DISTORTED QR-CODE CORRECTION ALGORITHM

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This article mainly study about the problems of image tilt and geometric distortion that may be encountered in the identification process of QR-code images,and the deformed code image is corrected by bilinear transformation, and then the QR-code symbol characteristics are used to rotate and orient the image.

INTRODUCTION

QR-code recognition mainly uses image recognition technology. First, an image containing a QR-code is collected through an image acquisition device, and then the QR-code is recognized by image processing and data processing, and finally the text information originally contained in the QR-code is extracted. Since obtaining bar code image data, there may be several deformations in the obtained image due to various reasons such as shooting angle and image bending, the acquired bar code image is not a square, but any quadrilateral.Due to the existence of this kind of distortion, the positioning and orientation of QR-code symbols and sampling and recognition work bring a lot of difficulties, so it is necessary to use a correction algorithm to correct the distorted image.In this paper, a bar code image geometric distortion correction algorithm based on bilinear transformation and interpolation methods is proposed. Binarization of the entire image, the distorted coordinates are corrected, and the corrected coordinates are obtained. The method of bilinear interpolation is used to deal with blank pixels that may appear after bilinear transformation.After solving the geometric distortion of the QR-code image, the biggest problem that affects the recognition result becomes how to correctly find the range and direction of the QR-code symbol.After binarization of the entire image, it is scanned vertically and horizontally.According to the reference decoding algorithm proposed by the QR-code standard, the position of its rows or columns can be recorded.When recording the first and last row positions and column positions, a total of 4 straight lines can be obtained, surrounded by a square.Connect the diagonal of the square to get the center point of the detection pattern.The tilt angle of the image is determined based on the triangle formed in the center of the three detection graphics of the QR-code.

I. CORRECTION OF DISTORTION

Bar code image is based on bilinear transformation and interpolation method geometric distortion correction algorithm.Vertex change shown in Figure 1, P_1, P_2, P_3, P_4 are the four vertices of the undistorted bar code image, and P'_1, P'_2, P'_3, P'_4 are the four vertices of the geometrically deformed barcode image.Use f(x,y) to represent the corrected image without any distortion, and f(x', y') to represent the uncorrected image.There is such a relationship between f(x,y) and f(x', y'):

$$f(x, y) = f(x', y'). \tag{1}$$

the coordinate value of the point (x,y) is transformed into (x', y') due to geometric distortion.The relationship between x, y, x', y' can be described as:

$$x = ax' + by' + cx'y' + d; \tag{2}$$

$$y = mx' + ny' + px'y' + q. \tag{3}$$

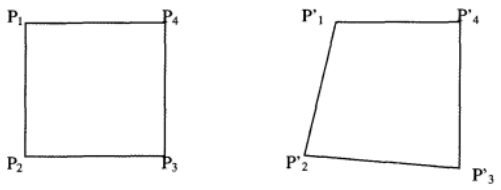

Рис. 1 – Figure 1 Vertex change

Let the coordinates of P_1, P_2, P_3, P_4 be (x_1, y_1), (x_2, y_2), (x_3, y_3), (x_4, y_4). And P'_1, P'_2, P'_3, P'_4 coordinates are (x'_1, y'_1), (x'_2, y'_2), (x'_3, y'_3), (x'_4, y'_4).

Then there are two linear mapping equations:

$$\begin{aligned} x_1 &= ax'_1 + by'_1 + cx'_1y'_1 + d; \\ x_2 &= ax'_2 + by'_2 + cx'_2y'_2 + d; \\ x_3 &= ax'_3 + by'_3 + cx'_3y'_3 + d; \\ x_4 &= ax'_4 + by'_4 + cx'_4y'_4 + d. \end{aligned} \tag{4}$$

$$\begin{aligned} y_1 &= mx'_1 + ny'_1 + px'_1y'_1 + q; \\ y_2 &= mx'_2 + ny'_2 + px'_2y'_2 + q; \\ y_3 &= mx'_3 + ny'_3 + px'_3y'_3 + q; \\ y_4 &= mx'_4 + ny'_4 + px'_4y'_4 + q. \end{aligned} \tag{5}$$

From the system of linear equations (4) and (5), a, b, c, d, m, n, p, q can be obtained, that is, the mapping coefficient of the bilinear mapping is

determined.For the gray value f (x,y) of any point (x,y) in the corrected image, the mapping coefficient can be obtained from the corresponding distortion point.[1]

II. POSITIONING AND ORIENTATION OF QR-CODE

QR-code is a kind of matrix QR-code, which is composed of dark and light-colored square modules arranged in accordance with certain rules, including coding areas and functional areas.Each detection pattern of the QR-code is staggered by the depth module in accordance with the relationship of 1:1:3:1:1.

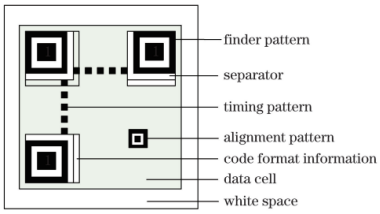

Рис. 2 – Figure 2 Structure of QR-code

Structure of QR-code is shown in Figure 3, and has this ratio in the horizontal, vertical and diagonal directions.Therefore, by searching for detection graphics, the QR-code area can be quickly located.[2]

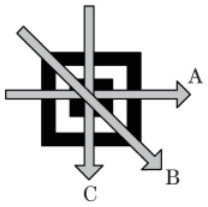

Рис. 3 – Figure 3 Detection pattern

Noting the proportional characteristics of the detection pattern, after binarization of the entire image, it is scanned vertically and horizontally.According to the reference decoding algorithm proposed by the QRcode[S] standard, the method of determining the image-seeking graphics is carried out in such a way: when the depth and depth pixels appear in a ratio close to 1:1:3:1:1, the position of its rows or columns can be recorded, and the adjacent positions can be searched until all adjacent rows or columns are found.When recording the first and last row positions and column positions, a total of 4 straight lines can be obtained, surrounded by a square, as shown in the figure.Connect the diagonal of the square to get the center point of the detection pattern.[3]

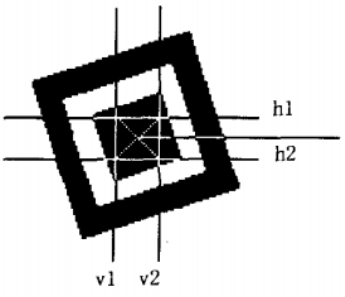

Рис. 4 – Figure 4 Detection center point

Following the above steps to find the three positions in the QR bar code symbol to detect the center of the graphic.After determining the three position detection graphics, determine the direction of the bar code.At this time, the center points of the three detection graphics can be directly connected to form a triangle.According to the structural characteristics of the QR bar code symbol, it can be seen that the vertex of the corner with the largest angle among the three corners corresponds to the center point of the detection pattern in the upper left corner of the QR bar code symbol.So as long as the position of the center point is used as a reference, rotate at a certain angle(An integer multiple of 90°) can realize the orientation of the bar code symbol.

III. CONCLUSION

This article discusses the correction and positioning methods of QR code images.First, using bilinear transformation and interpolation operations, the acquired image of the bar code symbol that has undergone geometric deformation is geometrically corrected; then it is analyzed according to the image characteristics of the QR code symbol, and based on the analysis results, a simple and fast QR code symbol positioning and orientation algorithm is proposed.

IV. References

1. Liu Ningzhong, Yang Jingyu Two-dimensional barcode recognition based on Fourier transform //-Chinese Journal of Graphics and Graphics, 2003
2. Zhang Min, Zhang Jianli Recognition algorithm of QR code based on symbol characteristic //Computer engineering,2011
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