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Based on correlation coefficient in image matching

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Abstract:*With the development of image technology, the application of image technology in industrial manufacturing become more and more widely. Image matching is animportantbranch of the image processing, and also it is very important in the process of industrial detection. The main purpose of this paper is aiming at the traditional image correlation matching algorithm in the application of detection in industrial, which based on similarity matching principle. This paper is going to discuss the similarity of the image matching algorithm on the application of detection in the connector. This paper improves the algorithm to speed up the detection velocity. In some specific circumstance, while correlation coefficient method is more simple and easy to use, the software development cycle will be short.*

Keywords: correlation, detection, image matching, algorithm improvement.

I. INTRODUCTION

Whenthe factory produce connectors, in order to use the machine hand smoothly connect the wire with the wire terminal, the machine hand need to know the state of the connectors clearly when the machine hand deal with the wire connectors. As known about the direction of the terminal,the machine hand can work accelerate with more efficiency. The original solution about connectors is before connectors appear on the work table, with the help of the vibration of transmission track, it can make the connectors in a stable position, thus reduce the possibilities of how connectors would be.

Image matching is one of the important parts of image recognition. Image matching can be divided into: A) template matching; B)feature matching, find out the characteristics of the image, and use the image which can represent the characteristics of the image to implement matching. The former solution fits the condition of the same environment while the picture been taken many times to compare, the latter solution is more suitable for the comparison of different shooting conditions pictures, such as a camera photo while the other one is the result of the infrared sensor. This paper is about to use the different sensor or at different times, in different imaging conditions with the same sensor at of the same scene to obtain two or more images implement comparison, or according to the known templateto find the corresponding template matchingin another picture, this processing method is known as Template matching[1]. The advantage of template matching is to be able to very precise matching image, compare with the relative characteristics by comparison, it don't need a lot of the early preparations for feature extraction, the disadvantage is about large amount of calculation.To improve this disadvantage, people come out various solutions to reduce the number of calculations.

This paper is aboutto use thecorrelation coefficient to solve the practical problems, with improve the algorithm it can reduce the time of matching and improve the efficient of the matching.

II. METHOD

2.1 THE CORRELATION COEFFICIENT

If the image which need to matching is f, the size is A*B, the each point can be represent by f(x ,y) (x∈A，y∈B), the template image is h, the size is a*b, and each point can be represent by h(x ,y)(x∈a，y∈b).Based on the coefficient of correlation matching method has use the correlation coefficient (standardization covariance) as similarity measure.

$$R(u,v) = \frac{\sum_{j=1}^{M}\sum_{k=1}^{N}(f_{j+u,k+v} - \bar{f})(h_{j,k} - \bar{h})}{\sqrt{\sum_{j=1}^{M}\sum_{k=1}^{N}(f_{j+u,k+v} - \bar{f})^2}\sqrt{\sum_{j=1}^{M}\sum_{k=1}^{N}(h_{j,k} - \bar{h})^2}} \tag{1}$$

$$\bar{f} = \frac{1}{MN}\sum_{j=1}^{M}\sum_{k=1}^{M} f_{j,k} \quad , \quad \bar{h} = \frac{1}{MN}\sum_{j=1}^{M}\sum_{k=1}^{M} h_{j,k}$$

While the value of correlation coefficient is in the range of [-1, 1], which canindicate the similarity of the two matrix, the correlation coefficient can describe the degree of approximation in linear description. In general, when this value is close to 1, that can indicate both have the approximate linear relationship, also indicates that the higher the similarity of both [2][3].

2.2 HOUGH TRANSFORMS

Hough transform is currently one of the most widely used feature detection methods, whichcan detect the image many geometric characteristics, mostly used in the straight line and rounddetection.This paper is the application of straight line detection in hough transforms, in the hough transform, each point can vote on a number of parameters of linear combination, hough transform traversal image to be detected on each feature point, the more frequent a line comes out, the more evidence shows this line.

In a straight line as an example, the relationship of the straight line is y = ax + b, at the same time it can be expressed as linear b = y- ax, and x, ycan be observed, assume that a and b is the variable what we are interested in the above equation, then equation represent a straight line in (a, b) space. If there are numbers of points in a straight line, then the corresponding parameter space (a, b) will be a straight line cluster, if all straight line through a point on the same point of (a, b), we can come to a conclusion that line is what we need.Also we usually represented a straight line in the polar coordinates, where X can be represented by $r \times \cos\theta$ and Y can be represented by $r \times \sin\theta$, so inpolar coordinates , we always use $x \times \cos\theta + y \times \sin\theta = r$ to represent the straight line. About the point (x, y), in the coordinate system it can be said a straight line, of course, there are a lot of corresponding r and θ, however, in the image, each pixel coordinates of the image is known, so r and θ isthe variables what we need to find, when at the start of the hough transform algorithm, point (x, y) is mapped to the space (r, θ), if there are numbers of points in straight line, then the corresponding parameter space (r, θ) on the numbers of the sine curves, the curve is made at a point on the (r, θ), so all the points on the parameter space are transformed to (r, θ), the largest number of the parameters ofthe r is linear corresponding parameters[4].

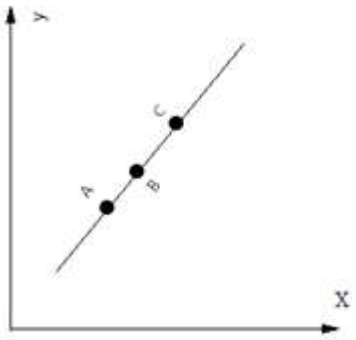

FIG 1.x-y coordinates

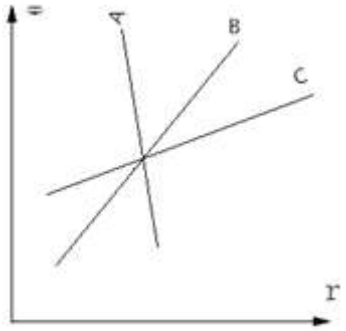

FIG 2. Polar coordinates

Hough transform can be summarized as follows:

1) Establish a discrete parameter space between the maximum and minimum about r and; θ
2) Set up an accumulator A(r,), and leθeach element be zero;
3) Do the image hough transform about every point in the curve, which can be calculate a point that corresponding curve on the grid, and the accumulator should plus one;
4) Find local maximum about A, which provide collinear parameters of collinear points on the image plane.

2.3 IMPROVEMENT OF THE ALGORITHM

The most important characteristic of correlation matching methodis that the detection precision is high, basically can achieve full match, but the disadvantage is need a great deal of computation, in the process of matching, what need to be done isthe template matching images need to move in x axis and Y axis, while move to a place,the template image shouldbe matched to the same size in what need to be matched image withcorrelation calculation.In the process of matching, this paper set the threshold value of correlation coefficient matching, when the matching correlation coefficient is lower than the threshold value, the template image will to move the distance as the length of the template image in the x direction, just skip the current matching position, if reached or higher that the threshold, where should need move slowly, movein x axisdirection with pixels, then move to the next match, the matching process will as below says:

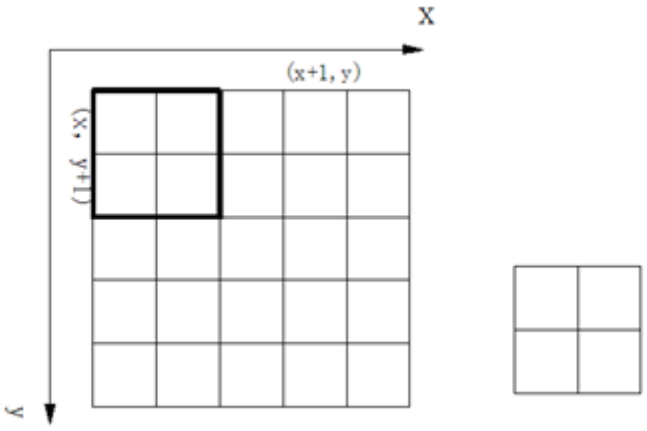

FIG 3.Template image move in x & y direction

III. RESULT AND ANALYZE

In the process of image matching, there has to be a series of image preprocessing before image matching.First, changing the RGB image to grey level image, the color image need to turn into grayscale image.

In the model of the RGB image,these three parameters (R\G\B)make up a full image, the range of each parameter is 0-255, which can display a variety color, but gray image is used only one color to represent the image, and the color is from white to black which rangefrom 0 to 255, according to the depth of the color, suitable use of grey value, when focus on the characteristics of the image, grey value can be enough to draw the outline of the characteristics of image.In order to improve the precision of matching, what need to be done is remove part of the image noise which can influence the result of the experiment. Also in the process of matching, the direction of the image is also uncertain, so calibration matching image is need, calibration of relative position Angle of the translation, rotation and scaling of size, geometric changes. This experiment mainly aims focus on how to correct image rotation Angle, which do not need to consider the image size scaling, translation and image withthe geometric change.

After preprocessing of the image, image matching is the most important. there are mainly six attitudes ofterminal placement now (as shown in FIG4), according to the standard terminalattitudeswhat need to do is cut out a small picture which can contain the obvious characteristics of the image, with this characteristics of images to match images, an image is called a template image, and another is called match images, whereneed to find the same size as the template image in and also the similarity between two of them. When the value close to 1, that means matching effectively.

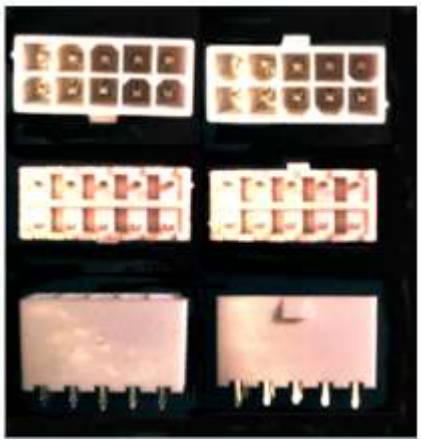

FIG 4 Attitudes of the standard

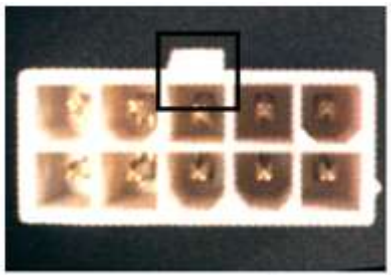

FIG 5 Template image where comes

The experiment is implemented on the computer withmatlab tools, the standard template images ofthe experiment aretakenin a standard environment and each attitude correspond to one of the standard picture.

Matching idea is mainly as follows:

A) First, do basic image processing, including gray level transformation, filtering;

B)Tocorrectthe image rotation Angle, the hough transform were used to detect the image of straight line, with a straight line to judge whether the image need to rotate relative to the template image, if it need to rotate, do the image rotation with the angle we achieve by hough transforms to implement calibration;

C) According to judge the area size of the binary image, choose the corresponding template matching;

D)Implement matching, the matching process using rough match first, then precise matching, until the match eventually.

Result of the experiment:

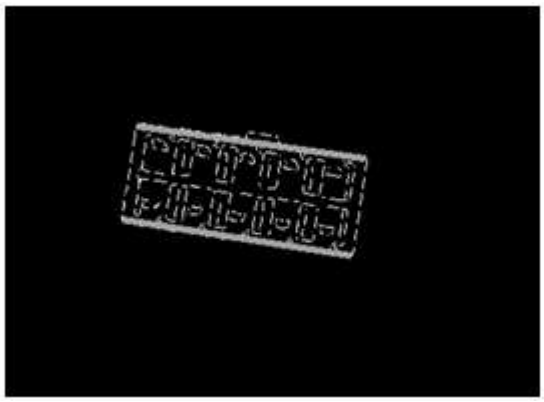

FIG 6Hough Transforms

FIG 7After rotation

FIG 8 Template image

Comparison of the traditional method with the improved method:

IMAGE	MATCHING TIME/s	
	TRADITIONAL	IMPROVED
Image1	159.755387	30.251332
Image2	158.271284	32.579095
Image3	167.121586	14.705329

From the table, there shows a big improveabout the dealing time, about traditional method, there are lots of time spend on the unnecessary work, and the improved method make the time more short.

IV. CONCLUSION

Through lots of experiments show that in this application, image matching based on correlation coefficient has certain desirable, with the part of the algorithm is improved, the correlation coefficient of image matching can be used in the circumstance where isn't require high real-time but demand the high-precision. Under the improved algorithm in this paper, the matching speed had the obvious enhancement.

REFERENCES

[1] wangzhanquan, xuhui. Proficient in Visual c + + digital image processing technology and the engineering case [M].POSTS & TELECOM PRESS,2009:69.(in Chinese).

[2] Lisa Gottesfeld Brown, A survey of Image Registration Techniques,1992.

[3] Zhu Yongsong , GuoChengming .The research of correlationmatching algorithmbasedoncorrelation coefficient[J].SignalProcessing,2003,19(6):531-534.(in Chinese).

[4] Li Zhuo, QiuHuijuan. Fast image matching based on correlation coefficient,[J]. Transactions of Beijing Institute of Technology.2007, 11(27):998-1000.(in Chinese)

[5] Wang Jun, Zhang Mingzhu. Progress on image matching algorithm[J]. Atmospheric and Environmental Optical Journal, 2007, 2(1):11-15. (in Chinese)