

Quick Response Code (QR Code) Data Security and Solution

Sonal Shirsath¹, Devyani Pagar², Mallikaraje Bhosale³

BE Students, Department of Electronics and Telecommunication^{1,2,3}

Maratha Vidya Prasarak Samaj's Karmaveer Baburao Ganpatrao Thakare College of Engineering Nashik, Maharashtra

Abstract: *Quick Response (QR) codes seem to appear everywhere these days. We can see them on posters, magazine ads, websites, product packaging and so on. Using the QR codes is one of the most intriguing ways of digitally connecting consumers to the internet via mobile phones since the mobile phones have become a basic necessity thing of everyone. Information about QR codes and their types get examine in the paper. Identification of objects and places in the real world is very important, and QR (2-D printing) code is useful to store identifiers of them. At the point when a barcode contains useful information or security data, the danger of security turns into an important issue. Because QR codes essentially highlight a square barcode with a special pattern, individuals have no clue whether the code will take them to legitimate data or a site loaded with malware. In recent year's security of information have become big concern in the internet, so the information hiding has become an important issue. In steganography, Steganography hides the data in a medium such as text file, image, audio, video etc., and restrain the very existence of the message in the medium from a third party. In this paper, we present a methodology for creating QR codes and how they can be used to attack human interaction and automated systems and their different data types. Latest approach is proposed for secret communication by combining the concept of steganography and QR codes.*

Keywords: QR code, Barcode, Scanner, Security, Steganography, Advantages, Dangers.

I. INTRODUCTION

A QR Code is a Matrix code; is a two-dimensional barcode developed by the Japanese organization Denso Wave. Data is encoded in both the vertical and horizontal direction, thus holding up to a few hundred times more information than a traditional bar code. Information is accessed to by capturing a photo of the code by using a camera (e.g. incorporated with a cell phone) and handling the picture with a QR reader. It is introduced in Japan by Denso Corporation in 1994 [1]. Nowadays, mobile phones with built-in camera are wildly used to recognize the QR code [1-4]. The security of one dimensional (1D) barcodes is lower than 2D barcodes. 1D barcodes are anything but difficult to read by scanning the lines and the spaces. Be that as it may, 2D barcodes are difficult to read an image pattern by human eyes. With regard to readability, one dimensional barcodes must scan along a single direction. On the off chance that the point of a scan line does not fit inside a range, the information would not be read correctly. However, 2D barcodes get wide range of angle for scanning. The key difference between the two is the measure of information they can hold or share. Scanner tags are straight onedimensional codes and can just hold up to 20 numerical digits, though QR codes are two-dimensional (2D) grid barcodes that can hold 7,089 numeric characters and 4,296 alphanumeric characters, and 1,817 kanji characters of data. Cryptography, Steganography and Watermarking techniques can be used to obtain security, secrecy, privacy and authenticity of data. Cryptography encrypts the message and makes it unreadable and unintelligent form called cipher. Steganography hides the data in a medium such as text file, image, audio, video etc., and conceals the very existence of the message in the medium. QR code is a two-dimensional bar code capable of encoding different types of data like binary, numeric, alphanumeric, Kanji and control code. A piece of long multilingual text, a linked URL, an automated SMS message, a business card or just about any information can be embedded into the QR code. Invention of two dimensional (2D) or matrix barcodes opened a new front for these cost-effective codes and their application in more complex data transfer scenarios like storing contact information, URLs

among other things, in which QR codes have become increasingly popular. A comparison of 2D barcode performance in camera phone applications can be found in Much of the efforts in matrix barcode development have been dedicated to barcodes displayed on a piece of paper as that is the way they are normally used. With the replacement of books with tablets and e-Book readers one could contemplate that replacement of the paper with LCD may open another promising front for broader application of 2D barcodes as a mean of data transfer.

II. QR CODE

QR Code has been approved as an AIM Standard, a JIS Standard and an ISO standard [5]. In 2000 years, QR Code is being issued as National standard in China [6]. QR Code (2D Code) contains data in both vertical and horizontal directions, while a bar code contains information in one way. QR Code holds large volume of data as compare to bar codes.

2.1 QR Code Structure

QR Code contains information in both the vertical and horizontal directions, whereas a bar code contains data in one direction only. QR Code holds a considerably greater volume of information than a bar code as shown in Fig. 1. QR Code is comprised of black and white patterns on geometric plane surface in the two dimensions. It uses black pattern to stand for binary number 1, and white pattern to represent binary number 0. The QR code is capable of 360 degrees (Omni-directional). There are three finder patterns located at the corners.



Figure 1: Two-dimensional QR code vs one-dimensional barcode [13]

2.2 Error Correction in QR Code

QR Code has a function of an error correcting for miss reading that white is black. Error correcting is defined in 4 levels as below.

- level L: about 7% or less errors can be corrected.
- level M: about 15% or less errors can be corrected.
- level Q: about 25% or less errors can be corrected.
- level H: about 30% or less errors can be corrected.

III. TYPICAL 2D CODE AND DATA TYPES

The comparison of the QR Code and some other kinds of 2D code are shown in Fig. 2. Below is a table of typical 2D codes and their features. QR codes information sorts QR codes can contain a wide range of sorts of data types. Different app readers on Smartphone can act and read this information. Consider it an option method for getting information into your Smartphone's (rather than writing it in manually).

3.1 Data Types

- Contact information: To view your contact details and add you on their phone. You can input your name, phone number, e-mail, address, website, memo, and more.
- Calendar event: QR codes containing event information that can contain event title begin and end date/time, time zone, area, and depiction. This could function admirably on an occasion flyer or possibly even on a website promoting.
- E-mail address: A QR code can contain your email address so somebody can check the code, see your email, and afterward open an email on their telephones. On the off chance that your invitation to take action is for the most part to have somebody email you, this would be extraordinary.

- Phone number: You need somebody to call. Connect them up to a telephone number.
- Geographic location: A QR code linking somebody to a Google Maps area. This will permit somebody to examine your QR code and get bearings so they don't need to physically sort in an address.
- SMS: QR codes can populate an instant message with a number and message. You can have your QR code send you a content saying "Reveal more about me".
- Text: You can also just have a sentence or a paragraph of text. This could be a good time for having some kind of QR code-based diversion where you can leave indicates in QR codes.
- URL: The conceivable outputs of encoding URL into barcode are endless. You can create a connection that takes people to your Facebook fan page, LinkedIn or Twitter profile. You can likewise connect somebody to a YouTube video. Register with some place by means of check in connection. Encoding android market or iPhone application store interface permits advancing and downloading your versatile application anyplace. Or, then again perhaps you need somebody to pay for something by means of PayPal.

3.2 Security for QR Code

Two differentiate threats models for manipulating Codes. Initially, attacker may invert any module, transforming it either from dark to white or the other path round. Secondly, a restricted attacker those can only change white modules to dark and not the other way around.

- **Single Color:** For this situation we restrict ourselves to the modification of a single color only. The background for this restriction lies in the situation of attacker seeking to modify a single (consequently decreasing the conceivable adjustments to changing white modules to dark).
- **Both Colors:** The simplest approach for attacking a current QR Code is by creating a sticker containing a QR Code with the manipulated QR Code in the same style as the original QR Code and positions it over the code on the advertisement. In any event when attacking large scale against one chosen target, the time required for preparation should not pose a serious limitation.

		QR Code	PDF147	Data Matrix	Maxi Code
					
Developer (country)		DENSO(Japan)	Symbol Technologies (USA)	RVSI Acuity CiMatrix (USA)	UPS (USA)
Type		Matrix	Stacked bar code	Matrix	Matrix
Data Capacity	Numeric	7,089	2,710	3,116	138
	Alphanumeric	4,296	1,850	2,355	93
	Binary	2,953	1,018	1,556	
	Kanji	1,817	554	778	
Main Features		Large capacity, small printout size High speed scan	Large capacity	Small printout size	High speed scan
Standardization		AIM International JIS ISO	AIM International ISO	AIM International ISO	AIM International ISO

Table 1: The comparison of the QR Code and some other kinds of 2D Code

3.3 Security Solutions

QR codes are tricky in fact that you can't get rid of the bad from the good by simply looking at the code. Consider downloading an application on your Smartphone which gives a preview to each code before it opens a webpage (e.g.: Inigma) reader. By this way, you can to refuse the corrupted QR code. Scan a code and get directed to a login form, dependably keep in mind never to fill it in for it might be a trap utilized by criminals to access personal data. Real QR codes never request personal data. Include signage telling the client 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 close to the code. Along these lines if the code is hijacked and pointed <http://google.xxx/the> the client can see they're not going to the right site. Include https in the URL. Get clients used to checking for https before they cooperate with you. Don't request that a client get their Visa out on an occupied road. Utilize a versatile instalment arrangement which charges to the client's telephone charge or deducts it from their credit.

3.4 Steganography

These QR codes are used for variety of applications like Secret communication, Copyright protection, and Marketing, Business, and Education etc. T. Morkel, J.H.P. Eloff and M.S. Olivier gives a brief idea about image steganography its uses and techniques. It also attempts to identify the requirements of a good stenographic algorithm and briefly reflects on which steganographic techniques are more suitable for which applications [14]. The proposed technique has been evaluated in MATLAB R2015b. The system makes use of the advantages of QR codes and Steganography to enhance data security. In this algorithm the normal message is encoded into QR codes using QR code generator (www.the-qrcodegenerator.com). The complexity of the QR pattern will increase when huge amount of data is encrypted. The modulated encrypted QR code so obtained was transferred from one phone to another by capturing the image. This captured image was successfully decoded and decrypted to obtain the actual data. This algorithm is tested with sample secret message of different sizes (100 bytes to 800 bytes). The diagram shows that the pattern and the complexity of the

QR code differs according to the size of the message encrypted. The complexity of the QR pattern will increase when huge amount of data is encrypted. The fig 3. showing the secret image is combine with generated QR code. The general message, which was generated with high error correction, gave us an opportunity to hide a secret message or normal message, this allowed the general message to scan successfully at 100% despite the presence of hidden information. The secret message was then created with an overall smaller size but still had the same pixel size. This allowed for the secret message to blend in and become completely undetectable. Unless someone knows of the secret message, there is no possible way to look at the QR code and see any modifications. If and only if the key is aligned correctly, the general message easily becomes disabled allowing only the secret message to be retrieved when scanned. The code cannot be interpreted if the key is one pixel off because of sensitive alignment. To further show the capacity of this communication method.



Figure 3: a) secret image b) Generated QR code image c) Stego image

3.5 Advantages

There are a number of other use contexts that involve creating as well using QR codes by individuals as a tool to transfer information as described by Narayanan (2012). Examples include encoding personal details in a QR code for others to scan and decode on their devices or scanning someone's QR code to load their details on the reader's phone (i.e., using the QR code as a machine-readable personal card), sending and receiving invitations (i.e., encoding detail

about an event including location in a QR code which can be posted on Web pages, or printed in other media, to be scanned by people who want to obtain the invitation). As an overview of advantages, they include the following:

- Can decide the action you want the customer to take. Follow ISO standards.
- Completely measurable.
- Instant information available to consumers.
- Reduces reprints of advertising materials, and
- Is an established marketing tool.

These advantages and ease of use of QR codes have found new adopters. New adopters and all users may not be aware that cyber criminals use these same applications to introduce “malicious QR codes.”

3.6 Dangers

The ease with which one can create and distribute QR codes has not only attracted businesses, but the criminal element as well. QR Codes, like many other mobile applications, have been developed with little forethought to security. While most of us will think twice about opening a questionable email or visiting an uncertain website, we often have no qualms about scanning a QR code. Most people are unaware that scanning an unknown QR code offers serious security concerns. While the QR code itself isn't dangerous, there is no opportunity to evaluate the site it will lead you to such as the case with an email or website. If the barcode application displays the URL, an observant user may notice a suspicious-looking URL. However, URL softeners can make it more difficult for users to evaluate the legitimacy of a URL (Vida's et al., 2012). Typically, the end user reads the code without evaluating risks, and then suffers the consequences if there are security problems. It is quite easy for a sticker to be printed containing a malicious QR code and then attached over the legitimate code, a type of attack that is known as attagging. QR codes are the perfect vehicle for malicious attacks, facilitating phishing (QRishing) attacks and redirecting users to malicious websites that host viruses, worms, and Trojans (Jain and Shanbhag, 2012). Malicious embedded URLs can lead to malware being installed on mobile devices and result in the loss of sensitive personal data and even damage to software and hardware (Narayanan, 2012).

When a user takes a photo of a QR code, the link it stores is first displayed on the device's screen; however, cybercriminals also use URL shortening services (such as bit.ly and others) to disguise the ultimate address stored in the QR code which may lead to a page with malware that steals the user's credentials or to a phishing site (Malenkovich, 2015). QR codes are seen in magazines, on billboards, and on storefronts. They seem to be anywhere and everywhere. Because of the unique ability of QR codes to bridge the gap between virtual reality and actual reality, many consumers forget that QR codes pose the same dangers as emails and websites that can have the ability to capture personal information. The general design of QR codes makes it impossible to distinguish one from another with the human eye, meaning that anyone can replace legitimate codes with an illegitimate one using a sheet of QR coded stickers. In Russia, cybercriminals used imposter QR codes to siphon cash and personal information from hundreds of smartphone owners in 2011 and were refining their methods to dupe even more users.

Several recommendations can be made with regard to security and QR code scanning. For example, companies such as Norton are developing products to help combat security issues around QR code. QR code reader Norton Snap verifies the safety of websites before they are allowed to load on your mobile device. When the QR code is read, the website's safety rating is checked and the application will block any suspicious sites. It also allows the user to view the URL. QR Pal, another secure QR code reader, utilizes SafeScan, a built-in fraud prevention technology, to alert the end user when it detects fraudulent activity associated with a scan. It is recommended that only QR code readers that allow evaluation of the URL before directing the user to a site should be used. As QR codes often lead to virus-infected sites, the mobile user should always use an antivirus app. But this is also an issue as smart phone users do not generally adopt security measures such as the use of anti-virus apps. Mobile devices are particularly susceptible to viruses, and should be actively protected. The most effective security measure is to carefully evaluate a QR code before scanning. Only scan codes from trusted sources. For example, while scanning a QR code in a magazine should be relatively secure, scanning a code on a handmade flyer would not be wise. Additionally, before scanning a code from a public venue, it

would be wise to simply feel the code to ensure that it is not a sticker, which could indicate a security risk (“Scanning QR Codes: Be safe”).

3.7 Recommendation

Several recommendations can be made with regard to security and QR code scanning. For example, companies such as Norton are developing products to help combat security issues around QR code. QR code reader Norton Snap verifies the safety of websites before they are allowed to load on your mobile device. When the QR code is read, the website’s safety rating is checked and the application will block any suspicious sites. It also allows the user to view the URL. QR Pal, another secure QR code reader, utilizes SafeScan, a built-in fraud prevention technology, to alert the end user when it detects fraudulent activity associated with a scan. It is recommended that only QR code readers that allow evaluation of the URL before directing the user to a site should be used. As QR codes often lead to virus-infected sites, the mobile user should always use an antivirus app. But this is also an issue as smart phone users do not generally adopt security measures such as the use of anti-virus apps. Mobile devices are particularly susceptible to viruses, and should be actively protected. The most effective security measure is to carefully evaluate a QR code before scanning. Only scan codes from trusted sources. For example, while scanning a QR code in a magazine should be relatively secure, scanning a code on a handmade flyer would not be wise. Additionally, before scanning a code from a public venue, it would be wise to simply feel the code to ensure that it is not a sticker, which could indicate a security risk (“Scanning QR Codes: Be safe”).

IV. CONCLUSION

QR code is now being widely used in a variety of businesses. QR code is a way of encoding more information than a traditional bar code. And most importantly, it contains information that can be easily decoded at high speed. Some possibilities are discussed in this paper and there are many clever ideas waiting for us to explore. Also, this paper can be provided as the first step for the readers to search out the exciting topic of mobile learning. QR Codes are spreading more popularity over their use for business & marketing purposes, we can believe that these kinds of attacks will receive more attention by the hacking organization in the future. In this paper a novel method is suggested for data security using QR codes and steganography. A general message encrypted in a QR code can be read easily by any QR code scanner. But since the proposed method incorporates steganography, so the secret image is hidden by using the generated QR code and the intruder can read only the information in the QR code and intruder didn’t know the existence of the secret message, it enhances the confidentiality and security. We have scoured through the internet and made a list of the top ten QR code generators. They are, -Visualead, QR code generator, QR- code Monkey, QR stuff, Scanova, QRickit, QR tiger, QR code API The purpose of this paper is easier to use QR-Codes; it is not possible to use them without technological responsibilities. It is also possible to argue that being accustomed to a technology may make the new technology easier to learn and use. In this perspective the use of QR code will increase in the related technologies like smart phones and tablets.

ACKNOWLEDGMENT

Authors wish to thank MVPS’s KBT College of Engineering, Nashik for the all-necessary facilities and their constant encouragement and support in carrying out this research review paper.

REFERENCES

- [1] Yue Liu, Ju Yang, Mingjun Liu, “Recognition of QR Code with mobile phones,” Control and Decision Conference, CCDC 2008. Chinese, pp. 203 - 206, 2-4 July 2008.
- [2] Yu-Hsuan Chang, Chung-Hua Chu and Ming-Syan Chen, “A General Scheme for Extracting QR Code from a Non-uniform Background in Camera Phones and Applications,” Ninth IEEE International Symposium on Multimedia, ISM 2007. pp. 123-130, 10- 12 Dec. 2007.

- [3] Aidong Sun, Yan Sun and Caixing Liu, "The QR-code reorganization in illegible snapshots taken by mobile phones," International Conference on Computational Science and its Applications, 2007. ICCSA 2007, pp. 532-538, 26-29 Aug. 2007.
- [4] Yuan-Cheng Lai, Frannie Han, Yi-Hsuan Yeh, Ching-Neng Lai and Yu-Chin Szu, "A GPS navigation system with QR code decoding and friend positioning in smart phones," 2nd International Conference on Education Technology and Computer (ICETC), pp.V5-66-V5-70, 22- 24 June 2010.
- [5] ISO/IEC 18004:2000. Information technology-Automatic identification and data capture techniques-Bar code Symbology-QR Code, 2000.
- [6] QR Code standard, GB/T 18284-2000, National standard of the People's Republic of China: Quick Response Code (in Chinese), Issued by China State Bureau of Quality and Technical Supervision, 2000.
- [7] Alapetite. Dynamic 2D barcodes for multiple device web session migration including cells phones. Personal and Ubiquitous Computing, 14(1):45-52, 2010.
- [8] J.Gao, V. Kulkarni, H. Ranavat, L. Chang, and H. Mei. A 2d barcodebased mobile payment system. In MUE, pages 320-329, 2009.
- [9] S. Lisa and G. Piersantelli. Use of 2d barcode to access multimedia content and the web from a mobile handset. In GLOBECOM, pages 5594-5596, 2008.
- [10] R. Bose and D. Ray-Chaudhuri. On a class of error correcting binary group codes*. Information and control, 3(1):68-79, 1960.
- [11] J. Z. Gao, H. Veeraragavathatham, S. Savanur, and J. Xia. A 2dbarcode based mobile advertising solution. In SEKE, pages 466-472, 2009.
- [12] Jagadish Paranjape. Mobile Contactless Payments Security using "NFC - Near Field Communication" technology.
- [13] T. Morkel, J.H.P. Eloff and M.S. Olivier, "An Overview of Image Steganography", June/July 2005.
- [14] "Scanning QR Codes: Be Safe." Retrieved from <http://beqrioustracker.com/scanning-qr-codes-be-safe/> on April 4, 2021.
- [15] "Scanning QR Codes: Be Safe." Retrieved from <http://beqrioustracker.com/scanning-qr-codes-be-safe/> on April 4, 2021.
- [16] "QR Code Advantages and Dangers" Retrieved from https://www.researchgate.net/publication/307879267_QR_Codes_Ad_vantages_and_Dangers/ on April 4, 2021.
- [17] https://volumeoftech.files.wordpress.com/2013/02/uc0lgbmsrermlyq_pj570bo046.gif
- [18] https://www.kaspersky.com/content/englobal/images/repository/isc/2_020/9910/a-
- [19] https://www.freebarcodegenerator.net/images/start/pdf417_link_en.png
- [20] <https://www.camcode.com/wpcontent/uploads/2012/01/DataMatrixCode1-1.jpg>
- [21] <https://www.barcodefaq.com/wp-content/uploads/2018/08/maxicodeups-example.g>
- [22] <https://4.imimg.com/data4/BY/MC/MY-12990669/dahlia-flower-pot500x500.jpg>
- [23] https://www.researchgate.net/profile/P_Sutheebanjard/publication/25_1987247_QR-code_generator
- [24] <https://ijesc.org/upload/15de67d580745fa9233dd9906e322d67.QR%20Code%20Se>
- [25] <http://www.ijirst.org/articles/IJIRSTV3I12062.pdf>

BIOGRAPHY



Sonal Ajay Shirsath
MVP's KBT COE, Nashik.
Savitribai Phule Pune University, Pune.
shirsathsonal@kbtcoe.org



Devyani Dhananjay Pagar
MVP's KBTCE, Nashik.
Savitribai Phule Pune University, Pune.
pagardevyani@kbtcoe.org



Mallikaraje Sanjaysing Bhosale.
MVP's KBTCE, Nashik.
Savitribai Phule Pune University, Pune.
bhosalemallikaraje@kbtcoe.org