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A survey paper on quick response codes and its image pre-processing methods based on steganography

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Abstract
Quick Response codes or QR codes are two-dimensional barcodes that can be scanned by mobile phone with embedded camera. In the automatic identification fields QR code has been widely. Picture steganography pictures are to establish the information of the mystery to such an extent that its reality cannot be recognized by the sender and other people separated from the recipient. Security of the secret information has been a challenge when a large amount of data is exchanged on the internet. Protected exchanges of data can be especially accomplished by steganography and cryptography. Steganography is a tool to hide data inside a photograph. Cryptography is a tool that provides encryption systems to verify correspondence. These codes can be used to provide fast access to URL, an SMS message, a phone number, a V-card, or any text and QR codes can hold much more information than a regular barcode. This paper displays a review of various steganography processes with various strategies used in writing. Similarly, some different methods were used, for example, different papers on LWT, DCT, DWT, RSTEG, and SSHDT so on. The work demonstrates the result that steganography has played an exceptional role in the various appliance. It increased the level of information security with wide use of its techniques.
Keywords: - Steganography, Quick Response Codes (QR), Information Hiding In QR Code, Types Of QR Code.

1. Introduction

Steganography is the art of concealing information in any other hosted object. Steganography is an embedding technique to hide data in an image or text form. The meaning of modern day of the word sometimes refers to data or a file that is hidden within a digital image, video, or audio file. Steganography essentially misuses human discernment; Human faculties are not prepared to discover records that have concealed information. Generally, in steganography, special data is not maintained in its original format and in this way it becomes an optional equivalent transmission file, such as image, video or audio that are hierarchically hidden between another object Is going. This clear message (commonly known as cover text in words) is sent to the recipient through the network, wherever the special message is separated from it. Steganography is used to obtain data confidentiality on privacy basis. [1]
QR codes are a 2-dimensional matrix. It allows storing a huge quantity of one of the information. Scanner tags are one-dimensional vector. Therefore, with standardized identification, QR codes have a higher stockpiling limit. QR codes can hold up to 7,089 numeric characters & 4,296 alphanumeric letters Esteem as information.
Instructions to utilize QR code in the field of cryptography (known as 'Quick Respond Code' normally). QR codes are mainly used to pass or store messages because they have a higher or greater capacity limit than some other specific scanner tags. It illustrates how the QR code is used for portrait portraiture. There is a quick response time of the QR code and it has a broad capability limit, the QR code can be used simply to send the information (message) sent to the beneficiary. Class-based DWT calculations are used for steganography and additional protection is accomplished by applying AES cryptography to QR code before transplanting in the spread picture. The QR code is a trademark for a sort of work institutionalized recognizable proof (or two-dimensional scanner tag). Four institutional encoding modes (numeric, alphanumeric, byte / double and kanji) are used to effectively store information. A QR code includes a dark square mastered the mastery of a square structure on a white foundation. The QR code can be utilized by an imaging contraption (for instance, scanner, a camera, etc.) [2] [3]

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A. Structure of QR Code: The structure of QR Code [4] includes different parts, for example, position design, separator, time design, and so forth, which do not make it similar to other 2-D standardized tags. These parts are advised here.

a) Position patterns: In the QR code, there are 3 classes present in the three corners of the image. They recognize the status and size of the class code. It tells about the code whether it is a QR code or not.

b) Separators: These positions are white pixels of width around the examples that enable them to be identified by the information part.

c) Timing patterns: It consists of two positions designs between white and dark modules. It helps in deciding the focal arrangement of each cell in the code. It tracks the season of application code.

d) Alignment pattern: This pattern is used to address abortion occurring during the capture of the code.

e) Data: It is the area of QR Code where data is stored after encoding. It also includes Reed-Solomon codes to provide error correction functionalities.

f) Quiet zone: To find out precisely this is the margin space around the code. A quiet area requires at least 4 bits.

g) Version Information: These bits tell the version of QR Code out of 40 versions.

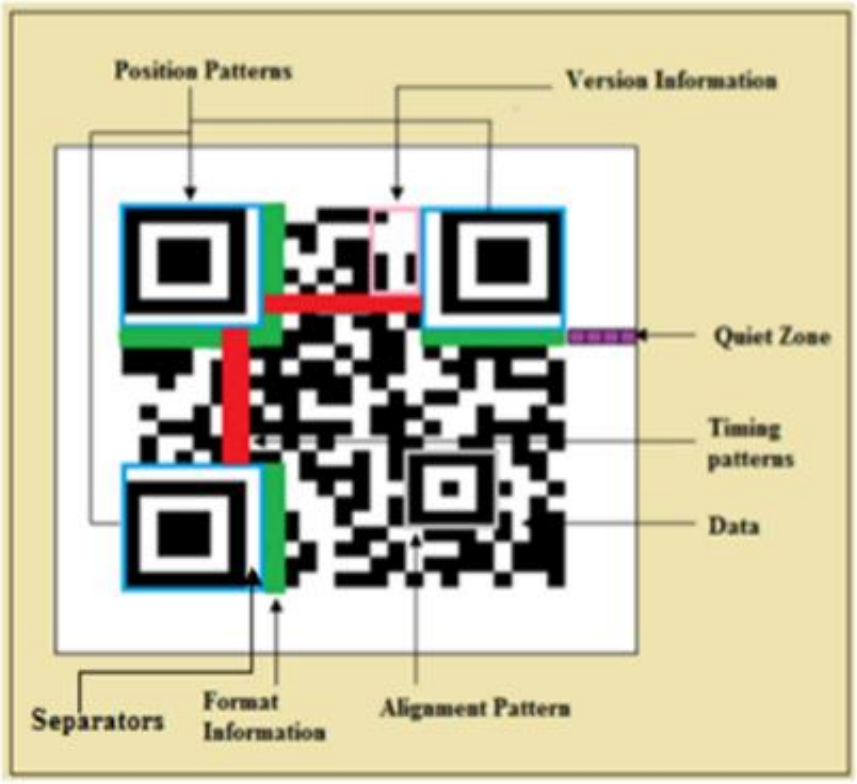

Figure-1 Structure of QR code [4]

2. Information Hiding INQR Code

The message to be hiding is divided in smaller parts in a way that it forms a string of characters. Further data is encoded for each part. The steps for information hiding in QR code are shown figure-2.

At the receiver stage, the QR code is decoded to give the number of QR patterns which was encoded in earlier stage. Further it is scanned by an optical device such as scanner or camera and with the help of inbuilt software application data in each QR code pattern is identified to retrieve back the original message which was encoded in QR code. [5]

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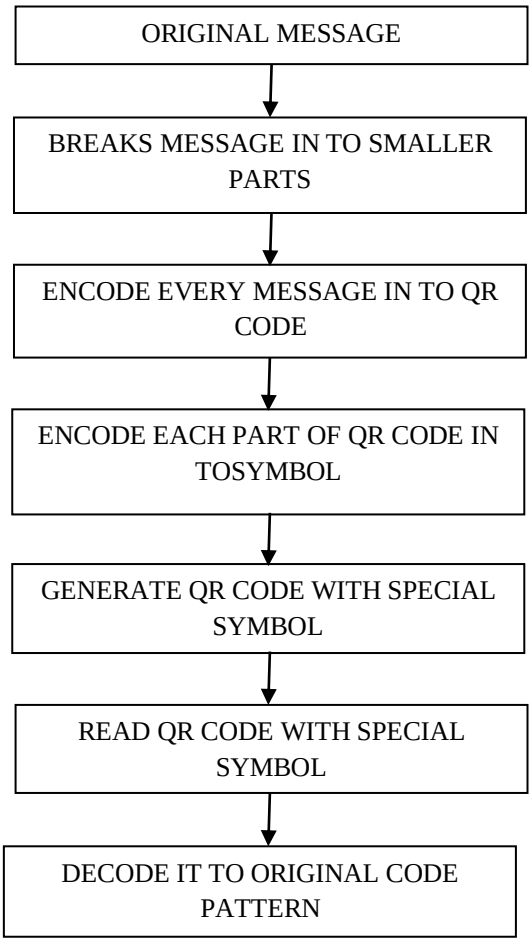

Figure-2 Procedure for information hiding in QR code[5]

3. Types of QR code

After the presentation of QR codes, enhancements have been made to make QR code; thus, we consistently use QR code (show 1 and model 2), micro QR code, iQR code, SQRC code and frame QR with various kinds of QR codes. We should go on. Codes These QR codes have been created with various highlights, which are talked about. [6]

a) QR Code Model 1 and Model 2

Model 1: It is original QR code and a prototype model to other QR Code types. It has adaptation 1 (21 * 21modules) to 14 (73 * 73 modules) and most extreme limit is 1,167 digits.

Model 2: This model-1 is enhanced smooth and effective perusing. There is an alignment pattern (which is not present in Model 1) to locate the situation in it. The greatest rendition of this model: 40 (177 * 177 modules) and most extreme limit is 7,089 digits. The present QR code alludes to this model.

It was created in the year 1994. QR code is enrolled as AIMI standard in 1997 and ISO/IEC 180004 standard in 2000. This type of QR code is usually considered as a specific / regular QR code. It is like some features, at least 4-module wide margins are required around the symbol, in this, there is a position to detect patterns on the 3 corners of the symbol, it is up to 30% damaged symbol (level H), Etc. can be restored.

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b) Micro QR codes

The Micro QR Code is different from traditional QR Code in many ways. It requires only one position detecting pattern and hence it takes less space for printing. It requires 2-module wide margin along the code (which is 4- module in case of regular one).here encoding of data is also easier. It has four type of version which ranges from M1 (11*11 modules) to M4 (17*17 modules). It has most extreme limit of 35 characters for numeric information, 21 characters for alphanumeric information, 15 characters for byte information and 9 characters for kanji information. It is developed in 1998.It is standardized as JIS-X-0510 in 2004 and it also get ISO standard as ISO/IEC 10084.

c) IQR Codes

IQR codes can be created either in class or rectangular modules. It tends to be imprinted in various structures, for example, rectangular code, turn-over code, high contrast reversal code or spot design code. Its versions ranges from 1 (9*9 modules) to 61 (422*422 modules.) and have maximum capacity of 40,000 numerals. But the point at which the attention should be given is that there are 61 variants in class IQR code and there are only 15 versions in the rectangular code. Least sizes of areas are IQR codes 9x9 modules and square shapes have 19x5 modules. It has not yet been given an ISO particular. Just exclusive Denso Wave Products can make or peruse IQR codes. IQR codes contain a wide scope of such codes, which are littler than the ordinary QR codes and smaller scale QR codes, and more established individuals store a larger number of information than them, that is, the point at which you need to store a similar size information Regularly stores 34 digits and it has a save of 63 points close about 80% expansion in information limit and you store a similar measure of information, the IQR code estimate is 30% not exactly customary. [6]

It requires a 2-module wide margin around the code, such as a micro QR code. One of the important enhancement in it is that it can restore data from 50% damaged code (which only 30% in traditional one) with an additional error correction level namely Level _S'. It is easily applicable within the same area as cylindrical products and 1-D barcode.

d) SQRC

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SQRC stands for Secure QR Code. So it is the QR code with security function. It has a reading restriction function. It has data divided into two types: public data and private data. Open information can be perused any peruse, for example, advanced cell like a typical QR code. Individual information is encoded with a secret key that opens data. A proprietary scanner is needed to scan the password and reveal the encrypted data. It also is not yet ISO standardized. These codes are registered trademarks of DENSO WAVE INCORPORATED in Japan and in other countries.
It appears same as regular QR code. It retains the appearance and properties of regular one. These codes apply to health care, identity verification, safety, access control, finance, shipping, promotions & many other topics, where safety considerations are important.

e) Frame QR Codes

To adjust the design and information in the frame QR code, there is a canvas area in the center of the code, where the illustration or the picture is arranged without harming its design. The canvas area does not interfere in code reading. In the canvas region, the code can undoubtedly be perused with no obstruction from pictures, photographs, and so on. The casing for canvas zone is accessible in numerous shapes and sizes. It is not yet ISO standardized but these codes are registered trademarks of Denso Wave Company of Japan.
It is virtually impossible to counterfeit the frame QR codes. The data density of these codes is much higher than the conventional QR code. It is efficiently readable with the ―Q‖ Reader. These codes are used as advertisement and posters, authenticity judgment, business card, entertainment etc.[6]

4. Literature Survey

Zhengxin Fu, et. Al. (2018) As a typical two-dimensional machine readable code, QR code is widely used in human life due to its fast reading speed, high data density and strong error correction capability. Combined with the characteristics of QR code and secret image sharing, an extended secret image sharing scheme was proposed based on QR code, where "extended" means that the generated shares were visually similar to the QR code. The main idea is to control the parameters' selection of polynomial using the binary QR codes. Meanwhile, the average gray difference of the shares was defined as α to measure the similarity between QR-like shares and the original carrier QR codes. Based on α, a secret sharing algorithm was designed to generate QR-like shares. At last, upper and lower limits of α are introduced through experimental analysis, and the relationship between the error correction level of carrier QR code and the lower limit of α.[7]
Shubham Patil, et. Al. (2018) the current implementation of system protects digital privacy that are used to prevent unauthorized access to computer and confidential data. The existing system uses SMS verification for transmission thus the proposed of implement secure file transmission model using hybrid algorithm for encryption of data and decryption of files is been converted into QR CODE and being transmitted to the receiver. Hybrid algorithm AES and BLOWFISH for improvement in security and use of AES for key encryption and BLOWFISH for data or text encryption. The result of existing system was not secure in this system is being overcome and a secured manner of transferring key by encryption it into an QR code is been achieved which increases the security and confidentiality. The key feature of our system is that the key for the decryption of files is converted in QR CODE and transmitted to the receiver and increases confidentiality between end users to have a secured mechanism for file transfer.[8]
D Jude Hemanth, et. Al. (2017) this paper proposes a data hiding based image steganography method that uses to perform image steganography four transforms from frequency domain. The working of the four transforms with steganography is also discussed in this paper. Exploratory outcomes demonstrate that the proposed technique gives unrivalled stego-picture quality and improves inserting capacity. It maintains for the stego-image quality the PSNR value of above 47 dB without affecting the retrieved secret message. In the scope of the future enhancement, the intelligent optimization techniques can be used to enhance the quality of the stego image.[9]
Himanshu Gupta and Nupur Sharma (2016) this paper are proposing a model which is consisting combination of Visual Cryptography and Steganography with the association of QR codes. Here, we are using Visual Cryptography for creating two shares in which one of the share will be rotated in a clock wise direction about 180 degree & other about 270 degree and then we are implementing Steganography by using two's complement on both the share image. After the transformation of shares into steganoimages, we are converting one of the steganoimage into a QR code which will be kept secret with the user. During the verification time, the QR code will be required for the authentication of user. [0]

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B Karthikeyan, et. Al. (2016) the proposed method suggests a combination of robust encrypting algorithms and steganographic techniques to make the communication of confidential information extremely difficult to secure, safe and decode. A coded message is employed to decode the encryption message. Encoded image is sculpted to achieve another security level. The frozen QR code is finally embedded in a suitable cover image, which is then transferred safely to give secret information. At the receiver's side the secret information is retrieved through the decoding process. Thus, a four level security has been rendered for the secret message to be transferred. This technique is applicable to security mechanisms which serve to communicate confidential information in banking, defense, educational, eBusiness sectors.[11]

Pei-Yu Lina and Yi-Hui Chen (2016) in this article, we explore the characteristic of QR barcode and design a QR barcode steganography mechanism. Private data can be installed in a secured QR tag with a high mystery payload. For an ordinary scanner, a program can uncover just the QR content secured by the checked QR code. Only authorized users / scanners can reveal private secrets from the forward-marked QR tag. According to the experimental, the new algorithm can express satisfactory secret payloads in a QR tag. This mechanism is efficient and viable for personal QR applications. [12]

Ming Luo, et. Al. (2016) the designed embedding secret scheme can carry secret bits into a cover QR code and preserve the readability of the QR code content based on the capability of error correction. According to the scheme, the designed scheme is efficient to conceal the secret into a QR barcode and satisfy the steganography purpose. Only the authorized receiver with private key can successfully retrieve and decrypt the secret. The proposed scheme can be applied to the QR barcode application.[13]

Shweta Sharma and Vikas Sejwar (2016) in the present work we try to embed encrypted secret Message in the form of QR code. Then we encode the QR code with image encoding technique. We use 3 layers of security in message sharing. We utilize a MATLAB code which encodes the picture of any RGB, dim picture of various arrangements. We proposed a secret message sharing algorithm which combines steganography and cryptography for achieving better security in message sharing. In theory, it would be difficult for anyone to decrypt the encrypted message without knowing the exact encryption method. [14]

K.Saranya, et. Al. (2016) this paper concludes that there are so many possibilities for QR Code's use in different areas for authentication and to provide security and lot more are yet to be explored .The SQRC technology has a firm ground for research aspects. More and more experiments are done with QR codes in different aspects like enhancing the security, better recognition, reducing redundancy in order to save space, possibility of encoding different types of data like audio. QR codes have found their way from automotive manufacturing plants into our everyday Smartphone usage.[15]

Narendra Panwar, et. Al. (2016) in the present work we try to embed encrypted secret message in the form of QR code. Then we encode the QR code with image encoding technique. We proposed a secret message sharing algorithm which combines steganography and cryptography for achieving better security in message sharing. In principle it will be infeasible for attacker to decrypt the encoded message without knowing the cryptographic key. The method can be used for better security.[16]

Vladimír Hajduk, et. Al. (2016) this paper image focuses on the motion of the steganographic method that is capable of embedded encoded secret messages into image data using the Quick Response Code (QR) code. Discrete wavelet Transformation (DWT) areas are utilized for inserting QR codes, while the installing procedure is additionally ensured by the Advanced Encryption Standard (AES) figure calculation. Moreover, the particular highlights of the QR code were broken utilizing encryption, so it makes the strategy increasingly secure. The objective of this paper is the design of the image steganographic method with a high safe level and high non-conception level. Prior to the embedding process, the relationship between the safety and efficiency of the law was improved by the special compression of the QR code. The capacity of the proposed method was measured by the peak signal-to-noise ratio (PSNR) & the results obtained were compared with other steganographic devices. [3]

Kong Suran(2013) this paper puts forward the algorithmwhich combines corner detection with convex hull algorithm. Firstly, binarization of the collected QR code image with uneven light is obtained by the methods of local threshold and mathematical morphology. Next, the outline of the QR code and the dots on it are found and the distorted image is recovered by perspective collineation, according to the algorithm rose by this paper. Finally, experimental verification is made that the algorithm raised by this paper can correctly finds the four apexes of QR code and achieves good effects of geometric correction. It will also significantly increase the recognition rate of seriously distorted QR code images.[17]

Jeng-An Lin and Chiou-Shann Fuh (2013) in this paper, we revise the traditional decoding procedure by proposing a serial of carefully designed preprocessing methods. The decoding procedure consists of image binarization, QR code extraction, perspective transformation and resampling, and error correction. By these steps, we can recognize different types of QR code images. The experiment results show that our method has better accuracy than Google open-source 1D/2D barcode image processing library Zxing-2.1. Moreover, we evaluate the execution time for different-size images. Our method can decode these images in real time.[18]

David Pintor Maestre(2012)This paper presents the design and implementation of QRP, an open source, proof-of-concept authentication system that uses a two-factor authentication by combining a password and a camera-equipped mobile phone, acting as an authentication token. QRP is extremely secure as all the sensitive information stored and transmitted is encrypted, but it is also an easy to use and cost-efficient solution. QRP is portable and can be used securely in untrusted computers. Finally, QRP is able to successfully authenticate even when the phone is offline.[19]


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Table-1 Different Techniques Methods [6]

S. NO.	Author	Technique/Method	Process
1.	Qichao Chen, Yaowei Du, Risan Lin, and Yumin Tian	Fast QR Code Image Process and Detection [20]	They proposed perspective transform matrix which used finder patterns and alignment pattern of QR Codes for correcting QR Code images which have geometric distortion or rotation.
2.	Yunhua Gu and Weixiang Zhang	QR Code Recognition Based On Image Processing [21]	They proposed to solve the QR code recognition problem caused by ordinary camera collection. They put forward the recognition algorithm based on image processing.
3.	Kong Suran	QR Code Image Correction based on Corner Detection and Convex Hull Algorithm [17]	His paper put forward the algorithm which combines corner detection with convex hull algorithm. Experimental verification made that the algorithm raised by the paper can correctly find the four apexes of QR code and achieved good geometric correction. It will also increase the recognition rate of seriously distorted QR code images.
4.	Jeng-An Lin and Chiou-Shann Fuh	2D Barcode Image Decoding [18]	They presented a method for 2D Barcode image decoding in Automatic Identification and Data Capture. In their paper, they revised the traditional decoding procedure by proposing well designed image preprocessing method. The decoding procedure consists of image binarization, QR code capturing, perspective transformation and resampling process, and error correction. By these steps, they tried to recognize different types of QR code images.
5.	David Pintor Maestre	QRP: An improved secure authentication method using QR codes [19]	He presented the design and implementation of QRP, an open source, authentication system that has authentication using two factors - a password and a camera-equipped mobile phone which act as an authentication token. QRP is highly secure as all the sensitive information stored and transmitted is encrypted. It can be used securely in untrusted computers and is able to successfully authenticate even when the phone is offline.
6.	Bhupendra Moharil, Vijayendra Ghadge, Chaitanya Gokhale and Pranav Tambvekar	An Efficient Approach for Automatic Number Plate Recognition System Using Quick Response Codes [22]	They proposed an efficient approach for automatic number plate recognition system using quick response codes. Their contribution towards ANPR was the attaching the QR codes with the automobiles which fine-tune the detection technique. This approach provides quick response and overcomes the issues related to noise in image processing and simultaneously fine tunes the detection technique.

5. Conclusion

Nowadays, the mobile phone with camera embedded is getting more popular and mobile phone is getting more important and practical to recognition QR code symbol. As QR Code is a new leaf in the world of bar codes so it has so many aspects in which researchers can work like enhancing error correction or increasing data capacity or providing good security or better and fast recognition. The method proposed here will be used to enhance the scanning process of QR Codes.

Conflict of Interest

In this manuscript the authors declare that there is no conflict of interest.

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