

A Different Approach for Implementation of Scanning QR Code for Security

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ABSTRACT:

QR code has a huge use in almost everything. Keeping information in a QR code for any customized purpose is a very common thing. Several authentication systems also have a base of QR code. Tampering a QR code has also made easier by many hacking techniques that can get sensitive information. There is a chance of a QR code to be tampered while a payment or any private transaction is taking place if the client device which is not secure and already been hacked. The purpose of this paper is to overcome this problem. No scanning of QR Code will take place in the client side. Whereas all the scanning and decoding of the QR code will take place in server. It will help in many aspects of information transformation and security.

Keywords –QR code, Server, Client, Android Device. Scanning through Camera

1. INTRODUCTION:

QR codes were initially created back in 1994. A Toyota subsidiary named Denso Wave developed the code so as to assist within the producing method, they assisted in following vehicles and components. It absolutely was designed to permit the quick secret writing speeds, thus the name Quick Response code. QR codes owe their existence to the event and success of barcodes. Since their creation barcodes became extremely popular because of the speed at that they might be scanned, the accuracy they provided, and their multiple functionalities. A barcode solely holds info nicely within the horizontal direction, a QR code will do thus vertically likewise. This can be why QR codes square measure brought up as two-dimensional, as a result of they carry info each vertically and horizontally. Another direct result to the present is a larger potential to hold info in an exceedingly smaller area. Compared to a barcode, it's no competition in the least. A conventional barcode will take up to 10 times quantity the

number of printing area as a QR code carrying a similar amount of knowledge. A QR code is capable of being browse in 360 degrees, from any direction, so eliminating any interference and negative effects from backgrounds. Also, the formula that is employed to form QR codes can leave a slip margin (approx. 7-30%). QR Code is an info matrix, wants to store and transmit information, and information may be retrieved by scanning the code by QR Code scanner. QR stands for Quick Response.

2. LITERATURE REVIEW:

Now a days QR Code or 2D barcode has become very popular. There are some common advantages which make QR Code very popular. The features that QR Code have is error correction, high data storage, fast scanning, omnidirectional readability [1] [4]. QR code can store up to 2953 bytes of data where a 1D barcode can store less than 100 bytes of data [6] [7]. QR code gives user the ability to learn more about a story and watch related multimedia content [2]. User can encode text, URL, and other than data in the QR Code. Now a day's smartphones, tablets such kind of android devices are being used by a large number of users. The camera of such devices can work as a 2-D barcode scanner no additional devices are required. Besides camera, mobile application processors, digital signal processors (DSP) also play an important role [2] [8].

In QR code black module is arranged in a white background [1]. But now a days QR Code with non-uniform background can also be detected [9]. Researchers are working with coloured QR Code which has much higher encoding capacity. Mainly for mobile application the colour profile is Red, Green, Blue [10]. There are mainly five types of QR codes are there i) QR Code Model 1 & 2, ii) Micro QR Code, iii) LogoQ (Logo QR Code), iv) iQR Code, v) Encrypted QR Code [1].

3. ACTUAL WORK

QR Code is are so much popular now a days and one of the main reasons for that it can access very easily with the small devices like smart phones, tablets. Most of the cases, user use rear camera of their device to decrypt the QR Code. Also, they need a QR Code decrypting software.

3.1. WORKING PROCESS

Following steps were followed sequentially to reach the result.

1) Client side:

User takes a photo of the QR Code. At the time of taking photo no storage permission is required. The photo is kept in the device as a temporary file until it is uploaded to the server. No storage is required.

2) Server side:

- i) User uploads the photo to the server. And the photo is saved temporarily at the server while server does not process it.
- ii) Server takes the photo and converts it into greyscale image as QR Code is made of black and white colour. It is easier to work with greyscale image.
- iii) Server detects the QR Code from the image. Then it decodes the code and gets it into its original form.
- iv) Then the string is taken for further work and the photo is deleted from the storage or can be store for some time for future reference.

Then the information can be used in any process as per requirement.

3.2. EXAMPLE

As an example, Fig 3.2.1 is taken by a user and uploaded in the server. Server takes 0.959536076 seconds to decrypt and to finish its job.

The configuration of the server machine is 8GB DDR4 RAM, 240GB SSD while the CPU usage is 31.472 %.



Fig 3.2.1

Detection of QR Code

As user is taking picture it is possible that i) the QR Code became tilted, ii) presence of background, iii) flipping of image may occur, iv) noise can be present.

But most of the problems can be solved by this method.

3.3. APPLICATION

But some situation may arise when

- 1) User does not want to use or does not have any decryption software.
- 2) The rear camera of the device is not working.

In these situation users can simply take a picture of the QR Code (using front camera in case of damaged rear camera) and send it to the server. The decryption method will be written in the server. Server will decrypt the QR Code by the photo and extract the code.

Or, it can be used in a way that the QR code can only be read by the server itself. Any third-party application cannot be able to read the information from the QR code.

3.4. ADVANTAGE

The advantages of the matter are:

- 1) Sending the photo to the server is more secure way than sending the decrypted code. As intruder can do anything unethical with this decrypted code. But it is harder to tamper an image.
- 2) For sensitive data encrypted QR Code is used. But the decryption mechanism is also written in the QR Scanner part means at the user side. If user can be allowed to upload the picture of the QR Code then the decryption algorithm should be in the server. This technique ensures

much more security. Commonly server has stronger computational power relative to client device. So comparatively it takes lesser time to decrypt the encryption.

- 3) If the image is not in proper form in the terms of angle, height and stretch then also server gives correct answer.
- 4) Different format of images can be decrypted. Like - .png, .jpg, .pdf, .bmp, .jpeg, .tiff.

The Table I shows results which were come out during the implementations. We have done experiments on different categories of images files many times, out of which only 52 fruitful results have been given in this table. Here we also want to show the execution time, taken for detecting correctly or wrongly. All the images had been tested with their different formats, like .png, .jpg, .pdf, .bmp, .jpeg, .tiff.

4. RESULT

Table I
Result of The Set of Experiment

Test No.	Category of Image	Execution time [Scanning time] (seconds)	Category of Noise	Code from QR
1	Designed Simple	0.337065458	No noise	https://lead.me/api-1
2	Simple	0.096783638	No noise	Hello :)
3	Two QR code with space In between	0.203532457	No noise	Hello :)
		0.231546845		https://www.samsung.com/au/support/
4	Two QR code with no space in between	0.190686464	No noise	https://www.samsung.com/au/support/
		0.191685438		Hello :)
5	Coloured QR	0.11623764	No noise	http://goo.gl/KvHW4
6	Overlapped	0.142666817	Noise of background QR code	Hello :)
7	QR code with cartoon character in image	0.030432701	Character not similar to QR code in image	q x12=\xc3\xb6 x16\xc3\x89
8	Five QR code in one image with colourful background	0.02692914	Coloured background as noise	\xc2\xa6\xc3\x93 x11\xc3\x83\xc2
		0.027926922		W\xc3\xa2\xc3\xbb x1a9\xc3\xad
		0.028923273		\xc2\xb8\xc2\x89\xc2\xbay\xc2
		0.02992034		\x7f\xc3\x900 x11\xc2\xad x13
		0.031914234		4\xc2\xb0\xc2\x84B\xc3\xa3\xc3
9	Five QR codes in one image with white background	0.025928497	No noise	\xc2\xa6\xc3\x93 x11\xc3\x83\xc2
		0.026926756		W\xc3\xa2\xc3\xbb x1a9\xc3\xad
		0.027925014		\xc2\xb8\xc2\x89\xc2\xbay\xc2
		0.029918194		\xc3\x92\xc3\xbd\xc3\x84 x11
		0.03091526		4\xc2\xb0\xc2\x84B\xc3\xa3\xc3
10	Multiple QR codes with same information but with different image inside	0.046872854	No noise	https://github.com/sylnsfar/qrcode
		0.047875404		https://github.com/sylnsfar/qrcode
		0.048870087		https://github.com/sylnsfar/qrcode
		0.049868345		https://github.com/sylnsfar/qrcode

11	Two QR codes in image, one coloured and another simple	0.015996456	No noise	http://uqr.me/howtos
		0.016955137		http://uqr.me/howtos
12	Three QR codes with same type of background as QR code	0.027955294	Same type of background as noise	\xc2\xb8\xc2\x89\xc2\xbay\xc2\xbbgv
		0.028922796		\xc3\x92\xc3\xbd\xc3\x84\x11\n\xc3
		0.029920578		4\xc2\xb0\xc2\x84B\xc3\xa3\xc3\x96
13	Small QR code in a large image	0.034905434	Magnifying issue with large background noise	\xc2\xa6\xc3\x83%\xc3\xba12\xc2
14	QR code on another QR code with no gap	0.115687656	Background QR as noise	https://www.samsung.com/au/support/
15	QR code on another QR code with small gap	0.017952919		Hello :)
16	QR code on another QR code with gap	0.044877529		Hello :)
17	White background but very small QR code	0.065698156	Magnifying issue	Hello :)
18	White background but very small overlapped QR code	0.049876532	Magnifying issue with noise of background QR code	Hello :)
19	Rotated QR code in 2D plane	0.095743895	No noise	Hello :)
20		0.094747305		Hello :)
21		0.101728201		Hello :)
22		0.121672869		Hello :)
23		0.110704422		Hello :)
24	Designed coloured QR code	0.00882268	No noise	http://opn.to/a/C4tER
25	Rotated in 3D space	N/A	Background as noise	Could not detect due to deformation of image
26	Small rotation in 3D space	0.025931358	Background as noise	http://www.qrstuff.com
27	Tilted in backward direction	N/A	Background as noise	Could not detect due to deformation of image
28	QR printed on	0.02094388	No noise	http://goo.gl/WYDk9

	paper			
29	Text string in image	0.008975029	Text as noise	surprise :D
30	Image captured from a small distance but with slight tilt	0.564892354	Background as noise	Hello :)
31		0.959536076		Hello :)
32		1.147661448		Hello :)
33-35	Image captured from a greater distance but with slight tilt	N/A	Background as noise	Could not detect due to deformation of image
36	Random capturing of image which can happen scanning a QR code while a mass gathering	0.623654646	Background as noise with reflection occurred while capturing the image in some samples	Iquflwuziz
37		0.692147732		Iquflwuziz
38-40		N/A		Could not detect due to deformation of image
41		0.655553341		Iquflwuziz
42-43		N/A		Could not detect due to deformation of image
44		1.073789358		Iquflwuziz
45-48		N/A		Could not detect due to deformation of image
49		0.584191322		Iquflwuziz
50		0.803847313		Iquflwuziz
51		0.878626585		Iquflwuziz
52	N/A	Could not detect due to deformation of image		

5. ANALYSIS

Based on the experiments mentioned in table I, we are analyzing the matter in different aspects. Section 5.1 is used for analyzing our execution time, while section 5.2 discusses about the come-out results for the different categories of the images. In section 5.3, we are trying to discuss the effect of the proposed mechanism on multiple QR Codes in a single frame. Section 5.4 involves itself to analyze the cause of accuracy. In section 5.5, we want to highlight a comparative study of detected image on correctly and wrongly.

5.1. EXECUTION TIME

Computation time depends on the configuration of the server machine. The results shown here is based on a personal computer of specification. Specification is described in section 3.2.

5.2. TYPE OF IMAGE

Various types of image have been used for testing. Types of images are

- i) Sample of simple QR code was being shown Fig 5.2.1 which was taken during experiments



Fig 5.2.1
Sample of QR Code

- ii) We were doing experiments by putting two QR codes side by side, in all the cases, they were detected correctly. A sample of it is given in Fig 5.2.2



Fig 5.2.2
Sample of 2 QR Codes placed side by side

iii) We were also doing experiments on Two QR codes side by side without any gap between them, in most of the cases, these were detected correctly. A sample of it is given in Fig 5.2.3.



Fig 5.2.3
Sample of Two QR Codes placed side by side without gap

iv) We were also doing experiments on Two QR codes placed overlap each other, in most of the cases, these were detected correctly. A sample of it is given in Fig 5.24.



Fig 5.2.4
Sample of 2 overlapping QR Codes

v) We also checked accuracy on a Rotated QR code in the same 2D plane. In all the cases, they were given correct detections. Some of them are being shown in Fig 5.2.5.



Fig 5.2.5
Sample of Rotated QR Codes

vi) As in this mechanism, the taken picture is being sent to the server without scanning the QR Code, we had done experiment on the Image where background images were present with QR Code within same frame, sample of which is shown in Fig 5.2.6. In all cases they were successfully scanned.



Fig 5.2.6
Sample of Image having characters not related with QR code

vii) As in this mechanism, the taken picture is being sent to the server without scanning the QR Code, we had done experiment on the Image where background images which is also similar type of QR Code that comes with original QR Code within same frame, sample of which is shown in Fig 5.2.7. Most of the cases, successful results were found.



Fig 5.2.7
Sample of Image having characters related with QR code

viii) We also ran our experiments on image of inverse of QR code. It was not detected, that indicated unsuccessful results.

ix) We also ran our experiments on image of Broken QR code (Hazy image, incomplete QR code), they were not detected, that indicated

unsuccessful results. Sample image of it has been shown in Fig 5.2.8.

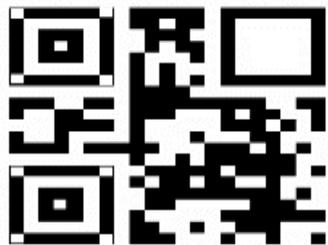


Fig 5.2.8

Sample of Image of Incomplete QR code

x) Tilted, stretched in 3D space images of QR code were being taken as experimental samples. Most of the cases, they were detected correctly. But there were some cases these were not detected, in section 5.4, the cause behind it is being tried to find out.



Fig 5.2.9

Sample of Tilted, Stretched in 3D space images of QR code

5.3. MULTIPLE QR IN SINGLE IMAGE



Fig 5.3.1

Sample of Multiple QR Code in a Single Frame

From the table in the result section we can see that multiple QR code in a single image can be decoded with a tweak of scanner program. Which is very useful for any type of image which contains many QR codes but the user needs to scan only one. Users can capture the whole image and the expected output can be created or in other terms, it can be said that the required code can be extracted which matches the purpose of use. Sample of Images were given in Fig 5.3.1.

5.4. ACCURACY

As various types of images have been used for testing, it can be seen in the result table that few of the test has not got any output as the image was deformed. The deformation can happen due to a few reasons, which are –

- i) over/under exposure of light
- ii) incomplete image (haziness, half image etc.)
- iii) Angle of taking picture-

A QR code is a square image of information. If an image of the QR code is taken from an angle, then there is a tolerance limit, inside which the QR code can be decoded else the image will get stretched causing deformation.

a. Stretching of the image-

C is the camera, which is moved to C' making an angle θ with respect to O i.e. angle of COC' = θ .

For this, B will be displayed as B'. Let, $p = BB'$.

$$\begin{aligned} \text{Tan (angle of } C'OB') &= C'B'/OB' \\ \text{Tan } (90-\theta) &= \text{Cot } \theta = h / (OB + BB') \\ &= h / (a/2 + p) \end{aligned}$$

$$a/2+p = h \text{ Tan } \theta$$

$$BB' = p = h \tan \theta - a/2$$

So, Stretch of the QR Code will be depending not only on the angle of movement of the camera, but also on the height of the Camera and length of a side of QR Code. We had observed after a certain stretch, QR Code could not be detected.

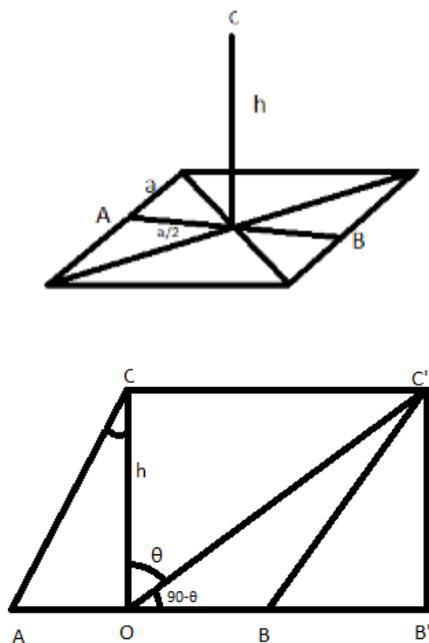


Fig 5.4.1
Figure of Explanation

iv) Noise in image-

While taking a picture from a screen, noise can appear as the screen pixels or reflection of other objects can occur the disturbance. Which can be taken care of in case of an anti-glare display screen. But regular display also does not show much disturbance. 8 out of 10 images get correct result in a single try while scanning the QR code.

5.5. ERROR RATIO

Out of 64 sample images (including multiple QR code in a single image) tested, 52 samples got the correct result and 12 samples failed to get detected. Which gives us an error of,

$$(12/64) * 100 = 18.75\%$$

In general, QR codes leave a simple margin of 7-30%.

5.5.1. ERROR REDUCTION

This error can be taken care of by simply taking a few actions which are -

- a. Not shaking the image capturing device while capturing image,
- b. Not keeping too much distance between the image capturing device and the QR code,
- c. Not tilting the image capturing too much while capturing the image, etc.

6. CONCLUSION

The primary focus of this work is to provide a solution to those who do not have a QR code reading application or have a damaged rear camera and also to secure the mode of transfer of data. The error reduction methods can reduce the error ratio up to a remarkable percentage. Also, a machine which has a good computation power can read the codes faster and process many at a time.

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