



## QR Codes and Security Mechanism Using Mobile Phones

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**Abstract:** Quick Response (QR) Code has been widely used in the automatic identification fields. In order to adapting various sizes, a little dirty or damaged, and various lighting conditions of bar code image, this paper proposes a novel implementation of real-time Quick Response Code recognition using mobile, which is an efficient technology used for data transferring. An image processing system based on mobile is described to be able to binaries, locate, segment, and decode the QR Code Which indicate that these algorithms are robust to real world scene image. 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. Experiments have shown that over 99% barcode can be optimally recognized with the proposed algorithm. Mobile phones can be made secure with generation & detection of QR code in android base application & with proper flow of information.

**Keywords:** QR Codes, Security and mobile phone.

### I. INTRODUCTION

QR Code is a two-dimensional symbol. It was invented in 1994 by Denso-Wave [1], one of major Toyota group companies, and approved as an ISO international standard (ISO/IEC18004) in June 2000. This two-dimensional symbol was initially intended for use in production control of automotive parts, but it has become widespread in other fields. Now QR Code is seen and used everyday everywhere in different countries for the following reasons:

- Several characteristics superior to linear bar codes: much higher data density, support Kanji/Chinese character, etc.
- It can be used by anybody free of charge as Denso has released the patent into the public domain.
- Data structure standard is not prerequisite for current usages.
- Most mobile phones in Japan equipped with cameras that enable reading of QR Codes can access Internet addresses automatically by simply reading a URL encoded in the QR Code.

It is nowadays a critical matter to be able to access the services like banking, shopping, communicating, storing and sharing personal information which is almost everything on-line, in the most se-cured manner. Indeed, as viruses and cracking methods become more complex and powerful by the day, the available security techniques must improve as well. Allowing users to protect their data and communications with the maximum confidence.

Some research has been undertaken on the subject of secure authentication: Young Sil [2], Kuan-Chieh [3], Mukhopadhyay [4] and Starnberger [5] present multiple approaches to this issue, the last four using QR codes and One-Time Passwords as an advisable manner to authenticate.

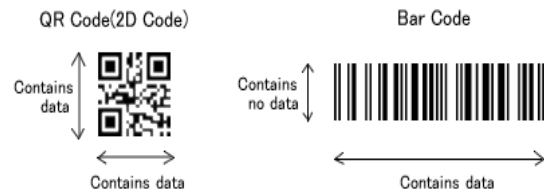


Figure 1: QR Code and Bar Code (Contains Data)

### II. BACKGROUND

QR Codes [6] have already overtaken the classical barcode in popularity in some areas. This stems in many cases from the fact that a typical barcode can only hold a maximum of 20 digits, whereas as QR Code can hold up to 7,089 characters. Combined with the diversity and extendibility offered, this makes the use of QR Codes much more appealing than that of barcodes. Statistically, QR Codes are capable of encoding the same amount of data in approximately one tenth the space of a traditional bar code. A great feature of QR Codes is that they do not need to be scanned from one particular angle, as QR Codes can be read regardless of their positioning. QR codes scanners are capable of determining the correct way to decode the image due to the three specific squares that are positioned in the corners of the symbol and the alignment blocks.

#### A. QR codes Data Types:

QR codes can contain many different types of information. Different app readers on smart phone are able to act and read this data. Think of it as an alternative way of getting data into your phone (as opposed to typing it in manually). Here are some of the possibilities.

- Contact information:** QR codes can contain contact information so someone can easily scan a QR code, view your contact details, and add you on their phone. You can input your name, phone number, e-mail, address, website, memo, and more.
- E-mail address:** A QR code can contain your e-mail address so someone can scan the code, see your e-mail, and then open an e-mail on their phones. If your call to

action is mostly to have someone e-mail you, this would be great.

- c. **Phone number:** Maybe e-mail isn't immediate enough and you want someone to call. Link them up to a phone number.
- d. **SMS:** QR codes can populate a text message with a number and message. You can have your QR code send you a text saying "Tell me more about XYZ," for instance.
- e. **URL:** The possibilities of encoding URL into barcode are endless. You can use a link that takes someone to your Facebook fan page, LinkedIn or Twitter profile. You can also link someone to a YouTube video. Check in to some place via check in link. Encoding android market or iPhone app store link allows promoting and downloading you mobile application anywhere. Or maybe you want someone to pay for something via PayPal.
- f. **Text:** You can also just have a sentence or a paragraph of text. This could be fun for having some type of QR code based game where you can leave hints in QR codes.

### III. LITERATURE REVIEW & RELATED WORK

QR Codes have already overtaken the conventional bar codes because of the main fact that the capacity of data that can be stored by a conventional bar code is very much less when compared to the data that can be stored by a 2-D barcode, the QR Code. QR Code contains data both in horizontal and vertical positions.

QR Codes have already overtaken the classical barcode in popularity in some areas. This stems in many cases from the fact that a typical barcode can only hold a maximum of 20 digits, whereas as QR Code can hold up to 7,089 characters [7]. QR Codes are capable of encoding the same amount of data in approximately one tenth the space of a traditional bar code. A great feature of QR Codes is that they do not need to be scanned from one particular angle, as QR Codes can be read regardless of their positioning. QR Codes can be easily decoded with a mobile phone with appropriate software (Kaywa Reader). Secure communication can also be established using QR Encoding techniques.

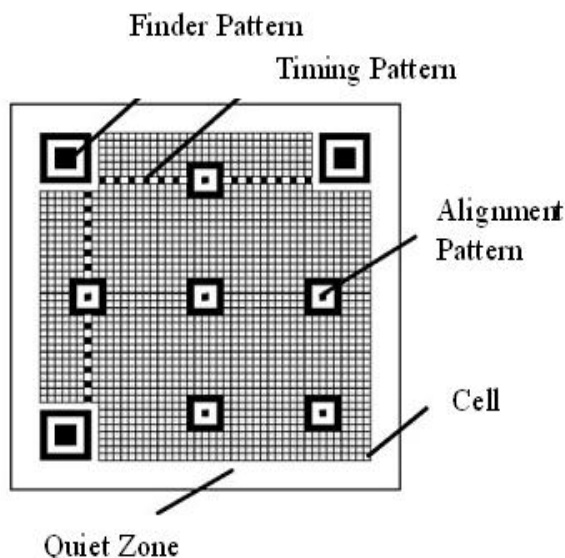


Figure 2: The structure of QR Code.

#### A. Structure of QR Codes:

QR Code is a matrix type symbol with a cell structure arranged in a square. It consists of the functionality patterns for making reading easy and the data area where the data is stored. QR Code has finder patterns, alignment patterns, timing patterns, and a quiet zone

- a. Finder Pattern
- b. Alignment Pattern
- c. Timing Pattern
- d. Quiet Zone
- e. Data Area

Fig.1 shows the structure of QR Code. The importance of each area is as described as follows

Each QR Code symbol consists of mainly two regions: an encoding region and function patterns. Function patterns consist of finder, timing and alignment patterns which does not encode any data. The symbol is surrounded on all the four sides by a quiet zone border [8]. A QR Code can be read even if it is tilted or distorted. The size of a QR Code can vary from 21 x 21 cells to 177 x 177 cells by four cell increments in both horizontal and vertical direction.

##### a. Finder Pattern:

This pattern can be used for detecting the position of QR Code. The position, size and angle of the QR Code can be determined with the help of the three position detection patterns (Finder Patterns) which are arranged at the upper left, upper right and lower left corners of the symbol. The patterns can be easily detected in all directions.

##### b. Alignment Pattern:

The alignment pattern consists of dark 5x5 modules, light 3x3 modules and a single central dark module. This pattern is actually used for correcting the distortion of the symbol [9]. The central coordinate of the alignment pattern will be identified to correct the distortion of the symbol.

##### c. Timing Pattern:

The timing patterns are arranged both in horizontal and vertical directions. These are actually having size similar to one module of the QR Code symbol. This pattern is actually used for identifying the central co-ordinate of each cell with black and white patterns arranged alternately.

##### d. Quiet Zone:

This region is actually free of all the markings. The margin space is necessary for reading the bar code accurately. This zone is mainly meant for keeping the QR Code symbol separated from the external area [10]. This area is usually 4 modules wide.

##### e. Data Area:

The data area consists of both data and error correction code words. According to the encoding rule, the data will be converted into 0's and 1's. These binary numbers will be then converted into black and white cells and will be arranged. Reed-Solomon error correction is also employed here [11].

#### B. The specification of QR code:

The specifications of the QR Code are as described in Table 1.

Table 1: The specifications of the QR Code

Symbol size	Min. 21x21 cell - Max. 177x177 cell (with 4-cells interval)	
Information type and volume	Numerical characters	7,089 characters at maximum
	Alphabets, signs	4,296 characters at maximum
	Binary (8 bit)	2,953 characters at maximum
	Kanji characters	1,817 characters at maximum
Conversion efficiency	Numerical characters mode	3.3 cells/character
	Alphanumerical/signs mode	5.5 cells/character
	Binary (8 bit) mode	8 cells/character
	Kanji character mode (13 bit)	13 cells/character
Error correction functionality	Level L	Approx. 7% of the symbol area restored at maximum
	Level M	Approx. 15% of the symbol area restored at maximum
	Level Q	Approx. 25% of the symbol area restored at maximum
	Level H	Approx. 30% of the symbol area restored at maximum
Linking functionality	Possible to be divided into 16 symbols at maximum	

#### IV. ANALYSIS OF PROBLEM

Bar codes have become widely popular because of their reading speed, accuracy, and superior functionality characteristics. As bar codes became popular and their convenience universally recognized, the market began to call for codes capable of storing more information, more character types, and that could be printed in a smaller space.

As a result, various efforts were made to increase the amount of information stored by bar codes, such as increasing the number of bar code digits or layout multiple bar codes. However, these improvements also caused problems such as enlarging the bar code area, complicating reading operations, and increasing printing cost. 2D Code emerged in response to these needs and problems. 2D Code is also progressing from the stacked bar code method (that stacks bar codes), to the increased information density matrix method [12].

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.

#### V. PROPOSED WORK & OBJECTIVES

One particularly interesting use of QR code is to exchange public encryption key information. Public key encryption is a great way to obscure and protect the integrity of data exchanged over a non-secure medium. A classic problem, however, has been the integrity of the key exchange itself. Exchanging a public key on paper and in person is the most obvious and secures solution, however inefficient. The de facto solution has been to use a trusted third party or Certificate Authority. This solution requires additional cost and more complexity, but is widely used in web transactions.

Now let's say you walk into an establishment and there is a QR code posted, or you meet a new business partner who

has printed one on his business card. Among other interesting information for your device is Intent to store a message digest of that entity's public key. A message digests, because the full text of the key is too large for QR code. There may also be information to download the public key, or in the case of Android, the key will be embedded in a signed APK file. The important thing is that you have transmitted information that allows you to verify the integrity of a public encryption key easily and over a secure medium (paper presented to you by the key's owner). Now you can trust that the key is valid, without having to go through a Certificate Authority. This paper proposes the use of public key encryption technique which allows safe transfer of data and it remains secure too.

#### VI. ATTACK VIA QR CODES

In September 2011, Kaspersky Lab detected a first-of-its kind malicious QR code. The attack method used in the QR code was that when a user scans the code he is directed towards a website and then a malicious file downloads in the user's device without the knowledge of the user. Till now, International Journal of Computer Science and Telecommunications [Volume 3, Issue 7, July 2012] 71 this is the only method of attack known about malicious QR codes. They detected several malicious websites containing QR codes for mobile apps (e.g. Jimm and Opera Mini) which included a Trojan capable of sending text messages to premium-rate short numbers [13].

#### VII. SECURITY SOLUTIONS

- QR codes are tricky because you cannot weed out the bad from the good by simply looking at the code. Because the vulnerability is practically part of the design, consider downloading an app on your phone which provides a preview to each code before it opens a webpage (e.g.: Inigma) reader. This way, you will have right to refuse the QR code is corrupted. • Scan a code and get directed to a login form, always remember never to fill it in for it may be a trap used by criminals to get access to personal information. Legitimate QR codes never ask for personal info.
- Include signage telling the user what the code does. Otherwise the user has no way of knowing if the code should point to a URL, phone number, or SMS.
- Print the URL near to the code. This way if the code is hijacked and pointed to <http://evilsite.xxx/> the user can see they're not visiting the correct site.
- Include https in the URL. Get users used to checking for https before they interact with you.
- If possible, use a short domain. Not only will it reduce the size of the QR code, it will give your users confidence if they can see the full domain in their phone's URL bar.
- Don't ask a user to get their credit card out on a busy street. Use a mobile payment solution which charges to the user's phone bill or deducts it from their credit.
- Every time you put out a QR Code in a public area, you should know where it is. If a code is on a billboard, on a storefront, or anywhere else it can be accessed by the public, it could be at risk. But you'll know your code is working correctly when you see "normal" traffic through it. If the traffic suddenly



stops, check up to make sure that the code is still there and hasn't been tampered with.

- h. Distinctive, branded QR Codes with special colors or other design features are far more likely to get attention, so you should be using them anyway. But what's more, it'll help people to know that they're dealing with a legitimate link to your brand and not a counterfeit code. It'll be much more difficult for a hacker to simulate a highly designed and colorful code than a plain one.

## VIII. CONCLUSION

As the mobile phone with camera device is getting more popular, recognition barcode based on embedded system is getting more important and practical. In general, we believe that QR codes have great potential in business media. Some possibilities are discussed in this paper and there are many creative ideas waiting for us to explore. Also, this paper can be served as the first step for the readers to investigate this exciting topic of mobile learning. In this paper examine outlined the dangers of possible malicious attacks utilizing manipulated QR Codes.

Nowadays, a relevant amount of people living in a developed country would have a smart-phone able to take pictures and scan QR codes. The suggested authentication approach is therefore a real possibility in the real world as it makes it more secure than the average authentication method, as it is based in a two-factor authentication method and not in the usual user- name and password approach. The fact that the user does not need to carry any additional device (as she would carry the phone anyway) makes it even easier and more comfortable, and the risks of misplacing the "token" will be reduced: seeing the cost of an average smart-phone and the sensitive information stored on them (contacts, pictures...) we can be sure that most users would look after it.

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