QR Code Analysis

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Abstract- QR code stands for 'Quick Response' code. It was developed by Denso Wave Corporation in Japan. QR code is a two-dimensional barcode which is able to encode more information than one-dimensional barcode. Also, QR codes are fast readable codes. The emergence of smart phones increases the use of QR code because a smart phone has features of scanning and decoding a QR code. The emergence of technology in the area of mobile internet access encourages the online marketers, newspapers and magazines to use QR codes for the advertisement of their products. These codes have various significances over traditional barcodes like greater storage capacity, fast readability, 360 degree reading, small print size, error correction, support for more languages and durability against soil and damage. Due to these benefits, the use of QR code has spread all over the world. The paper attempts to highlight the QR codes, its characteristics, working, significance and downsides.

Keywords- QR code, Barcode, URL, QR code reader, Smart phones, Encoding

I. INTRODUCTION

At the time of high economic growth period of Japan in 1960s, the supermarkets were selling a wide range of goods that are foodstuff, clothing, household accessories etc. At the cash counters, price of these goods had to enter manually in the cash registers. Consequently, many cashiers faced the wrist problems and carpel tunnel syndrome. So the cashiers wanted to find some way to reduce the burden of this manual typing.

The invention of barcodes was the first step towards the solution of this problem and the use of barcodes gave a relief to the cashiers. When the codes printed on the product were scanned by optical sensor then the price and other basic information of that product was automatically displayed on the cash register.

As the use of barcodes spread, one of the prominent limitations came in the way that a barcode can only store 20 alphanumeric characters of information. But the users were demanding more storage capacity in the barcodes and then after many years of research, Denso Wave Corporation developed a new type of code which has greater storage capacity than earlier barcodes and has fast readability also. Hence the code was named as "Quick Response code" (i.e. QR code).

This paper gives an understanding of QR codes and its characteristics in the next section. In section 3, working of QR code is discussed. In section 4, significance and uses of QR codes have been presented. Section 5 discusses the downsides of QR code. Section 6 is the conclusion of the paper [2], [5].

II. WHAT IS QR CODE

QR code is a two-dimensional encoding of information and it is also called matrix code. This matrix code is machine-readable that consists of black and white squares. It can store information in the form of URL (Uniform Resource Locator), contact information, link to videos or photos, plain text and much more [1].

A. QR Code Architecture

Each QR code symbol looks like a square pattern. This square pattern consists of two regions: encoding region and function patterns.

The function patterns concentrate on the positioning where the encoding region represents the data encoding.
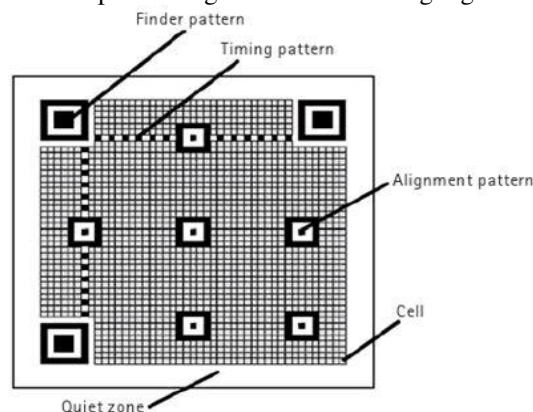

Fig. 1 Architecture of QR Code

Fig. 1 shows the structure of QR code symbol. The function pattern comprises finder patterns, timing patterns and alignment patterns. Three common structures on the three corners of QR code symbol are called finder patterns. Finder pattern is used for deciding the correct orientation of the symbol. Timing patterns are used by the decoder software to find the side of pattern. Alignment patterns are used in the case of image distortion to correctly decode the symbol by decoder software.

The rest of the region i.e. other than function pattern is the encoded region where data code words and error-correcting code words are stored [3].

The Quiet zone is the spacing provided to distinguish between QR code and it's surrounding. It is important for the scanning program.

B. *Characteristics of QR Code*
1) High Storage Capacity

A QR code symbol can store up to 7,089 characters of information, which is a huge amount as compared to 1-D barcode.

2) Encodable Character Set
  ➢ Numeric data (Digits 0-9)
  ➢ Alphanumeric data (upper case letters A-Z; Digits 0 - 9; nine other characters: space, : % * + - / _ $)
  ➢ Kanji characters

3) Small Printout Size

The information in QR code is stored in both horizontal and vertical directions. Due to this feature, for the same amount of data, space acquired by QR code is one fourth times less than the space acquired by 1-D barcode.

4) 360 Degree Reading

QR code is readable from any direction. This feature is provided by the finder patterns present at three corners of the symbol. The finder pattern helps to locate the QR code.

5) Capability of Restoring and Error Correction

If the part of code symbol is damaged or dirty, data can be recovered. The error detecting procedure can focus on the region of correct information. There are four levels of error correction of QR code that are L, M, Q and H. The level L has the weakest and level H has the strongest error correction capability [3].

III. WORKING OF QR CODE

Main objective of QR code development is encoding and to make reading easy for user. The working of QR code includes coding and decoding of information.

A. *Creating a QR Code*

QR code can be created in a few seconds. Firstly go to a website that generates QR codes. The www.qr-code-generator.com is used here to create QR code symbol.
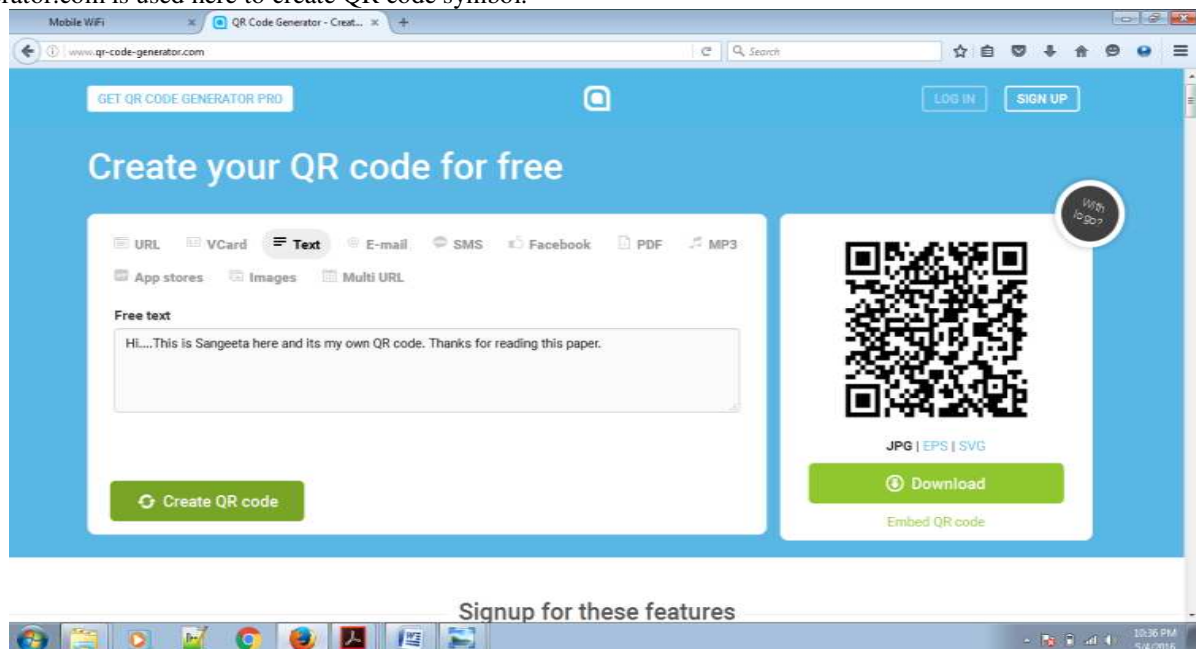

Fig. 2 Creating QR Code for Text Message

Fig. 2 shows how a QR code can be generated. User can choose the type of code that he wanted to create and then enter the information to be attached with the symbol. Then click "Create QR code" button and then the QR code symbol gets generated on the right side of the screen. Now it can be downloaded by clicking on "Download" button present below the generated code. The next step is scanning or decoding.

B. *Scanning a QR Code*

To scan or read a QR code, user is required to install a QR code scanner app on his smart phone. A number of QR code scanner apps are there on app stores for free. After installation, start the application and bring the camera of smart phone in front of the QR code to scan it. It will automatically display the content of QR code scanned.
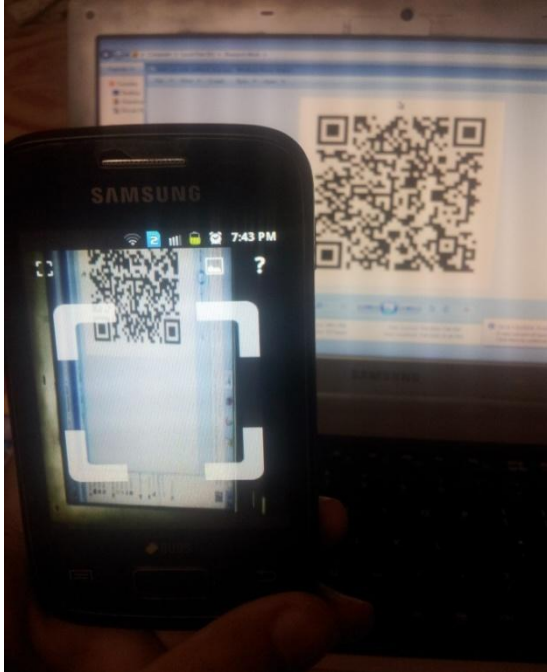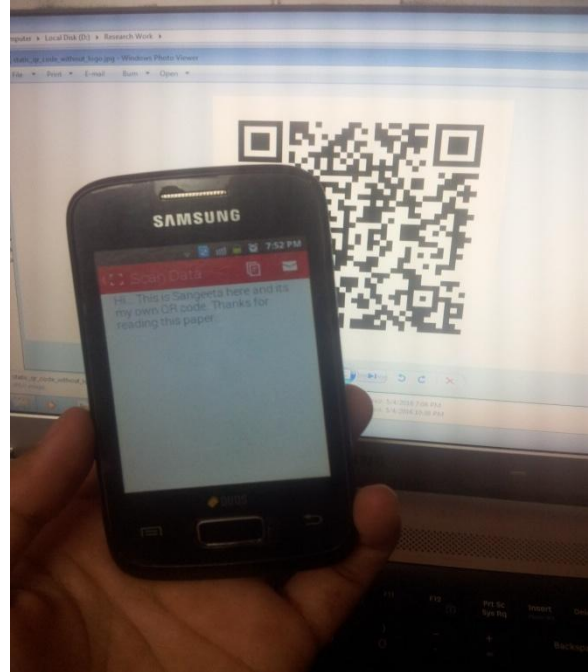

Fig. 3 Scanning QR code

Fig. 4 Displaying Decoded Message

Fig. 3 and 4 shows the scanning and decoding of text message.

IV.   SIGNIFICANCE AND USES OF QR CODE

QR code provides simple creation and easy access to QR code readers. Hence the QR codes are being widely used for linking to companies' website, advertising products, online menus and contest sign-up pages.

QR codes printed on a building might enable the visitors to know about the history of the building or it may give the information of its architect and about how the building was built.

There are many ways of using QR code. Some of them are listed below.

A. *On Company Business Cards*

An excellent location for QR codes is business cards. Meet somebody at any gathering, scan a code and get their contact information saved in your smart phone automatically.

B. *Magazine Advertisements*

The ad of a product in a magazine along with a QR code may bring the reader to the company's site and customer may read about the product and he may end up buying the product.

C. *Cafes and Restaurants*

The preferred customers of a cafe or any restaurants may be offered something free or special discounts with their next meal by using the printed QR code on their dining tables.

D. *Equipment Manufacturers*

The product manufacturer may add QR codes on instruction manual that can take people to the online content for helping them to use their products.

E. *Talking Labels*

A product label may become alive by printing QR code on it. The code may take the visitors to a video or may display some interesting photos of the product that may impress the buyers.

V.   DOWNSIDES OF QR CODE

Everyone is not aware of QR codes. Consequently, not everyone who sees a QR code symbol will pull out his cell phone and take a picture of the code.

Also, not everyone has a camera phone and many mobile phones do not include a QR scanner.

Moreover, users may be directed to a web address that is not able to display properly on a mobile phone.

If the code printed on the product gets fully damaged during transportation then the code cannot be scanned [4].

VI. CONCLUSION AND DISCUSSION

In this paper, QR codes are analyzed from the perspective of their significance and uses. The working of QR code is discussed to make reader familiar with the QR codes. QR code can store complex information within a small code. As awareness increases about the usefulness of these codes, we can expect them to be used in more public domains.

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