Survey on Various Techniques to Decode Low Quality QR Codes

Remya Paul

Abstract: ***QR codes also known as quick response code is a two dimensional barcode. It was created by Denso Wave .It was frame worked for automotive industry but today it was found everywhere in magazines, billboards, newspapers and so on. Compared to barcodes QR codes can carry large data and it's more fault tolerant. Earlier there are specific scanners are used to decode QR code. Today modern handheld devices like mobile phones can capture and read QR code. But the problem is that images can be blurred or of low quality. It may be due to poor quality of the camera or external elements present in the code. This paper does a survey of various techniques available decode low quality QR codes***

Keywords: Bar Codes, Binarization, Decoding, Image Pre-Processing, QR codes, Symbologies

I. INTRODUCTION

A barcode (also bar code) is a machine-readable representation of data. Data is represented by parallel lines varying the widths and spacing and are known as one-dimensional barcodes. Later, two-dimensional barcodes were developed which are of rectangles, dots, hexagons and other geometric patterns .QR code is a 2 dimensional barcode

A. Dimensional Barcode

2-2dimensional barcodes are of two types, Database barcodes and indexed based barcodes. In database barcodes are used to increase the data capacity in barcodes. QR codes and data matrix codes are examples of database barcodes. These barcodes can be scanned by a mobile phone making it as a portable database. Indexed barcodes like visual code and color code have lower data storing capacity than database barcodes .index barcodes are more reliable and robust. Each barcodes works as an index which is having a link to any websites

B. QR Codes

Most popular 2D barcode is QR code. QR code stands for "quick response". QR codes have many advantages. They have high error correcting capacity. QR codes can be scanned from any direction and different encoding schemes can be used. While scanning there can be low quality images due to varying lighting conditions, blurring of image, and presence of scratches or arbitrary rotation of the barcodes in images. Even though here are various commercial programs available for QR code decoding, finding more robust QR code decoding algorithms still attracts many researchers. This paper deals with a detailed study on various techniques available for decoding low quality QR code

II. SURVEY WORKS

Kamon Homkajorn et al., [1] proposed a method to remove scratches by applying the HSV values in the QR code. The Hue, Saturation and value (brightness) will indicate small differences in color. This will make the scratch more distinct. Next image dilation process is applied to make the scratch even clearer .It uses a Structure Element lay over position having value 1 to add white spot and reduce black spot. So the adjacent pixels will be updated with a value 1.From this binary image a median filter is used. This experimental procedure shows an average bit error rate of 2.54. And the QR codes are now in a state where it can be decoded N.Poompavaiet al., [2] proposed a solution to remove scratches from QR code with the help of spatial thresholds. Here the scratch removal involves 3 stages .In first stage the QR code is scanned as an RGB color image. It is then transformed into a binary image based on their pixel values. In second stage from neighborhood pixels the threshold values are calculated. For a point (x,y)its pixel value is compared with all pixel values in its neighborhood and the value which is maximum among the nearest neighbors is taken as the actual value .in third stage the new binarized image having equal size of the input image is created. The proposed method claims an accuracy of 0.98 in decoding the scratched QR image Ashna Thomas et. al. [3] proposed a system that decodes low contrast QR codes which are rotated and deformed. The first step is contrast enhancement using histogram equalization. Then identified the area where the QR code is present in the corresponding image. This is performed with the help of a canny edge detector. To have the whole QR codes apply morphological processes like dilation. Then removed unwanted artifacts which are nearer to the code. The images which are having quality that is lower than a threshold are discarded. Then scratch removal operations are performed.RGB image is converted into its HSV values. Then dilation process is applied to remove the scratch from QR code .After that median filter is applied to remove noise. if the image is having some shape deformation then code alignment is performed by line scanning method and affine transformation is applied. The paper also proposes algorithm for shifted module and for invaded modules J. P. Liyanage et al., [4] proposes a barcode decoding algorithm which are suitable at barcode scanning in Point of Scales terminals. It works for charge coupled scanners and also laser scanners. This algorithm have four stages.in first step the black and white bars are identified using image detection.

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Remya Paul, Department of Computer Science and Engineering, Viswajyothi College of Engineering and Technology, Ernakulam (Kerala), India. E-mail: remyap@vjcet.org

In second step the width of the bar is calculated and bar code symboslogy is identified. Two different types of symbologies are supported, Code39 and EAN13. Last step is decoding the bar width to obtain the text data. The paper also suggests the use of dynamic values from attributes instead of empirical values and adaptive thresholding to improve the decoding rate Ramtin Shams et al., [5] proposes a novel approach to detect one dimensional bar code images. This method deals with barcodes that are of low resolution, low quality or blurred images and are de-focused with non-uniform illumination and noise. This algorithm is useful for real-time recognition of bar codes in devices like mobile phones. The preprocessor decompress the input image into a gray scale intensity map. An region of interest (ROI) detectors used to find the presence of the barcode. For this the directional nature of bar codes is used The bar code boundaries are identified by segmenter .For EAN13 symbology the minimum quiet zone width is 9dm, where d is the code density. The code density is taken as the smallest possible code density that can be detected by the algorithm. So the invalid quiet zones can be detected inside bar codes. The advantage of this method is that it's useful for real-time recognition of bar code D. Chai et al., [6] suggested a method to find and decode EAN-13 barcodes from images captured by digital cameras.

EAN stands for European Article Numbering. It have 13 numeric characters, also known as digits, where the first 2 or 3 characters are the country code followed by either 9 or 10 characters (depending on the length of the country code) for manufacturer code and product code. And the 13th character of the EAN-13 barcode is the checksum digit. The algorithm has three stages .In the first stage preprocessing is applied to the given image. Here the luminance component is obtained from the input image .In second step barcode are located by a block based technique. Here the input image is divided into non overlapping blocks of equal sizes .Using Otsu method image is converted to binary format and skeletonzing is performed in each block. The Connected Components within each block are identified and extracted. The orientation of labeled region in a block is calculated. it is measured by the angle between x-axis and major axis of ellipse which is having the same 2nd moments. If the angles in the block have same value then they have a parallel line pattern and that indicates the presence of a barcode. The third step is decoding where a sample row is obtained across the barcode image. The signal is converted to a binary image using a threshold .Now run-length encoding is performed on the binary sequence .Now it searches for left hand guard pattern. Decoder will read the next 6 sets of 4 bars to determine the values from 2nd to 7th barcode digits. Now detect the center guard pattern should be detected to read from 8th to 13th digits. The detection of Right hand guard pattern will verify the end of the barcode. The disadvantage of this method is it's designed only for EAN-13barcodes and not suited for blurred barcodes Yue Liu et al., [7] proposed a novel implementation of QR code recognition using mobile. This method can locate, segment and decode the QR code. In gray conversion method captured image is RGB color is converted into gray image. An adaptive multilevel thresholding algorithm is used in binarization. The noise is removed by using filtering method. Then perform some orientation techniques using modular distance offset algorithm. Location is found by alignment pattern. The disadvantage of this approach is that it's using filtering technique only to remove noise Jeng-An Lin et al., [8] proposed a a method to decode QR codes more efficiently and accurately. Firstly image binarization is performed to get a clearer image. From this QR code is extracted .This is done by identifying finder patterns and alignment patterns. After obtaining the QR codes resample it by perspective transformation. Then Reed Solomon error correction algorithm is used for error correction. The advantage of this method is that it is more accurate Zxing-2.1

III. CONCLUSION

The decoding of QR codes from low quality images is a challenging problem due to differences in light intensity, blurriness, orientation, alignment and complex background. Many algorithms have been proposed for decoding low quality QR Code. . It is found that various pre-processing methods like conversion to HSV values improved the accuracy of the decoding procedure. Some algorithms showcased more accuracy than Google open-source 1D/2D barcode image processing library Zxing-2.

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