits, to determine whether the current Chinese text images need to correct [1]. According to the perspective distortion image and camera imaging principle, Qin Dai and others put forward an improved perspective correction algorithm of Hof transform and perspective transformation [2]. Yong Zhang and others combine Hof transform, perspective transformation, simulation transformation and similarity transformation to propose a license plate correction algorithm [3] based on prior information and projective geometric transformation. Xu Liu and others proposed the use of vertical stripes for projection, using the gray change of pixels on the time dimension, and the correction algorithm [4] for calculating the tilt angle of the image. The ticket face image is different from the color characteristics of the bar code and the text image, so that these algorithms are used directly to the ticket direction detection. The problem of the algorithm is difficult, the execution time is long, the direction detection rate is low, and the hardware is not realized.

In view of the limitations of the above algorithm in the application process of ticket direction detection and correction algorithm, a region segmentation based algorithm for ticket direction detection and correction is proposed. After analyzing the par information, the algorithm divides the face segmentation into subregions and demarcate them, and combines the histogram statistics of the calibrated region image, finds out the characteristics of the characteristic values between different calibration regions, determines the direction of the calibrated region, and then discriminate the

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direction of the ticket image. On this basis, the image geometric transformation method is used to realize the correction of the ticket image orientation.

2. Ticket direction detection and correction principle

The most commonly used area mask method is to identify the ticket surface information intelligently, and the area mask method of ticket recognition is to identify the area of ticket information and shield other regions. As shown in Figure 1, for the forward image (a), the train number and departure time of the ticket are extracted by the area mask method, but the ticket information or the error of extracting information can not be extracted for the backward ticket (b) area recognition. Based on this, we need to rectify the original image captured by the camera.

（a）　　　　　　　　（b）

Figure 1 Ticket information extraction

Direction detection and correction are the core of this algorithm. After analyzing the ticket face image, the image can be divided into several regions for regional eigenvalue statistics. The judgment of direction detection is based on the analysis of regional eigenvalues. The characteristic value analysis is carried out in each region determining the image position, and the difference of the characteristic values of each region is compared, and then the direction of the image is determined. The principle of image segmentation is particularly important for the analysis of the regional eigenvalues. There are two kinds of image segmentation methods, one is based on region and the other is edge based segmentation method [5]. In this paper, the region based segmentation method, the area average segmentation method, is used to divide the area into subregions, the area of each subregion is equal, and the pixels in each region are continuous. The regional area average segmentation method is as follows: Set $f(x, y)$ o an image of M * N, (x, y) defined as pixels of the image. For M, N are even numbers of images, the area average segmentation method is divided into four sub regions, as shown in Formula 1.

$$f(x, y) = \begin{bmatrix} A1 & A2 \\ A3 & A4 \end{bmatrix} \quad (1)$$

Among them, $A1$, $A2$, $A3$ and $A4$ four subregions are equal to each other.

For any odd number of M and N images, we need to interpolate the image. Bilinear interpolation is a classical interpolation method. Its computation is small and its precision is moderate. It can meet the experimental requirements. The concrete expression is as follows:

Set interpolation point to P point, if the pixel value adjacent to the interpolation point is gray value D_{11}, D_{12}, D_{21}, D_{22}. The distance between the interpolation point and the adjacent pixels is projected in the direction of X axis and Y axis. Δx, Δy ,order D_{ij} as to interpolate the gray value of(i,j),The gray value D_P of the interpolation point P we can see at formula (2).

$$D_P = \begin{bmatrix}(1-\Delta x) & \Delta x\end{bmatrix} \begin{bmatrix} D_{11} & D_{12} \\ D_{21} & D_{22} \end{bmatrix} \begin{bmatrix} (1-\Delta y) \\ \Delta y \end{bmatrix} (2)$$

After bilinear interpolation, the M and N of the images are all even numbers, and then the image is segmented (1) in order to ensure the equal area of each area.

Histogram statistics is used for regional eigenvalue statistics. Histogram is the graph [7] of the frequency of every gray level of the image. The main idea is quantitative statistics. In the case of normalized histogram, the frequency of each gray level appears as the probability of the occurrence of the gray level. The histogram corresponds to the probability density function, and the probability distribution function is the cumulative sum of the histogram, that is, the integral of the probability density function, and the expression (3).

$$P(r)=\int_0^r p(r)\mathrm{d}r, \qquad p(r)=\frac{\mathrm{d}P(r)}{\mathrm{d}r} \tag{3}$$

Among them,, $P(r)$ and $p(r)$ They are probability distribution function and probability density function respectively.

For the image with 256 gray levels, the pixel points corresponding to gray level K are expressed by discrete functions, see expression (4).

$$u(k)=n_k \qquad (0\le k\le 256, n_k\ge 0) \tag{4}$$

Among them, the number of pixels of the gray level K is n_k

Histogram statistics are used to find the eigenvalues of each region. The feature area is extracted by statistical eigenvalues, and the location relationship of each area of the ticket face is analyzed. Characteristic value statistics (5).

$$T=\sum_{k=\mathrm{i}}^{\mathrm{j}} n_k \tag{5}$$

Among them, it represents the eigenvalue, K represents the gray level,

Among them, T represents the eigenvalue,K represents the gray level, n_k the number of pixels of the gray level K ,I, J.

It represents the start and end gray scale. After the direction detection determines the direction of the ticket face image, the original image should be corrected for the inverted image. There are many ways of image correction. For the inverted ticket image, the geometric transformation method can be used to correct the image. The digital image geometric transformation method is based on the transformation of the pixel coordinates of the image, and transforms the pixels of the image into space positions to realize image correction [8]. Geometric transformation is applied to inverted image Zheng-zhong Jiao. In this paper, horizontal mirror conversion and vertical mirror image conversion, horizontal mirror transformation and vertical mirror image conversion are described in this paper (6) and formula (7).

$$[x,y,1]=[x_0,y_0,1]\begin{bmatrix} -1 & 0 & 0 \\ 0 & 1 & 0 \\ width-1 & 0 & 1 \end{bmatrix} \tag{6}$$

$$[x,y,1]=[x_0,y_0,1]\begin{bmatrix} 1 & 0 & 0 \\ 0 & -1 & 0 \\ 0 & height-1 & 1 \end{bmatrix} \tag{7}$$

Among them, width is defined as the width of the image, and height is defined as the height of the image. (x_0, y_0)The coordinates of the pixel points of the original image, (x, y)The coordinates of the pixel points of the converted image.

3. Direction detection and correction algorithm

3.1 Ticket direction detection and correction algorithm flow

Based on the above analysis of ticket image and ticket features, an algorithm based on regional segmentation is proposed for the detection and correction of ticket direction based on the region segmentation. First, the ticket image is preprocessed, including gray, enhancement processing, and then the image region average segmentation method is used for preprocessing. The image is segmented. According to the location of the ticket, the divided ticket is marked as region 1, region 2, region 3 and region 4. Statistical analysis of each sub region's eigenvalues, combined with the location of each sub region relative to the face image, determines whether the current image is a backward image or a forward image. If we want to reverse the image, we need to correct the image and correct the processed image as output image. If it is a forward image, we will output the original image directly. The specific algorithm flow is shown in Figure 2.

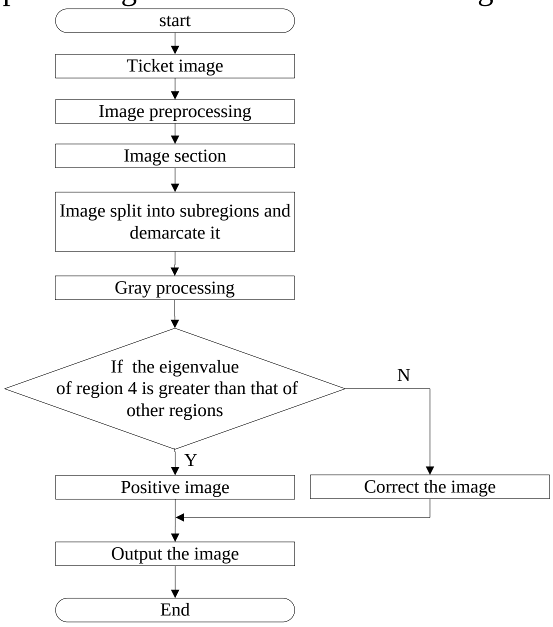

Figure 2 Direction detection correction algorithm flow

3.2 Ticket image preprocessing

Median filtering is used to filter the original ticket image. Because the image captured by the camera is disturbed by salt and pepper noise, this noise will affect the image feature extraction and information recognition, so the median filter is used to filter the original ticket image. Experimental results show that this filtering method is very effective for image denoising contaminated by salt and pepper noise.

The grayscale index enhancement is used to enhance the image processing. In order to eliminate the difference of each image caused by this uncontrollable printing layout, the gray index is used in this paper to reduce the background color of each image. In this paper, the background color of the ticket image is dimmed, and the font and the two-dimensional code area are blackened. The purpose of this is to highlight the characteristics of the ticket area.

3.3 Ticket image segmentation

The average area segmentation method eliminates the influence of the ticket background color on the statistics of the eigenvalues. Image segmentation is the premise of image annotation. In this paper, the method of segmentation based on region is adopted to analyze ticket face image.

After debugging the algorithm, the image is divided into two subregions, three subregions, four subregions, and six subregions. When the image is divided into two subregions and three subregions, the characteristic values of each subregion are not distinctly different, and the correction rate of the ticket surface image is very low. For the segmentation of four subregions and six subregions, the correct correction rate of ticket face image can reach more than 98%. But from the time of execution of the algorithm, the algorithm is divided into four subregions, which has high efficiency and practicability, which is beneficial to the realization of the real-time performance of the intelligent identification system.

3.4 Regional calibration of ticket image

Regional calibration is the key basis for judging whether a region is in a reasonable position. Through image segmentation, the ticket face image is divided into four sub regions, which are marked as region 1, region 2, region 3 and region 4 respectively. The two-dimensional code region of the ticket is illustrated as an example. For the forward picture, the two-dimensional code region is located in the area 4, and for the backward image, the two-dimensional code region is located in the region 1. The effect of the inverted image segmentation is shown in Figure 3.

Figure 3 Effect of backward image segmentation

3.5 Direction detection and correction of ticket image

Histogram is used to estimate the area eigenvalue to determine the ticket face direction. After dividing the ticket face image and calibrating the area, how to judge the basis of the ticket is the difficulty of this paper. Through the histogram statistics of 101 car tickets, each subregion characteristic value is [9]. It is found that for the positive image, the feature value of the region 4 at the low gradation is far larger than the other three subregion feature values. For the backward image, the 1 feature value of the region is far greater than the eigenvalues of the other three subregions, and by combining the characteristics of the eigenvalues, the image is judged to be a forward or an inverted image by calibrating the sub regions of the image. The histogram distribution of the eigenvalues of the inverted image is shown in Figure 4.

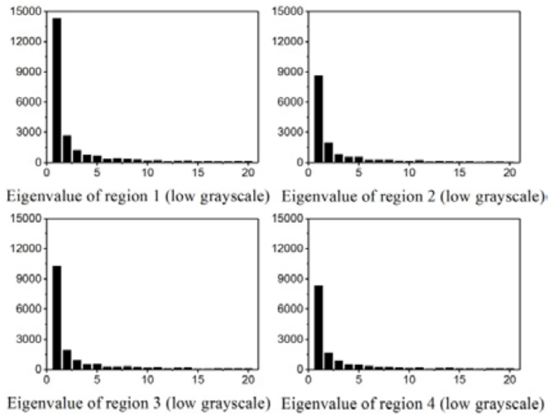

Figure 4 Inverted image region feature values

For the correction of ticket face image, the method used in this paper is the geometric conversion method. By the horizontal image and vertical image conversion to the inverted image, the backward image is corrected to the forward image. Then it ensures the consistency of the direction of the ticket.

4. Algorithm test and analysis

Through the test and analysis of ticket face image, the original image is positive image, direction detection result is positive image, and the original image is backward image, and the detection result is backward image. The direction detection effect is shown in Figure 5.

Backward image Positive image

Figure 5 Direction detection effect map

For the original image as the inverted image, we need to rectify the inverted image. The effect of reverse image correction is shown in Figure 6.

The original image Correcting image

Figure 6 Reverse image correction effect

After analyzing the corrected image, the corrected image is invisible, and the clarity, resolution and image information integrity are the same as the original image. The corrected image can be applied to the intelligent recognition of ticket face information.

In order to verify the validity of the direction detection and correction algorithm based on regional segmentation, 101 tickets are tested from the project, and the test results are shown in Table 1.

Table 1 algorithm running time and results

	ticket
sample size(piece)	101
Correct number of directions(piece)	99
Direction judgment error number(piece)	2
Correct correction rate (%)	98.02
Average running time (s)	0.39

Error analysis, because there are stains on the ticket and the defective information of ticket, there is error in the area characteristic value statistics, which affects the judgment of the face direction of the image, and then affects the correction of the image.

Through the above experimental data and the error analysis, it can be shown that the direction detection and correction algorithm based on regional segmentation can correct the tickets of different background colors and the difference of the background color caused by different print layout, and can fully achieve the actual project. Need. It can effectively detect and correct the direction of backward and forward train tickets, and facilitate the subsequent intelligentization to identify the train ticket and departure time, which is beneficial to the realization of the real-time performance of the intelligent ticket system.

5. Conclusion

This paper systematically introduces the image processing technology and the related theoretical basis and technical implementation of the direction detection and correction algorithm based on regional segmentation, and expounds the flow of direction detection and correction algorithm in detail.

The algorithm of vehicle ticket direction detection and correction based on regional segmentation has been applied to the research project of the key problem of ticket inspection based on machine vision in complex background. The algorithm can eliminate the difference of background color caused by the different print layout, and can eliminate the influence of the inconsistency of the direction of the vehicle tickets on the intelligent recognition of the ticket information. Through the test of 101 car tickets, the experimental results show that the algorithm has high correction rate, fast correction speed, and can be quickly solved. The engineering problem is very practical.

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