Evaluating Quick Response Code and Its Scanning Process Using USB Device

Anjali Singh

Department of Computer Science and Engineering
DCRUST, Sonipat (Murthal), Haryana, India

Parvinder Singh

Department of Computer Science and Engineering
DCRUST, Sonipat (Murthal), Haryana, India

Abstract: - A Quick Response Code is a 2D barcode which enhances the features of 1D barcodes like it can store a lot more information than 1D barcode. It looks like a square made up of black and white small boxes or cells. These cells contain information and data of the QR code. This proposed work concentrates on the concept of QR Code and its scanning process. Firstly a study is done to get the general information about the QR Codes in order to give people a detailed understanding about them. Additionally, it explores the usage of QR Code in different fields. Secondly proposed work learns about the scanning process of QR Code and gives an idea about its scanning techniques. This research work proposed a website which explores and analyses the scanning of QR Code Using USB device. Alongside scanning of QR Code this website also scans three other barcodes to give an idea about other existing barcodes.

Keywords – QR Code, Scanning, Image Pre-processing, Binarization, Linear Barcode, PDF 417, Data Matrix Barcode, USB Device

I. INTRODUCTION

The QR code is a new marketing technique followed by the marketers in different countries. It is addition to the linear barcodes which store data horizontally but this code is two dimensional which stores data both horizontally and vertically hence making more space for storing more data and still takes less representational space on products on which it is printed. Increased usage of the internet and smart phones were the major reasons for the increased use of QR codes as marketing tools. Marketing surveys in India found that the QR codes were attractive and the increasing smart phone users were taking interest in knowing the advantage of scanning the QR codes and then use it to get more information about the product by scanning them from newspapers advertisements, bill boards, visiting cards, brochures, products. Analyzers expected that it would lead to a change in print advertising techniques for marketing new products.

QR Code is created and protected by the Japanese company Denso Wave in 1994. The main objective of QR Code development is encoding and reading easily for user. Denso Wave announced QR Code is released to the world in 1994 whereas Denso Wave retains the patent right of the QR Code. [1][2]

1.1 Characteristics

The characteristics of QR Code make it more reliable technology to use instead of linear barcodes. It has high capacity encoding of data. It can store up to 7089 character in just one symbol. It has small printout size. It has capability of encoding numeric, alpha-numeric, kanji and kana characters. The QR codes have restoring capacity using its 4 different levels of error correction. It is readable from any direction in 360 degrees and it has structured appending feature i.e. QR code can be divided into different QR codes and also data of different QR code can be stored in one QR code. [4]

1.2 Structure

In structure of QR Code, each QR Code symbol is constructed by square. The structure consists of different patterns and zones which make it different from other 2-D barcodes. [3][4]

-The Position patterns of QR Code verify that it is QR code which is confirmed by 3 squares located at three out of four corner of the symbol.

-Separators are white pixels which separate the position pattern cells from the rest of the data.

-The timing pattern cells are placed between two position patterns alternatively which tracks down the timing of incoming code.

-The alignment pattern is used while capturing the code using camera for correcting the distortion caused while taking picture.

-Data zone of QR code is the area where encoded data is stored.

-The Quiet zone is the margin of at least 4 bits around the code in order to detect it properly.
-The version module shows the version of QR Code.

-Format Information helps in error correction and data restoration while code is distorted .It is located next to separators and while decoding it is read first by the scanner.

1.3 Type

With the development of QR code five different types of it is also developed which are QR Code model 1 and model 2, Micro QR Code, IQR code, SQRC code and Frame QR Code [4][5].
-QR Code Model one and Model two is the typical type of QR code which is considered as main structure of QR code for other types.

-Micro QR Code is type of QR code which is has main feature different from it is that it has one position detection pattern and it has reduced size of printing.

-IQR Code is QR code which is present in both square and rectangular shape so that they can easily be printed on cylindrical products too. It stores more data in less space as compared to regular one.

-SQRC is full formed as Secure Quick Response Code hence it provides security to encoded data by providing reading restriction to it.

-Frame QR codes are the QR code which has canvas area for providing different shapes to QR code and making it more attractive to users and customers.

1.4 Usage

QR codes are used worldwide and in the last decade its usage is increased in different aspect of life like in marketing, advertisement, sales, business, film industry, education etc. It has entered in India too, in last few years QR code is recognized by Indians too and making full use of it. Few examples of its usage in India are illustrated below.

-Now ticket booking is done using QR Codes whether it is movie ticket or railway ticket both are booked using QR code scanning. Book My Show app and Indian railway official site IRCTC are now using QR code in their ticket booking process.
-In India newspaper advertisements are very popular means for communicating with customers and with the increased use of smart phones companies use QR codes in their ads to get good access and give more information about their product to customers. Brands like SBI Bank, Fair and Lovely, LG, SimplyMarry, Sikka Group,Job Vacancies use QR code in their advertisement now.

-QR codes are now used in newspaper articles too. The Times of India an English newspaper now use it in its articles so that if user want to know more information about the news than they can scan the QR code on their mobiles.

-The Aadhaar Card newly introduced in India as an individual identification card use QR code to store information about the person whose card is that.

-In business QR codes are used for developing business/visiting cards. These cards have Google Maps location encoded in QR code. Besides visiting cards, QR codes are also used in marketing also.

-To access a nearby hotspot user just have to scan the QR code and then freely use the Internet.

-Nowadays in job search too QR Codes are used by linking resume and other details in QR codes.

-PayPal and Paytm apps which use mobile money transferring use QR code for their purpose for better experience to users.

-QR codes are used on products while packaging so that users can access more information about the product and give their feedback by visiting their respective sites which is encoded in QR code.

II. RELATED WORK

QR code is a 2D barcode which is extension to the linear barcodes that means former one extends the features of latter one. QR barcodes are also used to store the encoded data but store a lot more data as compared to traditional ones. The scanning of QR code is the technique with the help of which the QR code is captured and scanned for extracting the encoded data which is present in it. For scanning barcodes a method called image pre-processing is performed in order to get capture good image of barcode for decoding the encoded data. Below given some related researches done by researches on scanning and decoding of QR code.

Yunhua Gu and Weixiang Zhang [6] proposed to solve the QR code recognition problem caused by ordinary camera. They present a recognition algorithm based on image processing. Based on other recognition algorithm, some improvements are presented to speed up the image processing and to achieve more simply.

Kong Suran [7] paper proposed the algorithm that uses corner detection with convex hull algorithm. Experimental verification tells that the algorithm raised by the paper achieves good effects of geometric correction by finding four apexes of QR code. It also increased the recognition rate of distorted QR code images.

Jeng-An Lin and Chiou-Shann Fuh [8] presented a method for 2D Barcode image decoding in Automatic Identification and Data Capture (AIDC). In their paper, they revised the traditional decoding procedure by proposing preprocessing methods and by using this method they tried to recognize different types of QR code images.

Yue Liu et.al. [9] presented an implementation of real–time QR Code recognition using mobile. An image processing system based on mobile is able to binarize, locate, segment, and decode the QR code. The result shows that these algorithms are robust to real world images.

David Pintor Maestre [10] presented the design and implementation of QRP, an authentication system that uses a two-factor authentication by combining a password and a mobile phone which has embedded camera, as an authentication token. It can be used securely in untrusted computers and is able to successfully authenticate even when the phone is offline.

Manoj S. Rewatkar and Shital A. Raut [11] presented a survey on information hiding methods. Information hiding method using QR barcode using Hash function, information hiding method using QR barcode using TTJSA symmetric key algorithm, information hiding method using QR barcode using SD-EQR and information hiding method using QR barcode using reversible data hiding are surveyed.

Sankara Narayanan [12] discussed QR codes different data types, attack via QR codes and security solutions because it is easy to modify the content stored in the 2-D code so verifying the identifier written in the 2-D barcode is issued by the authorized party is important.

III. QR CODE SCANNING

The QR code images are scanned in different environmental conditions using camera and in order to get information stored in the code it must be scanned correctly. By scanning code means that the user wants to see the data stored in the code. To get the access to the information or encoded data user install the scanner app in their device or they use scanner and scan it. As a result the scanner after scanning the image and show the information stored in code on the screen. This process of scanner is known as QR Code Recognition Process which consists of Image Pre-processing and QR Code Extraction. [4][13]

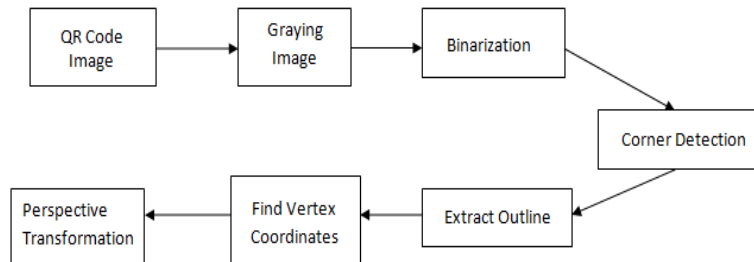### QR CODE IMAGE PRE-PROCESSING METHOD

Figure 1. QR Code image pre-processing method

In QR Code recognition image processing is an important step. The QR Code recognition rate depends on the results of image processing [14]. The image pre-processing method generally consists of following steps as shown in figure 1.
-QR Code Image: The image of QR code is captured using camera which is in RGB format.
-Graying Image: The QR Code is captured in RGB format which is vulnerable to redundancy. Hence Graying of RGB image is done first i.e. RGB image is converted in gray level image. [14]
-Binarization: In real life situations, due to improper light in the surrounding the brightness of the image also affected and this makes difficult to get a good image. Here comes the role of binarization [6]. Binarization plays a very important role in QR code scanning process.
-Corner Detection: To extract the vertices and outline of the code corner detection is done first and then it makes easy to extract apexes coordinates.
-Extract Outline of QR Code: To remove skewness caused while taking picture of code this is to be done in order to avoid difficulties while decoding.
-Find Vertex Coordinates: In order to extract outline, at first the coordinates of all four vertices of code are obtained and then the skewness is corrected.
-Perspective Transformation Correction: In last step perspective transformation is done. It is done to correct perspective distortion of QR code image. The distorted QR code image contains the details of irregular quadrilaterals which help in correcting geometrical distortion [7].

IV. PROPOSED WORK

The proposed work is based on scanning of QR code using USB device. Based on the investigation done on earlier researches this work tries to enhance the scanning portion of QR code. The features proposed in this work are as follows:

- The proposed work is based on web based version of scanning barcodes.

- In this research scanning of QR code is done by developing a website. The website act as scanner for users, it takes input i.e. barcode image using USB device like webcam and scans it to show the data encoded it the shown barcode.
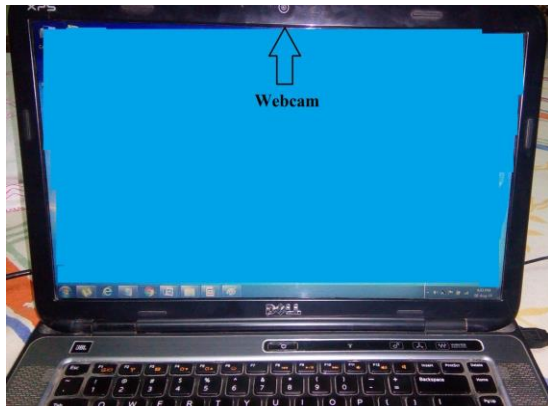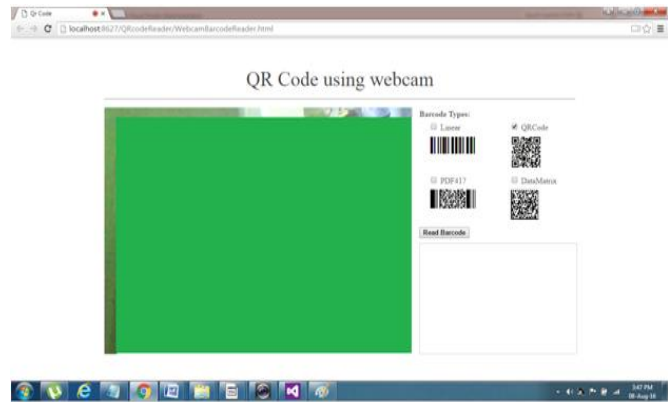
Figure 2. Laptop with build-in webcam   Figure 3. Proposed website used for scanning barcode

-The proposed website gives details about the barcode type, its size, date and time of capturing the image along with the output i.e. encoded data.

Figure 4. Proposed website gives details about barcode

- The proposed work develops a website which not only scans QR code but along with it three barcodes are also scanned which are linear barcode, pdf417 barcode and data matrix barcode. By this user can scan four different barcodes on single website.
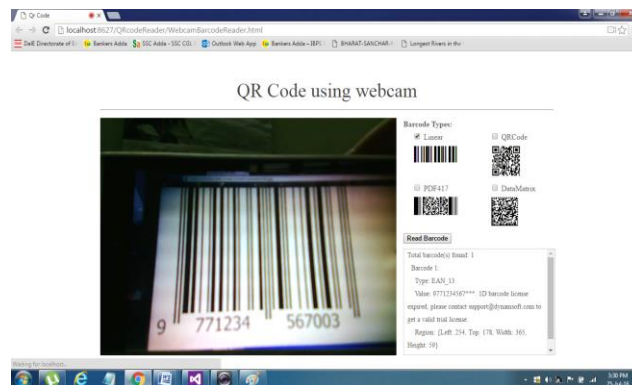

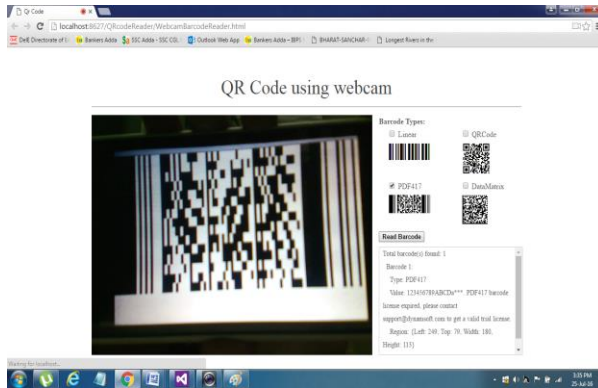Figure 5. Scanning Linear Barcode
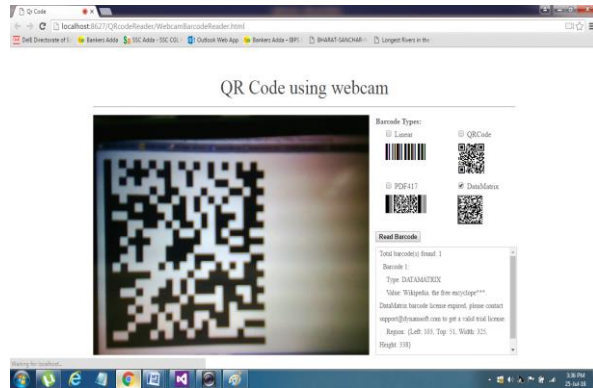
Figure 6. Scanning PDF417 Barcode

Figure 7. Scanning Data Matrix Barcode

The proposed work focuses on scanning of QR code for which a web page is developed. Following are some terms which should be known for this research work are discussed here.

- USB Device: USB device which is used in this work is webcam. Web cam is short form for Web camera which is a video camera and used for capturing image in your computer. It can connected using USB cable to computer or nowadays laptops have a built-in camera and microphone. The features of web cam includes a microphone, head has ability to pan and tilt in all directions, a built-in sensor to recognize movements and hence start recording and a light to let the user know that camera is on. [15]

- Linear Barcode: A linear barcode or 1D barcode is the barcode which stores data one dimensionally or we can say that horizontally. These characteristics limits the size of linear barcode hence 2D barcodes are developed. It contains machine-readable data encoded in it. In the beginning of linear barcodes they are used to represented data by changing width and space between parallel lines. Some examples of it are Code128, Code 93, Code 39, EAN-13, UPC-A, Codabar. 1D barcode has size of less than 85 characters. Usually these barcodes are used to store information about companies' products. [16]

- PDF417 Barcode: PDF417 barcode is a 2D barcode which has very high data density. One PDF417 symbol is illustrated as numerous linear barcodes stacked over each other and that's why it is sometimes called stacked linear barcode. The term PDF stands for Portable Data File and 417 shows that each pattern contains 4 bars and spaces, and 17 units long. Some of the additional capabilities of PDF417 are linking, user-specified dimensions and public domain format. The PDF417 is rectangular in shape and its size can be changed by user. For high quality of PDF417 good printing accuracy and printer resolution plays vital role. This code can be used in marketing, transport, ID cards, etc. [17]

- DataMatrix Barcode: Same as QR barcode datamatrix barcode is also a 2D matrix barcode matrix which contains black and white modules. It is either in squares or rectangular shape. The encoded data in it consists of text or numeric. Its data size ranges from few bytes to 1556 bytes. The number of cells in the code determines the size of encoded data. The main determining factor or finder pattern for this code is two solid adjacent borders in the shape of "L" and its timing pattern consists of other two borders having alternate dark and light modules. The size of code varies from 10×10 modules to 144×144 module. The applications of this code are in aerospace, medical, electronic, postal services automotive industry, etc. [18]

V. RESULTS AND ANALYSIS

In previous section proposed website is discussed. By using the website the scanning of QR code is done. The most popular method of scanning the barcode is done by using desktop based version scanners in which users have to first download and then install the software of scanner in order to scan the barcode and all this effort to scan only one barcode. A more convenient way of doing so is checking barcode using web based version hence in this work we use web based version of scanning. Using this site user's scan barcodes by just showing their barcode in front of webcam and website displays the data store in it. Earlier mostly web based version are used to scan only one or two barcodes on one site but proposed website not only scan QR code but also scan other barcodes like linear barcode,

pdf417 and data matrix barcode so in order to scan other barcodes, users don't have to switch to other sites. The proposed work provides a convenient way to scan barcode using USB device like webcam which is available easily to users and it also scans four barcodes which are very popular among product making companies.

The usage of QR codes is increasing on daily basis now and more and more people took interest in using it for their respective purposes especially marketing. So below discussed are the statistics related to the popular use of QR code worldwide and also its increasing use in India.

According to website Google Trends [19], at present i.e. in 2016 the top 10 countries which take keen interest in QR Code scanning are Japan, Qatar, Taiwan, Hong Kong, South Korea, Czech Republic, Singapore, Germany, Sri Lanka and Uruguay. The related data is shown in below given table and graph. The usage of QR code is highest in Japan but now its use is spreading worldwide very rapidly due to the era of smart phones.

Table1 shows the percentage of people who scan QR code in different countries.

Country	Percentage QR Code scanned by people worldwide
Japan	100
Qatar	74
Taiwan	68
Hong Kong	59
South Korea	45
Czech Republic	40
Singapore	35
Germany	32
Sri Lanka	31
Uruguay	30

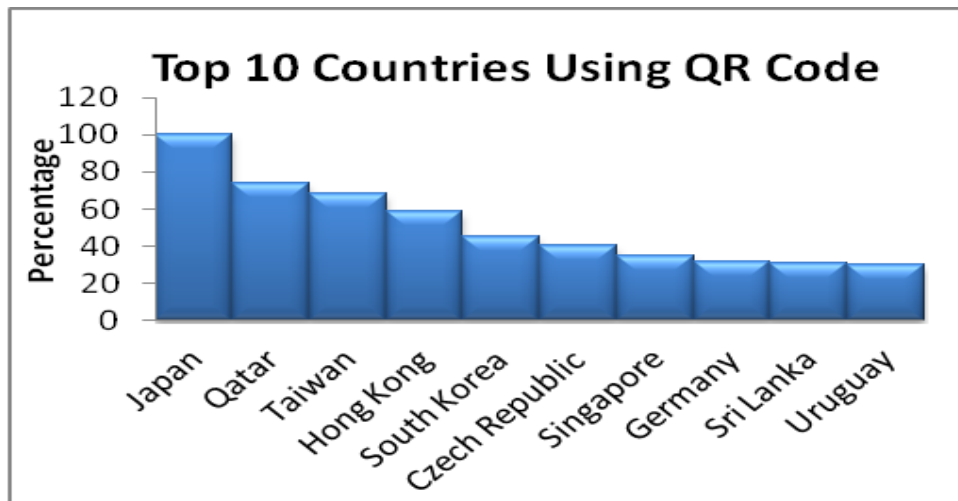Table 1. Top 10 countries which use QR code

Figure 8. Bar Graph shows list of top 10 countries using QR Codes

The below given data is created by QRStuff.com [20] users which is based on analysis of QR codes in the year 2014. This data gives us the idea of the usage of QR codes i.e. figure 9 gives us information about the usage of QR code for different purposes and the users who scanned it for those purposes.
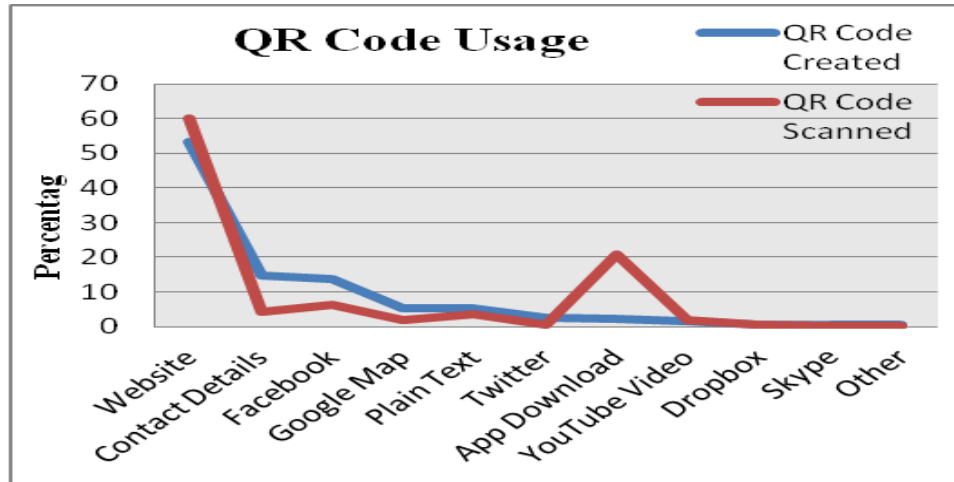
Figure 9. Line Graph shows QR code usages for different purposes

According to website Google trends [19] the interest of people in India has increased over the past decade and the figure 10 gives the relevant data about it and table 2 shows the percentage of people using QR code in India from year 2004 to 2016.

Figure 10. Line Graph shows QR code interest in India (2004-2016)

Year	Percentage QR Code Scanned in Respective Year
Jan,2004	12
Jan,2005	15
Jan,2006	17
Jan,2007	6
Jan,2008	11
Jan,2009	17
Jan,2010	11
Jan,2011	37
Jan,2012	70
Jan,2013	72

Jan,2014	66
Jan,2015	96
Jan,2016	85
June,2016	92

Table 2. Interest of People in India over Time

Figure 11 shows the detail about the top ten states of India which shows keen interest in using QR code. This list is topped by Goa state in which user shows 100 % interest in using this barcode.
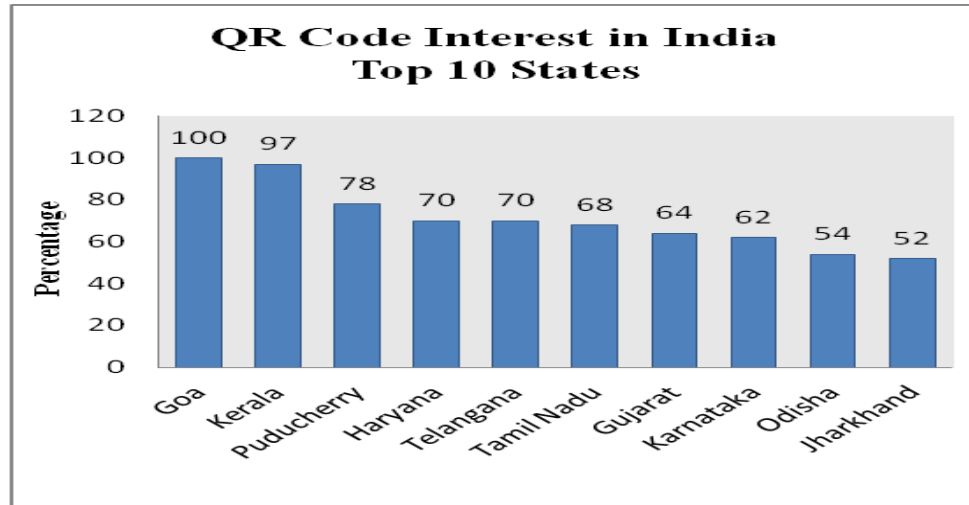

Figure 11. Bar Graph shows top 10 States using QR code in India in 2016

Now QR code is used worldwide and India is also taking interest in using it. Many companies are now using it for their business purposes. Now newspapers advertisements have QR code for getting more information related to the advertisement. Moreover people of India with the use of their smart phones are scanning it and using it for getting information, discount coupons etc. This technology has very much which is to be explored in the favor of customers. Like with the development [21] of internet technologies, transmission of data over the internet is easy hence the security problems arise which can be solve using encryption i.e. by encrypting the data of QR code enhance the security level. Encryption is technique is used to solve all kind of security problems. [22] [23] So this aspect of QR code should be taken into account by the future researches.

VI. CONCLUSION AND FUTURE SCOPE

This work concludes that QR code is an increasing trend worldwide. But being new its possibilities are yet to be explored and also it has so much on which researchers can do research on. Experiments can be done on different aspects of QR codes like enhancing the security for the encoded data, better and fast recognition rate, reducing redundancy of data in code for adding more data in the saved space, encoding data like audio, etc. Due to structural flexibility of QR code the researchers can increase the performance by combining it with other technologies. By doing so, experiments can be done to increase data capacity of QR codes or find out the way of using coding techniques in it or use better encryption on the encoded data for enhanced security. In general, we believe that QR codes have great potential and there are so many creative ideas yet to explore.

REFERENCES

[1] H. Hanks, "Successful Scanning: A Guide to QR Code Best Practices", (2012), The Agency Inside, PP. (1-18), [Online] Available: http://www.harte-hanks.com/static/base/ qrcode-wp.pdf
[2] Anekar et al., International Journal of Advanced Research in Computer Science and Software Engineering 5(3), March - 2015, pp. 694-698
[3] Prabakaran et al., International Journal of Advanced Research in Computer Science and Software Engg. 5(1), January - 2015, pp. 660-666

[4]   Singh, A, & Singh, P, "A REVIEW: QR CODES AND ITS IMAGE PRE-PROCESSING METHOD," IJSETR, Vol.5 (6), pp.1955-1960, 2016.

[5]   QR Code.com. Web. 20 Apr. 2016. <http://www.qrcode.com/en/codes/>.

[6]   Gu, Yunhua, and Weixiang Zhang. "QR code recognition based on image processing." Information Science and Technology (ICIST), 2011 International Conference on. IEEE, 2011.

[7]   Kong, Suran. "QR code image correction based on corner detection and convex hull algorithm." Journal of Multimedia 8.6 (2013): 662-668.

[8]   Hindawi Publishing Corporation Mathematical Problems in Engineering Volume 2013, Article ID 848276, 10 pages <http://dx.doi.org/10.1155/2013/848276>

[9]   Liu, Yue, Ju Yang, and Mongjum Liu. "Recognition of QR code with mobile phones." Control and Decision Conference, 2008. CCDC 2008. Chinese. IEEE, 2008.

[10] Pintor Maestre, David. "QRP: An improved secure authentication method using QR codes." (2012).

[11] Rewatkar, Manoj S., and Shital A. Raut. "SURVEY ON INFORMATION HIDING TECHNIQUES USING QR BARCODE."

[12] Narayanan, A. Sankara. "QR codes and security solutions." International Journal of Computer Science and Telecommunications 3.7 (2012)

[13] Abdullah et al., International Journal of Advanced Research in Computer Science and Software Engineering 4(11), November - 2014, pp. 62-72

[14] Y. Wang and X. Zhang (Eds.): IOT Workshop 2012, CCIS 312, pp. 305–312, 2012.© Springer-Verlag Berlin Heidelberg 2012

[15] Shital Y. Gaikwad et al, / (IJCSIT) International Journal of Computer Science and Information Technologies, Vol. 5 (5) , 2014, 6102-6105

[16] Wikipedia.org. Web. Downloaded June11, 2016. <https://en.wikipedia.org/wiki/Barcode>

[17] Wikipedia.org.Web. Downloaded June 11, 2016.<https://en.wikipedia.org/wiki/Data_Matrix>

[18] Wikipedia.org. Web. Downloaded June 11, 2016. <https://en.wikipedia.org/wiki/PDF417>

[19] Google.co.in. Web. Downloaded August 11,2016.<https://www.google.co.in/trends/explore?date=all&geo=IN&q=/m/03ffwl>

[20] QRStuff.com. Web. Downloaded August 11, 2016. <http://blog.qrstuff.com/ >

[21] Singh et al., International Journal of Advanced Research in Computer Science and Software Engineering 4(4), April - 2014, pp. 81-86

[22] D. Hooda and P. Singh, "A Comprehensive Survey of Video Encryption Algorithms," Ijca, vol. 59, no. 1, pp. 14–19, 2012.

[23] Kalra, Mamta, and Parvinder Singh. "EMD Techniques of Image Steganography." Kalra, Mamta, and Parvinder Singh. "EMD Techniques of Image Steganography."