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QR Code Recognition from Image

Abhishek Mehta
Shrimad Rajchandra Institute of Management and Computer Application,
Uka Tarsadia University, Gujarat, India

Abstract— One of the most challenging topics is the recognition of QR code recognition from image and encryption or decryption the information. The recognition of QR code that was defines by computer or made by the computer its self using some encryption or decryption algorithm. The particular domain is the information is encrypted or decrypts information it describe particular information in secret code that contain authentication. QR code is the type of matrix barcode, which was first designed for the automotive industry by Denso Wave in Japan. The QR Code system has become admired outside the automotive industry due to its fast readability and greater storage capacity compared to standard UPC barcodes. This paper take account of QR codes basics, its real time application in day to day life and research areas associated. With the technology of mobile phones constantly emerging, especially in the area of mobile internet access, QR codes seem to be an adequate tool to quickly and efficiently converse URLs to users. This also allows offline media such as magazines, newspapers, business cards, public transport vehicles, signs, t-shirts and any other medium that can embrace the print of a QR code to be used as carriers for advertisements for online products. QR code being so versatile because of its structural flexibility that it leads to so many diverse field for research such as increasing data capacity, security applications such as different kinds of watermarking and steganography as well. Some experiments have also been done for better recognition of the QR code image that includes scratch removal techniques. Thus, this paper is an attempt to highlight some of possible research areas while considering QR codes.

Keywords— QR code, Universal Product Code (UPC), watermarking, security, data capacity, scratch removal, steganography, encryption, decryption.

I. INTRODUCTION

A barcode is an optical machine-readable exemplification of data relating to the object to which it is committed. Primitively barcodes represented data by varying the widths and spacing of parallel lines, and may be referred to as linear or one-dimensional. Later they evolved into rectangles, dots, hexagons and other geometric patterns in two dimensions. Albeit 2D systems use a variety of symbols, they are in general referred to as barcodes as well. QR code stands for Quick Response Code, Which is the trademark for the type of matrix barcode which was invented by the Japanese corporation Denso Wave. QR code has a number of features such as large capacity data encoding, dirt and damage resistant, high speed reading, small print out size, 360 degree reading and structural flexibility of application. The basic of qr code are as follow:

A. Understanding of QR Code:

A QR code, or quick response code, is a type of barcode that can be read using a bar code scanner. These scanners are commonly referred to as QR code scanners. The scanners are in the form of apps for smart devices. These codes can contain encoded info such as website URLs, data, and text as well as pre-formatted SMSs among other things. These codes originate from Japan where they were used by Toyota to track car parts. Today, all smart phones come with a QR code scanner to ensure that everyone using a smart phone can benefit from this technology. Today, QR codes are used by businesses and companies to reach out to their client base.

B. Architecture of QR Code:

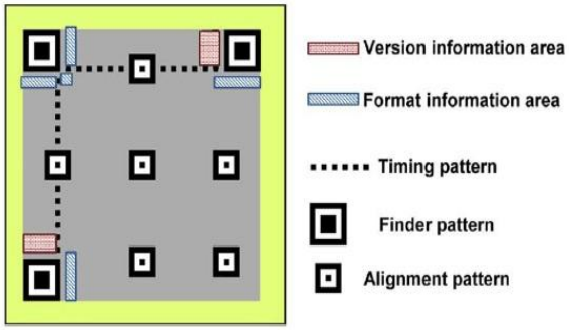

Fig.1 Structure of QR Code

Data can be translated into QR code by any QR generator, many of which are available on lie for free. User's simply enter the data converted in to secrete code electrically form. That contain authentication information like some people personal information and company's logo etc.

C. Characteristics of QR Code

1) High Capacity encoding data

While conventional bar codes are capable of storing a maximum of approximately 20 digits, QR Code is capable of handling several dozen to several hundred times more information. QR Code is capable of handling all types of data, such as numeric and alphabetic characters, Kanji, Kana, Hiragana, symbols, binary, and control codes. Up to 7,089 characters can be encoded in one symbol.

Fig.2 Example of high capacity encoding data in QR code

2) Small print out size:

Since QR Code carries information both horizontally and vertically, QR Code is capable of encoding the same amount of data in approximately one-tenth the space of a traditional barcode. (For a smaller printout size, Micro QR Code is available.)

Fig.3 Example of small print out size of QR code

3) Kanji and kana capacity:

As a symbologies developed in Japan, QR Code is capable of encoding JIS Level 1 and Level 2 kanji character set. In case of Japanese, one full-width Kana or Kanji character is efficiently encode in 13 bits, allowing QR Code to hold more than 20% data than other 2D symbologies.

Fig.4 Example of kanji and kana capacity in QR code

4) Dirt and damage resistant

QR Code has error correction capability. Data can be restored even if the symbol is partially dirty or damaged. A maximum 30% of codeword can be restored.

1: A codeword is a unit that constructs the data area. In the case of QR Code, one codeword is equal to 8 bits.
2: Data restoration may not be fully performed depending on the amount of dirt or damage.

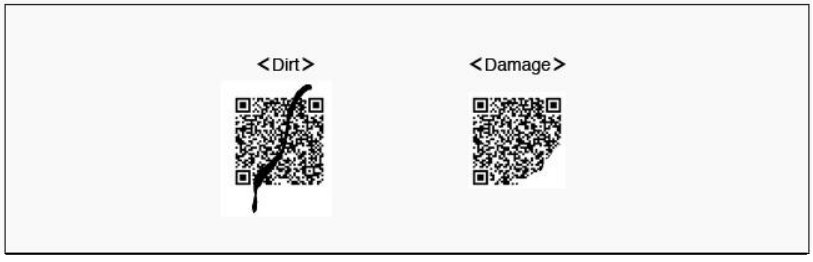

Fig.5 Example of dirt and damage resistant in QR code

5) Readable from any direction of 360

QR Code is capable of 360 degree (Omni-directional), high speed reading. QR Code accomplishes this task through position detection patterns located at the three corners of the symbol. These position detection patterns guarantee stable high-speed reading, circumventing the negative effects of background interference.

Fig.6 Example of readable from any direction of 360 in QR Code

6) Structure appending features

QR Code can be divided into multiple data areas. Conversely, information stored in multiple QR Code symbols can be reconstructed as a single data symbol. One data symbol can be divided into up to 16 symbols, allowing printing in a narrow area.

Fig.7 Example of structure appending features in QR Code

D. USE OF QR CODE:

Your business, no matter how small or large, could use QR codes in a number of ways. You might auto generate one next to every product on your web site containing all the product details, the number to call and the URL link to the page so they can show their friends on their cell phone. You could add one to your business card containing your contact details so its easy for someone to add you to their contacts on their cell phone. Add them to any print advertising, flyers, posters, invites, TV ads etc containing:

- Product details
- Contact details
- Offer details
- Event details
- Competition details
- A coupon
- Twitter, Face book, MySpace IDs
- A link to your YouTube video

II. LITERATURE REVIEW

QR (Quick Response) code recognition from image that can be input the image with qr code. That can be contain information for particular people and particular institute logo etc. that code can recognize the image and extract that portion of image. That portion contains the QR code. The different techniques are for recognition to provide the authentication code quick response codes that are as follow:

1. The algorithm for QR code recognition process based on image processing :

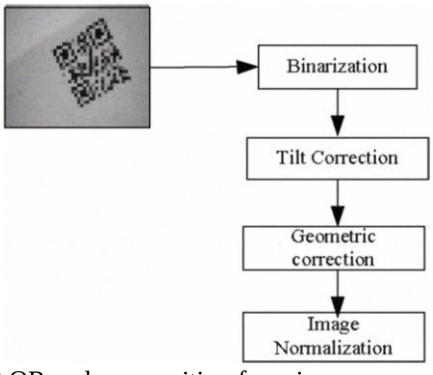

Fig.8 QR code recognition from image processing

A. Image Binarization:

Images collected are converted to grayscale format by gray-scale processing. A good binarization method takes a very important role in the entire bar code identification system. The reference points out that Nib lack method is the best method comparing a variety of local threshold algorithm. But it is very difficult to set an appropriate window size on the way, has great influence on the modules, and also takes too much time. The reference used a block thresholds method combined SOM neural network with the Niblack algorithm for binarization. The reference proposes a binarization method based on surface fitting technology using two-dimensional second-order polynomial fitting way to make the QR code background image of the surface fitting, and image segmentation. This method requires that the number of points should be two to three times than the matrix structure and the amount of image fitting in the image segmentation process of the background also need to be determined when selecting the Fitting samples for the image. The reference advises to judge the light intensity by calculating the histogram of gray image bar code, removing noise by median filter and analyzing the peak feature of the histogram. In summary, we choose the global threshold method (OTSU method) in ordinary light condition while a local threshold method (adaptive threshold) is used in the uneven light condition [1].

B. Tilt Correction:

The two methods are there *position detection* and *rotation correction*. These methods above can be used to implement image positioning, however, the time complexity is very high in some of them and others are difficult to apply in development. This paper proposes the following strategy for positioning and rotation [1]. Firstly it needs to extract the QR code symbol, and then capture the image region to ensure that the center of the QR code is the center of the new image, this step eliminates the surrounding noise information. Then the rotation angle should be determined, and finally the rotation is carried on with bilinear interpolation.

C. Geometric Correction:

The two method are used for geometric correction first is Obtain images of the *four vertices of QR codes* and *Determine the fourth vertex* [1].

*The first method contain***,** Due to the rotation process the external noise information has been ruled out, so we can scan QR code image line by line, from the eight directions of the QR code region (up, down, left, right, upper left, lower left, upper right, lower right) in a straight line to scan the QR code until two or more intersection between the line and black block. After the scan at eight directions, we will get 16 points at least; the point appeared in both directions is the vertex. When these steps are completed, there are three or more vertices. Based on the distance between vertices and the center of position detection patterns, 3 shortest vertices can be obtained and there are the vertexes.

*The second method contain***,** According to the know relationship among the location of three vertexes, we can determine the orientation of the fourth vertex in the QR code (upper left, lower left, upper right, lower right). Then the location of the adjacent two lines to the resulting the fourth vertex can be known. Scanning along the center coordinates of position detection patterns until the intersection between black line and the QR code module. The slope of the two boundary lines can be calculated.

D. Image Normalization:

The QR code image which is almost on regular can be obtained by geometric transformation. Firstly, make sure the version number of the QR code based on the decoding algorithm given in the national standard and symbol structures of QR code itself. Secondly, divide equally the QR image into n x n small grids according the version number, re-sample the center of each grid as the sampling point and get the normalized QR code symbol. In this process, since the computer step length is integer, the cumulative error must produce more or less [1]. By using of averaging method, some modules that are supposed to be within the grid shift, leading to errors in QR codes dividing. Thirdly, decode the standard QR code symbol according the National Standard Method of Quick response Code after image re-sampling.

2. QR Code Recognition using the Camera Device in Mobile Phones:

In this literature a new image reorganization algorithm for EAN barcode and QR-code (2D barcode), and this is implemented in our application platform, which was introduced in. This algorithm was developed for the current mobile phone architecture which implements an embedded camera and an application processor including DSP [2]. This algorithm used the spiral scanning method to detect a key black bar for 1D barcodes, and code area finding by four corner detection for 2D barcodes. In this study, the image processing part is implemented in DSP and the decoding and user software part are implemented in the host CPU of the application processor [2]. The following phase used for that:

- **Pre-processing:**
  The gray level histogram calculation is adopted.
- **Corner marks detection:**
  Three marked corners are detected using the finder pattern.
- **Fourth corner estimation:**
  The fourth corner is detected using the special algorithm.
- **Inverse perspective transformation:**
  Inverse transformation is adopted based on the obtained corner geometry positions to normalize the size of the code.
- **Scanning of code:**
  Sample the inside of code and output the normalized bi-level code data to host CPU.

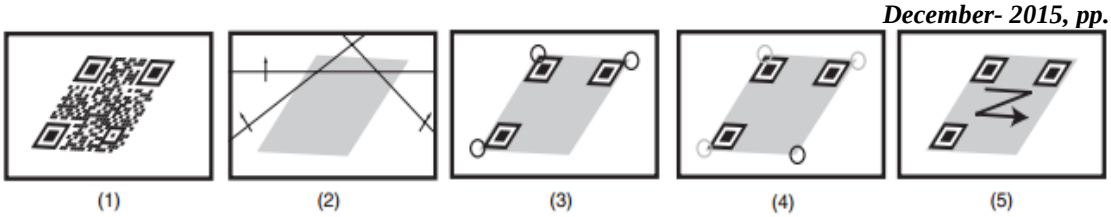

Fig.9 Phases of QR code recognition using the camera device in mobile phones

3. Automatic Recognition Algorithm of Quick Response Code Based on Embedded System

The automatic recognition algorithm of quick response code is discussed in this paper. An image processing system based on embedded system is described to be able to Binarization, location, segment, and decoding the QR code. In order to adapting various sizes, various gray-level values, and under various lighting conditions of real bar code image, a high-speed, high-accuracy Binarization method is developed, which can locate the finder pattern accurately and integrate the local thresholding method with global thresholding [3]. Experiments have shown that over 99% barcode can be optimally recognized with the proposed algorithm. It can achieve higher recognition rate of high density bar code, and is applicable to real world scene image.

III. CONCLUSIONS

The QR Code Recognition from images is a challenging problem due to differences in size, style, orientation, and alignment, as well as low image contrast and complex background. Find a completely robust and generalized technique for QR code recognition. Many algorithms have been proposed for recognizing QR Code Recognize in an image. Each method gives robust results for specified set of images. I used following method of pattern extraction: image pre-processing, Tilt Correction, Geometric Correction , Image Normalization, Segmentation and localization, feature Extraction, and classification.

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