

A Review on QR Code Analysis

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ABSTRACT

“Quick Response” (QR code) is a matrix code. As compared to one dimensional barcodes it must store huge volume of information and using any handheld devices like Smartphones it must be decrypted at high speed. These two points are taken into consideration while designing two dimensional matrix codes. When a bar-code contains vital information or privacy information, the chance of security becomes a very important aspect. Because QR codes merely feature a square bar-code with a distinctive pattern, individuals are not aware if the code can take them to respectable information or misguide them to a website loaded with malware. Now of late, a QR code is applied in several application streams associated with promoting, security, lecturers etc. and gain popularity at a really high pace. Gradually more people are getting familiar with this technology and use it accordingly. The popularity of QR code grows swiftly with the growth of smartphone users and thus the QR code is briskly arriving at high levels of acceptance worldwide. With the wide implementation of QR code, the protection feature of QR code is serious, like data leakage and data alteration. This paper emphasizes on the analysis of QR code and its applications.

Keywords: QR Codes, Quick Response Codes, QR Code Analysis.

1. INTRODUCTION

QR Code is the acronym for Quick Response Code, specifies that the code contents should be decoded quickly at high speed. QR code is an optical tag that can be read by machine with information on the associated product or item. A QR Code is a two-dimensional code that can store data information and designed to be read by smartphones. In Japan, in 1994, Toyota subsidiary, Denso Wave developed the QR codes to keep check on automobile components throughout manufacturing.

Data is retrieved by capturing the picture of the code employing a camera and process the image with a QR reader. The major contrast between the QR code and Barcode is the volume of information they can store or share. A QR Code can store the same volume of information accommodated in a 1-D Bar Code in one-tenth the space. Bar codes are linear 1-D codes and can store up to 20 numerical digits only, whereas QR codes are 2-D matrix barcodes that can store 4,296 alphanumeric characters, 7,089 numeric characters and 1,817 kanji characters of information.

The code composed of black modules organized during a square pattern with white background. The QR Code was designed with special position-detection patterns situated in three corners of every image. The QR code system consists of a QR code encoder and decoder. It is the responsibility of the encoder to encode the data and generate the QR code, while the decoder decodes the data from the QR code. A unique feature of QR Codes is that it can be scanned from any angle, as QR Codes can be read despite of their positioning. QR Code encompasses many options like massive capability information encryption, dirt and damage proof, high speed data reading, small print out size, 360 degree reading and structural flexibility of applications. The QR Code's, powerful error-correction potentiality is achieved by adding Reed-Solomon Codes (mathematical error-correction method), to the authentic data. This allows a QR Code image to be scan even if it is dirty or broken.

QR Codes is utilized in a spread of how to promote a business, to produce any info on a product or service by encryption general text, URL, phone numbers, business cards and even provide Wi-Fi access. A recent application of QR codes is India's 'Aadhar' project which assigns a unique identification number to the residents of India.



Figure 1. QR Code^[3]

2. LITERATURE REVIEW

Quick Response code is usually authenticated with the help of the camera of one's mobile phone. QR codes can easily be scanned through mediums like Tablets, laptops and personal computer desktops. The system automatically generates the ID of the user and its password. The characteristic which makes QR codes stand out is they can still be scanned even if they are partially damaged.

QR codes are a 2 dimensional printing code on a paper or a screen which makes it pretty vulnerable from various type of cyber-attacks. It can harm your device by unknowingly directing you to a virus contaminated page or website. To avoid this, one must verify the origin of a particular QR code and must have a full understanding of the data type of that particular QR code. There are many attacks involving QR codes as well as their solutions.

QR codes are becoming quite popular nowadays because of the rapid increase in smart devices by the normal people around the world. Obviously, 2D QR code is way better and store huge amount of encoded information compared to the old traditional 1D codes. People are using smartphones to do authentications and for this the QR codes are the most ideal way to do it. Many types of QR codes are getting popular nowadays including logo QR code, encrypted QR code, iQR Code etc.

QR codes are becoming popular day by day in the upcoming generation as it offers way easier authentication than the traditional old fashioned user id and password. QR codes offers many advantages such as greater storage capacity, fast readability, 360 degree reading, small print size, error correction, support for more languages and durability against soil and damage. Many firms who are relatively new in the online business are tend to use these codes instead of normal login process.

To fix the QR information / security issue, Xiaohe Cao proposed a safe QR code scheme based on visual cryptography. The security problem of QR code is severe, such as data loss and data tampering as the implementation of QR Code is wide enough. The QR code is split into two shared pictures which will be transmitted singly. The development of the two shared pictures is based on the pseudo-random matrix, i.e. the pixels are determined by the pseudo-random matrix values in the two shared pictures. The two images shared can only be stacked to revive the information. Simulation output demonstrates that the picture of the QR code can be masked well and can be efficiently reconditioned.

Peter Kieseberg has examined how both automated systems and human interaction can be attacked using QR Codes. As the encoded data is meant to be machine readable only, one cannot differentiate between a legitimate and a harmful corrupted QR code. While automated readers are very much endangered to SQL injections and command injections, individuals might be prone to phishing attacks. Peter Kieseberg contribution is a survey of the QR code as an attack vector, demonstrating different attack plans for the attackers to read and explore their implications.

3. METHODOLOGY

Scientific research has been playing an important role in the progress and enrichment of new age technology. Research is invention or scientific investigation or scientific enquiry to extract truth or invent new concepts by scientific way. Descriptive research consists of fact-finding enquiries and surveys of various kinds. The main motive of descriptive analysis is explanation of the state of affairs as it currently exists. Research can be either applied to study or to fundamental studies. The objective of applied analysis is to find a solution to an instant issue facing a community or an industrial/business organization, whereas basic study is primarily worried with generalizations and the formulation of a theory. Quantitative research is based on quantity or quantity measurements. It applies to events that can be stated in

quantity terms. On the other side, qualitative research is concerned with the phenomenon of quality. Conceptual study involves some theory or abstract ideas. Theorist and thinkers typically use it to develop fresh thoughts or reinterpret current ones. However, inquiry relies on knowledge or examination alone, often without proper scheme and theory consideration. It is data-based study, resulting in judgments that can be checked through observation or experimentation. We did QR Code analysis with the assistance of all these techniques.

3.1 QR CODE STRUCTURE



Figure 2. Structure of QR Code^[3]

Finder Pattern (1): The finder pattern comprises of three identical structures that are situated in all corners of the QR Code except the bottom right one. Each pattern is based on a black module matrix of 3x3 encircled by white modules that are again surrounded by black modules. The Finder Patterns allows the decoder software to identify the QR Code and determine the exact orientation.

Separators (2): The white separators have a width of one pixel and boosts the recognition of the Finder Patterns as they isolate them from the actual data.

Timing Pattern (3): In the Timing Pattern, alternating black and white modules allows the decoder software to determine a single module's width.

Alignment Patterns (4): Alignment Patterns helps to reimburse the decoder software for mild picture deformation. Version 1 QR codes have no Alignment Patterns. With increased code size, more Alignment Patterns are added.

Format Information (5): The Formation Information section is made up of 15 bits next to the separators and stores data about the QR code error correction rate and the masking model selected.

Data (6): Data is converted into a bit stream and then stored in information segment in 8 bit sections (known as code-words).

Error Correction (7): Similar to the data section, error correction codes are stored in 8 bit long code-words in the error correction section.

Remainder Bits (8): This section consists of empty bits, if data and error correction bits cannot be split into 8 bit code-words without remainder.

To enhance code recognition by the decoder software, the entire QR code must be encircled by the so called Quiet Zone, an area in the identical color shade as white modules.

3.2 QR CODE ATTACK

Kaspersky Lab diagnosed a first-of-its kind corrupted QR code in September 2011. The attack method applied in the QR code was that once the individual scans the code he is taken to a website which downloads a malicious file within the user's device without the knowledge of the user. Till now, this is the sole technique of attack familiar regarding malicious QR codes. They detected many malignant websites having QR codes for mobile apps (e.g. Jimm and Opera Mini).

4. RESEARCH FINDINGS

QR codes contain many alternative styles of information. Different app readers on Smartphone are able to act and read this data. Think of it as an alternate means of obtaining information into your phone (as substitute to writing it manually).

Here are some of the possibilities:

Calendar event: If there is an event that you would like to promote, you can create a QR code containing info for that event. QR codes containing event information will contain event title, start and end date/time, time zone, location, and description.

Geo location: If you have an event you want to promote, you might want to stick a QR code linking someone to a Google Maps location. This will permit somebody to scan your QR code and obtain directions so that they do not have to manually search for an address.

Wifi network: does one hate telling somebody an extended WEP wireless key that is a pain to input manually on a mobile phone? Set it up therefore somebody will scan a QR code and automatically connect to WiFi on through their smartphones.

URL: the probabilities of encryption web address into barcode square measure endless. You can use a link that takes someone to your Facebook fan page, LinkedIn or Twitter profile. You can link somebody to a YouTube video. Check in to some place via check in link. Encoding Android Playstore or iPhone app store link enables promoting and downloading your mobile application anytime anywhere. Or maybe someone can just pay for product or service via PayPal.

4.1 MERITS OF THE QR CODE

- **Omnidirectional and Fast Scanning:** QR code can be read much faster and within 360 degrees can be scanned from any angle i.e. no need to place the scanner as per the code symbol.
- **Small Size:** QR code takes less space. A QR Code can hold the same volume of information contained in a 1-D barcode in only one-tenth the space.
- **Huge Data Storage Capacity:** QR code has high data storage capacity. A single QR Code token can store up to 7,089 numerals (200 times the volume of information storage capacity of the traditional 1-D barcode).
- **Many Types of Data:** The QR Code can handle numerals, alphanumeric characters, Japanese, Chinese or Korean letters and binary data.
- **Error correction:** Error correction technique used in QR codes enables successful decoding of the code symbol even if up to 30% of the data is dirty or damaged.
- **Available for Everyone:** Anyone can make their own QR code according to their need, for example, user can create QR code of the URL of its own website for advertising purpose.
- **Wide Range of Uses:** There are lots of potential uses of QR codes. They can be implemented to extend the user experience in store, restaurants, websites and more.

4.2 DEMERITS OF THE QR CODE

Although QR code has many positive points on its side but, there are some demerits of the QR code too, such as, Need of QR code scanner; to decode the code users must have a QR reader app, which limits the audience; Security issues, the scanner never really knows where the code is going to lead the user before scanning a QR code; Lack of public awareness, large portion of population is still unaware of this technology.

5. FUTURE SCOPE

QR codes are becoming one of the most prime facet in cashless transactions. They were already hugely popular and in use in the European countries as well as in America but in past few years, they are gaining momentum in South and East Asia.

In China, the implementation of QR code has even surpassed cash and card based transactions. This has to be one of the biggest achievements so far for these QR codes. In India, there is a rapid hike in the usage of QR codes and the new era of cashless India is ushering upon the country's horizon.

Many people argue with the fact that QR codes are used as a second fiddle while doing money related transactions. These codes are slowly becoming first preference for many users in the recent times.

The main limitation of QR codes is that they are only being used to redirect to a webpage or website but they are not collecting any information on their own. If in this hugely data driven world, if these codes start to collect information and start a two-way transaction then it will surely stabilize in this technology market for future years.

Another limitation regarding the application of QR codes is that one must have a QR code reader or scanner installed in their mobile or tablet to be able to scan and read the data held by the QR code. Instead of this, we can create and integrate the QR code scanners in our smartphone's camera itself so that we don't need any other third party application to scan the QR codes.

QR codes have been scrutinized by many of the technology and security pundits but still it has been loved and accepted by the normal people at a high context. They have been literally used everywhere as far as promotional events are concerned like mobile payments, coupons, air ticket coupons, business cards, new business profile promotions etc.

There are new technologies launching in the last couple of years who are better or more secure than QR codes, but still QR codes will be there for many more years to come because of the ease of their use and many people in the developing countries already adapting them in the recent past. So it is a rare possibility that they will again turn to a new technology after taking so much years to get used to the QR codes.

6. CONCLUSION

In this paper, we have discussed about the analysis of QR codes as well as their applications. The capacity of these codes to store data is very high plus they are damage resistance which makes them overcome one of the key concerns of security. In the past decade or so, the application of QR codes in public domains like supermarkets and in educational purposes like book scanning or stationary scanning has been increased rapidly and it will continue to thrive in more fields as the awareness will increase.

The QR code technique is getting popular day by day and at the same time it is becoming increasingly secure as the technology is enhancing. Once, the awareness about these codes increases, it will get a wide spectrum to evaluate its significance. In near future, this technology will be used in wide public domains. Firstly, QR codes were used to store the information about inventory products but nowadays it is being used in the huge industries like marketing, secure payment systems, advertising, education systems etc.

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