

A novel approach for enhancing data storage capacity in Quick Response code using multiplexing and data compression technique.

Mona M Umaria

Department of Computer engineering and Technology
Parul Institute of Engineering and Technology
Vadodara, India

G.B Jethava

Department of Information and Technology
Parul Institute of Engineering and Technology
Vadodara, India

Abstract—This paper focuses on increasing the data storage capacity with less storage space of QR code by applying compression techniques. Further data capacity can be increased by applying multiplexing techniques i.e. grouping of bits into codeword and providing security by replacing the codeword by special type of character. As there are varieties of medium for information sharing over distances. Thus QR code can be used as information sharing medium. QR code is 2 Dimension Barcode and comes under the category of data hiding techniques as it store data in hidden form. It stores data in matrix form using unique pattern. Data from QR code can be retrieved by using phone Camera of 2 Mega pixels or more. As QR has many advantage over 1D so it has been used in many diverse field for research areas such as techniques for data hiding like scanning of barcode, watermarking , steganography, Histogram based techniques, techniques for better recognition and also for security purpose it can be used in more application.

Keywords— 1D Barcode, 2D Barcode, Security.

I. INTRODUCTION

QR code is abbreviated as Quick Response codes, started out as an extension of the standard UPC barcode commonly used in retail and production^[27]. Unlike a 1-D barcode, a QR code is a 2-D matrix code that conveys information by the arrangement of its black and white elements in columns and rows in matrix form as shown in Figure.1. The data in a QR code can be accessed by taking a picture of the QR code and processing it with a QR code reader^[27]. Throughout history, there is a huge effect of technology on the means of communication. Far before, the means of communications used to be a letter which was replaced with fax and e-mail with the rapid growth of the technology. Thus, it increased requirements of faster means of communications. Every day the researchers all over the world work on developing new technology tools for safe and better media of information sharing. Communications of Secret data is transmitted by using appropriate information sharing medium according requirements of application. Finally 2D barcode is generated for given data which hides data readability. This paper focuses attention on the basic understanding of QR code and applying methods for enhancing QR data capacity. Section II shows features and issues of QR code. Section III shows Comparison with 1D barcode. Section IV shows proposed techniques for increasing data storage capacity of QR code by applying

compression algorithm and providing security by multiplexing of data and replacing with special character/symbols of mapping table shared between transmitter and receiver.



Figure1: QR code with some data.

II. FEATURES AND ISSUES OF QR CODE

Feature:

(1)It is effective way to share information as it can be used by anybody free of charge as Denso wave has released the patent into the public domain and High Encoding Capacity.^[1] (2)It can't be duplicated as data is in hidden form^[21]. (3)It compresses the size of data thus increase efficiency. (4)QR code is readable also in online or offline mode.^[1] (5)Reduce Memory Requirements and faster readability as by arranging the finder patterns into three corners of the symbol, the decoding speed of the QR Code can be made 20 times faster than that of other matrix symbols. (6) Dirt and Damage Resistant as Symbols often get distorted when they are attached onto a curved surface or by the reader because of tilting. To correct this distortion, QR Code has alignment patterns arranged at three corners of the QR code symbol and also has Structure linking functionality.^[1] (7) 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.^[1] 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.

Real life Issues:

The QR Codes gain increasing popularity through their use for marketing purposes, it is expected that this kind of attack will receive more and more attention by the hackers in the future. (1)It is commonly used in many advertising purpose and making payments thus security issues also arise so always use

secure protocol like “https” for transaction [10].(2)The attack method used in the QR code was that when a user scans the code, a malicious file downloads in the user’s device without the knowledge of the user and data can be easily hacked by hacker[11] (3)By Scanning a QR code and the user get redirected to a login form, and ask for the confidential information always remember never to fill it in, because it may be a trap used by criminals to get access to secret information as Legitimate QR codes never ask for personal information[11]. (4)QR codes are tricky because you cannot judge out the bad from the good by simply viewing at the QR 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 so that one can know that it is corrupted [10].

III. COMPARISON BETWEEN 1D BARCODE AND 2D QR CODE

Barcode scanning is one of the data hiding techniques containing 1D and 2D barcode type. The 1D barcode does not contain any data within itself, rather it represents the “key” to a record in a database, where associated information is stored e.g. By scanning barcode of the product we can easily retrieve the product price from its database, where as Quick Response code contains data that are encoded in both the dimensions i.e. row and column of the symbol. The main advantage of using 2D barcodes is that possibly a large amount of easily and accurately-read data can be carried to which it is attached.

TABLE 1: COMPARISON OF 1D BARCODE AND 2D QR CODE [1]

| Features | 1D | 2D |
|------------------------------------|-----------------------|---------------------------|
| High Capacity | 10-20 digits | Up to 7089 numeric digits |
| Language supported | Numeric, Alphanumeric | kanji, kana, Numeric, etc |
| Reduced space | 10 digits numeric | 40 digits numeric |
| 360° Reading | Not supported | Supported |
| Durability against dirt and damage | Not possible | Possible |

IV. PROPOSED METHOD

The aim of proposed work is to create a two-dimensional barcode which achieves a high encoding capacity by using data compression algorithm and concept of multiplexing and demultiplexing of data which occupies a small area and provides security. More amount of information can be grouped into single quick response code as data is compressed first. Here, data is hidden in unique pattern by data hiding technique i.e. 2D bar-code. By Combining data compression techniques and multiplexing method [2] we can increase data capacity and provides data security. Privacy of data is preserved by generating QR code for message to be sent. Now Multiplexing of QR code image is done depending upon the values of n and 2^n where n is the combination of bits to be multiplexed and 2^n is number of patterns formed by the combination of bits.

Depending on the value of n the pattern can be increased or decreased and data capacity can be increased.

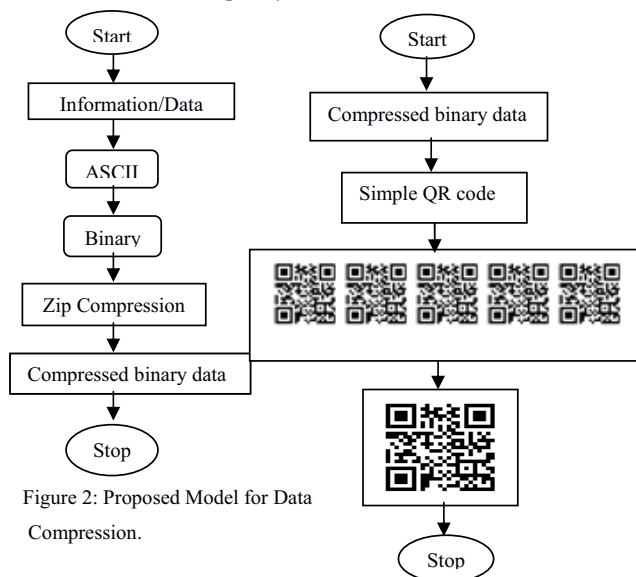


Figure 2: Proposed Model for Data Compression.

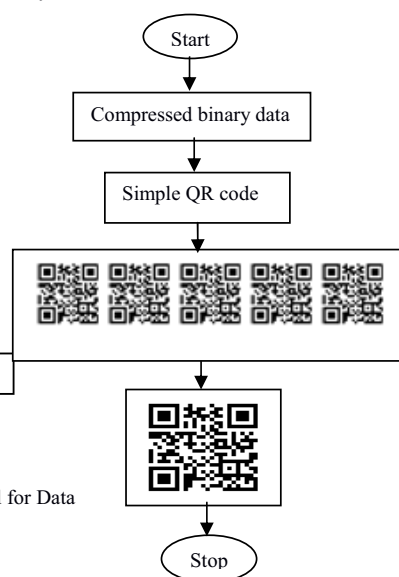


Figure 3: Proposed Model for Data Multiplexing.

As shown in figure.2 the proposed model analyze the input data stream to identify the variety of different characters to be encoded. Data can exist in variety of forms such as text, bits, bytes, numeric, meta data alphanumeric. QR Code includes several modes that allow different sub-sets of characters to be converted into symbol characters in efficient ways. Here conversion of information is done into ASCII which provides character a unique number that can easily be converted into its equivalent binary values, so that faster computation of data can be done. The binary data is faded to zip compression algorithm thus compressed binary data is obtained. Compression helps to store data more efficiently, reduced transmission costs and faster transmission time. The compressed binary data for encoding is divided into smaller parts i.e. n. Each part of n will be inputted to QR code generator and QR Code is generated for each part of data in its standard black and white form. All generated QR code are multiplexed with 2^n combination here $n=5$ so 5 QR code is multiplexed. Acquiring single bit from each 5 QR code, 5 bits of grouping data will be replaced by respective special characters/symbols as shown in Table.2. Resultant QR Code with special symbol will be generated as shown in Figure.3. Thus it can increase the amount of data capacity compared to original data capacity of QR code as well as keeping secret information. QR code with special symbol can be used for transmitting information. At receiving end this QR Code with special symbols is decoded to give back the original QR Code

patterns that were multiplexed. These regenerated QR Code scanned by general QR Code reader and then decompression is done to obtain binary data and using ASCII value data can be concatenated back to form its original information.

TABLE 2: MAPPING OF 5BITS BY SYMBOLS.

| Module in each pattern | Symbol | Module in each pattern | Symbol | Module in each pattern | Symbol |
|------------------------|--------|------------------------|--------|------------------------|--------|
| 00000 | ! | 00110 | (| 01100 | . |
| 00001 | # | 00111 |) | 01101 | , |
| 00010 | \$ | 01000 | + | 01110 | : |
| 00011 | % | 01001 | - | 01111 | ; |
| 00100 | & | 01010 | * | 10000 | < |
| 00101 | “ | 01011 | / | 10001 | > |
| 10010 | = | 10100 | @ | 10110 | V |
| 10011 | ? | 10101 | \ | 10111 | ^ |
| 11000 | L | 11010 | [| 11100 | M |
| 11001 | | 11011 |] | 11101 | { |
| 11110 | } | 11111 | ^ | | |

CONCLUSION

Security is the prime concern for sharing confidential information. QR code is inherently a data hiding mechanism and most efficient technique for digital data encoding among the various data hiding techniques available. Here, Data Zip Compression technique is used to compress user data as its give more efficient result than other compression; this compressed data is fed in to QR code generator. The generated QR code is used for Data multiplexing by multiplexing the bits of 5 QR code the further storage capacity enhance by 5 times by generating a QR code with special symbols which can be used as secret information passing medium. Future work can be carried out for transmitting secret message through Audio and Video files.

RESULT

| Input Data | Compression size | |
|------------|---------------------|-----------------|
| | Huffman Compression | Zip Compression |
| Size | 3KB | 1.2KB |
| | | 1KB |

REFERENCES

[1] Kinjal H. Pandya, Hiren J. Galiyawala, "A survey on QR codes: in context of Research and application", s.l.: International Journal of Emerging Technology and Advanced Engineering, Issue-3, March-2014, Vol.4. ISSN 2250-2459.

[2] Sartid Vongpradhip, "Use Multiplexing to Increase Information in QR Code", 8th International Conference on Computer Science & Education IEEE, Colombo, Sri Lanka, April 26-28, 2013.

[3] Pei-Yu Lin Information Communication, Yuan Ze University, "Secret Hiding Mechanism Using QR Barcode", International Conference on Signal-Image Technology & Internet-Based Systems © 2013 IEEE.

[4] Artur Hłobaż, Krzysztof Podlaski, and Piotr Milczarski, "Applications of QR Codes in Secure Mobile Data Exchange" A. Kwiecień, P. Gaj, and

P. Stera (Eds.): CN 2014, CCIS 431, pp. 277–286, 2014.c Springer International Publishing Switzerland 2014.

[5] Stefanie Falkner^{1,2}, Peter Kieseberg¹, Dimitris E. Simos¹, Christina Traxler^{1,2}, and Edgar Weippl¹, "E-voting Authentication with QR-codes", LNCS 8533, pp. 149–159, Springer International Publishing Switzerland 2014.

[6] Darunee Bunma, Sartid Vongpradhip, "Using Augment Reality to Increase Capacity in QR Code", ISBN, Bangkok, 10330 Thailand, 2014, IEEE.

[7] Vinit Agham, Tareek Patterwar, "A Novel Approach Towards Separable Reversible Data Hiding Technique", 2014, IEEE.

[8] Jen-Shiun "High Density QR Code with Multi-View Scheme" 2013, IEEE.

[9] Max E. Vizcarra Melgar, Alexandre Zaghetto, Bruno Macchiavello, Anderson C A. Nascimento, "CQR codes: colored Quick-Response Codes", IEEE Second International Conference on Consumer Electronics - Berlin (ICCE-Berlin), 2012.

[10] Vishrut Sharma, "A STUDY OF MALICIOUS QR CODES", s.l.: International Journal of Computational Intelligence and Information Security, May 2012, Vol. 3 No.5. ISSN: 1837-7823.

[11] Narayanan, Sankara, "QR Codes And Security Solutions", s.l.: International Journal of Computer Science and Telecommunication, Issue-7, July 2012, Vol.3.

[12] Ji-Hong Chen and Chin-Hsing Chen, "Image Tamper Detection Scheme Using QR code and DCT Transform Techniques", International Journal of Computer, Consumer and Control (IJ3C), Vol. 1, No.2 (2012).

[13] Enhancing the Data Capacity of QR Codes by. No.2, s.l.: International Journal of Computer Applications, December 2012, Vol. Volume 60. 0975 – 8887.

[14] Hsiang-Cheh Huang, "Reversible Data Hiding With Histogram-Based Difference Expansion For QR Code Applications", IEEE Transactions on Consumer, Electronics, Vol. 57, No. 2, May 2011.

[15] Omprasad Deshmukh, Shefali Sonavane, "Multi-Share Crypt-Stego Authentication System", International Journal of Computer Science and Mobile Computing Vol.2 Issue. 2, pg. 80-90, February- 2013.

[16] Nancy Victor, "Enhancing the Data Capacity of QR Codes by Compressing the Data before Generation", International Journal of Computer Applications (0975 – 8887) Volume 60– No.2, December 2012.

[17] Hiren J. Galiyawala and Kinjal H. Pandya, "To Increase Data Capacity of QR Code Using Multiplexing with Color Coding: An example of Embedding Speech Signal in QR Code", ISBN 978-1-4799-5364-6/14, Annual IEEE India Conference (INDICON) 2014.

[18] Kim Ho Yeap, Yuen Kiat Cheong, Humaira Nisar, Peh Chiong Teh, "A Simple Data Storage System Using QR Code", ICCSE, ISBN 978-1-4799-4653-2, IEEE 2014.

[19] Raed M Bani-Hani, Yarub A. Wahsheh, Mohammad B. Al-Sarhan, "Secure QR Code System", ICCSE, ISBN 978-1-4799-7212-8/14, IEEE 2014.

[1] WEBSITE

[20] Denso wave incorporated "http://www.densowave.com! grcode/index - e.html".

[21] <http://code.google.com/p/zxing/>

[22] <https://github.com/kenglxn/QRGen/>

[23] <http://www.efgh.com/software/rijndael.htm>

[24] <http://www.advancedsourcecode.com/source.asp>

[25] http://in.mathworks.com/matlabcentral/fileexchange/41437-qr-code-encoder/content/encode_qr.m

[26] <http://in.mathworks.com/help/wavelet/ug/two-dimensional-truecompression.html>

[2] BOOK

[27] International Standard ISO/IEC 18004, "Information technology Automatic identification and data capture techniques Bar code symbology QR Code", Reference number - ISO/IEC 18004:2000(E), First edition 2000-06-15.