

## A Review on Combined Techniques of Cryptography and Steganography using Color QR code

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**Abstract**—In the internet eras, where security is main concern and access to any service is quite easy, the issue of cyber security aimed at protecting customer data and thus this leads to creation of such a safe environment where user can be ensured of safety and security of all fields which aftereffect the usage of cryptography and steganography has increased. Cryptography encrypts a message so it cannot be understood while the Steganography hides the message inside a cover medium so that it's concealed. In this paper we use color QR (Quick Response) Codes which are 2-dimensional bar codes that encode data or text strings and color QR code for increase QR code capacity. They are able to encode the information in both vertical and horizontal direction, thus able to encode more information, for secret communication we combine the concepts of Cryptography and Steganography and color QR codes. We use Cryptography side for encrypting the message by a color QR code encoder and thus creating a color QR code, whereas steganography hides the color QR code inside a cover image, after the encryption process, the color QR code image which has the original data is watermarked over a cover image using Spatial domain (LSB) and transform domain (DCT& DWT). In reverse, De-Watermarking extracts and decrypts the color QR coded data image from the Stego- image to recover the original image.

**Keywords**- cryptography, steganography, stego-image, color QR code

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### I. INTRODUCTION

In today's world internet plays a vital role in data communication providing cheaper and fastest way of data transmission over the web. However, demand for the security of data over the internet still exists. The data transmitted via the World Wide Web consists of many kinds of data i.e. informal data as well as confidential details like medical diagnostics, financial, credential and military data. Here Cryptography and Steganography both techniques can be used to obtain security, privacy and authenticity of data. Cryptography and steganography are two major techniques to encrypt and hide the information before transmission

#### A. Cryptography and steganography

A cryptography change the message or information in such a way by which cannot be understood where as the steganography hides the information inside the cover medium such as text file, image, audio, video etc, which cannot be seen. Data hiding can be achieved with the help of steganography and cryptography when they are implemented together resulting in greater data security as well as data integrity. [6]

Steganography is a Greek word which means covered script. The word "steganos" means "covered " and "graphial " means "writing" . Thus, steganography doesn't mean hiding data but it also hides the fact of transmission of secret data. Steganography hide the secret data in a different file in such a way that only the receiver knows the existence of message. Some of the Applications of Steganography where it can be used are following [8]

- Confidential Communication and Secret Data Storing
- Protection of Data Alteration
- Access Control System for Digital Content Distribution
- E-Commerce
- Media
- Database Systems.
- Digital watermarking.

#### B. QR Code and Color Model

QR codes (Quick Response codes) were introduced in 1994 by Denso-Wave, a Japanese company subsidiary of Toyota. It is a type of data matrix codes. QR Code can handle a range of data, not only alphabetic characters but also numbers. Since QR code stores information both horizontally and vertically, it is capable to contain alphabetic characters over 100 times the amount of data hold by a traditional 1D barcode. In addition, QR code possesses many benefits such as fast reading speed, high accuracy, and considerable small physical size. Due to its advantages, QR code has been universally recognized and gained more popularity. It is currently more accessible because of the availability of decoding software on portable devices such as mobile phones and the opportunity for users to create a code through QR Code generator websites. QR Code information capacity depends on versions, The advanced features of color QR code are:

- High embedding Capacity.

- High speed scanning
- Represented by two bits of data.
- It can be readable from any direction from 360 degree.

QR Code can be generated in 40 different versions. Each higher version has 4 additional modules per side (16 additional modules per version). Whilst version 1 contains 21x21 modules, version 40 comprises 177x177 modules.[9]

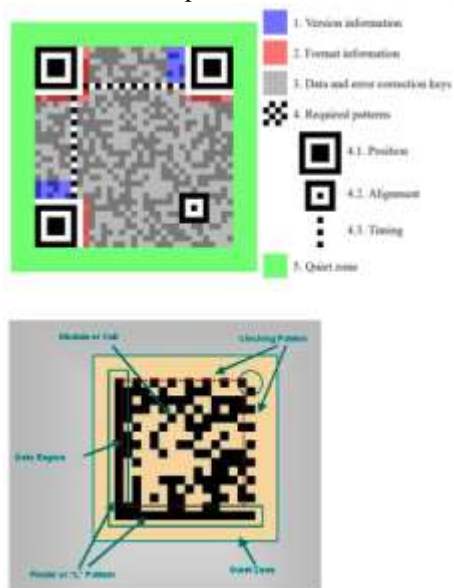


Fig.1 Color QR code structure

In this paper, propose color QR code is a two dimensional bar code capable of encoding different types of data like binary, numeric, alphanumeric, and control code. LSB (Least Significant Bit) and DCT (Discrete Cosine Transform), DWT (Discrete Wavelet Transform) with the help improving the stego-image quality and increases the data storage capacity and make a system more secured and robust.

## II. RELATED WORKS

Anjaly Raj, vidya N [1] a survey on data security and confidentiality using 2D color barcode, 2D color barcode can hold much information in comparison to a binary barcode. 2D color barcode technology increase the data density and robust data transmission. Color barcodes increases the data embedding capacity than normal 2D barcodes. Here the message had been encrypted with the help of cryptographic which uses color QR Code (Quick Response Codes). The embedded QR code may be sent to destination or may be saved for future use. Color QR Codes are mainly used to communicate and store data because they have higher or large storage capacity than any other normal conservative 'barcode's. The data is encrypted using asymmetric key, and then inserted in color QR code, so that data cannot be easily retrievable without adequate authorization / permission. This paper studies two dimensional color barcodes for data confidentiality and security. It provides high level security and data confidentiality. It is also used for private information sharing.

Aryachandran S1, Jyothi R L [2] this proposed work based on secure color (QR) Quick Response codes have become the efficient and 2D barcodes improved the condition. QR codes, the most popular 2D barcodes are widely used for the purposes other than product identifications. 2D barcode by its features and comparative study of 2D barcode. Data rate of QR codes can be enhanced by using the colors. Replacing the black and white by Cyan-White; Magenta-White; and Yellow-White enhances the data rate by a factor of three. Now the security can be enhanced by the use of password protection. The password protection is enhanced by xor encryption. This paper also discusses why we go for password protection rather than the classical encryption color.

D. Antony Praveen Kumar, M. Baskaran, J. Jocin, Mr. G. Diyu Danie [3] this work is concerned by implementing Steganography for images with the improvement on image security and image quality. Here the algorithm is used LSB (Least Significant Bit). The LSB method is one of the best methods for hiding the message. It helps to transferring of the message from one place to another place in secure manner. But, in today's retrieval of hiding message possible to the third person. All kinds of message are stored into the cover image based on LSB. One of the main problem is that stored messages are may be retrieved by another person, because previous method partially hidden the message. It is the process with the help of improving the steganography method using QR-code data input pattern image and LSB technique in RGB image. In this proposed work shows that the proposed work of the message transfer successfully in secure manner based on Least Significance Bit method and QR code pattern image. Thus the proposed system is to increase the system performance

Navneet Kaur and Sunny Behal [4] in this proposed work uses hiding information or text in an image file using LSB, and DCT&DWT and its comparison. Here least significant bit algorithm is implement into spatial domain in which the payload bit are embed into the Least Significant Bits of cover image to make the stego-image, DCT&DWT are implemented in frequency domain. The stego image is transformed into spatial domain to the Frequency domain. It is more secured and robust techniques.

S. Vijay Ananth1\* and P. Sudhakar2 [5] proposed research in author used both techniques Cryptography and Steganography. The data or text to be hidden is first encoded into equivalent barcode image using barcode encoder. Than after the encoding process of, the barcode image has the original secret data is watermarked over a thermal image using improved LSB and here Steganography side, Least Significant Bit (LSB) substitution method use the barcode image to hide over the thermal image to generate the Stego- image. The experimental result of this proposed method does not alter the quality of the Stego image.

Vladimír Hajduk, Martin Brode, Ondrej Ková, Dušan Levický [6] in this proposed work based on image steganography with using QR code and cryptography. Author used cryptography side encryption process with the help of Advanced Encryption Standard (AES) cipher algorithm and steganography side used embedding technique and encoded secret message using Quick Response code (QR) code this process provide the two level of security and measured the result by Peak Signal-to-Noise Ratio(PSNR).

### III. EXISTING TECHNIQUES

Basically two types of image steganography techniques we used in this proposed work as follows:

#### A. Spatial domain

Spatial domain technique use LSB (Least Significant Bit) embedding for hiding information. Whereas Frequency domain technique uses DCT (Discrete Cosine Transform) for hiding information in transform domain. The Least Significant Bit (LSB) is replacement technique.

1) *Least significant bit (LSB)*: The Least Significant Bit technique embeds the secret message into the least significant bit of the image and this embedding process starts from the first character to the end of the secret message. Each character of the secret message will be change into binary format according to the American Standard Code for Information Interchange (ASCII) code, and then embed each bit of binary numbers and each character starting from the least significant bit to the most significant bit (20 to 27). 1 byte of image data can only hide 1 bit of message. Thus, 8 bytes of image data it will be needed to hide 1 character because each character is made up of 8 bits. When LSB using a 24-bit color image, that is representing a each bit of the red, green and blue color components can be used, so a total of 3 bits can be stored in each pixel. For example, the following considered as 3 pixels of a 24-bit color image, using 9 bytes of memory:

```
(00100111 11101001 11001000)
(00100111 11001000 11101001)
(11001000 00100111 11101001)
```

When the character A, which is equal to the binary value 10000001, is inserted, the following grid results:

```
(00100111 11101000 11001000)
(00100110 11001000 11101000)
(11001000 00100111 11101001)
```

#### B. Transform domain

In this technique the secret message is embedded in the transform or frequency domain of the cover. This is more complex way of hiding message in an image. In this domain describe the Different types of algorithms and transformations are used on the image to hide message in it. Transform domain techniques are broadly classified such as:

1. Discrete Fourier transformation technique (DFT)
2. Discrete cosine transformation technique (DCT)
3. Discrete Wavelet transformation technique (DWT) these techniques have high embedding and extraction complexity. Because of its robustness properties of transform domain embed the secreta data and these techniques are generally more applicable to the “Watermarking” aspect of data hiding.

1) *Discrete cosine transform (DCT)*: DCT is a method of hiding information in transforms domain images. This method hides messages in a cover image. The DCT transforms into signal from an image representation into a frequency sign by grouping the pixels into  $8 \times 8$  pixel blocks for the original image and transform the pixel blocks into 64 DCT coefficients and each alteration of a single DCT coefficient will affect for all 64 image pixels in that block.[10]

DCT is used in steganography and its working from left to right, and top to bottom ; DCT is apply to each block and each block of the table is compressed through the quantization table to scale the DCT coefficients and message is implanted in DCT coefficients.

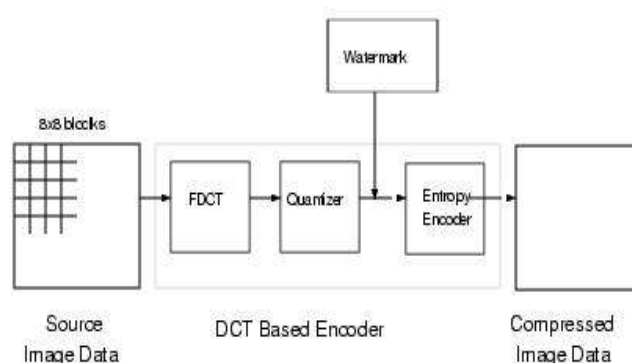


Fig.2 DCT block diagram

The main procedures for all encoding and message embedding processes based on the DCT where, the procedures for all decoding and message extracting processes based on the DCT. Discrete cosine transform (DCT) is widely used in image processing, and especially for image compression.

2) *Discrete wavelet transforms (DWT)*: DWT also a frequency domain and image transform method that is used to divide the information of any digital media into sub signal (used to show the pixel value) and full sub signal (used to show the vertical, horizontal and diagonal details). In this procedure data hide in the form of coefficients, for both of these techniques (DWT and DCT), the encoding system and decoding system of compression are required to transfer the original image take as input and compressed image take as output while in decoding system compressed image take as output and original image take as input. [11]

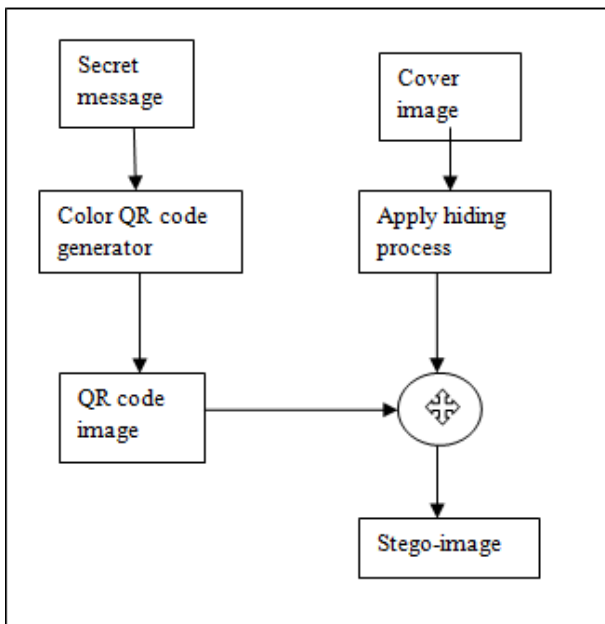
### IV. PROPOSED WORK

A color QR code generator encrypts the given message into color QR codes which could not be read or understood by human beings. But the message hidden in these color QR codes can be easily decoded by any smart phone with built in camera. In order keep the message secret and to protect it from unauthorized access a new method is suggested by merging color QR codes with cryptography and Steganography technique. In this proposed method an encoding process at the sender and a decoding process at the receiver.

A. *Encoding Process*: The encoding process involves encryption of the secret message into color QR codes followed by:

- 1) Select the secret text or data.
- 2) Encode it into a color QR code using any color QR code generator ([www.theqrcodegenerator.com](http://www.theqrcodegenerator.com))
- 3) Read a color image and embed the quantized bits of the color QR codes in the pixels of the color image using DCT and DWT method.

4) Save the stego image.



**Fig.3 encoding process**

## V. CONCLUSION

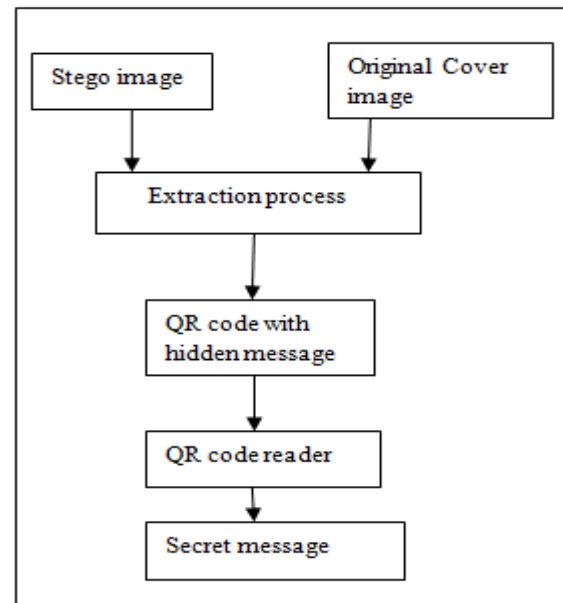
In this paper provides review on the combine of cryptography and steganography techniques and using the color QR code and cover image for LSB and Transform domain technique. Cryptography side Encrypting the message by a color QR code encoder and thus creating a color QR code .steganography side hiding the color QR code inside a color image, After the encryption process, the QR code image which has the original data is watermarked over a color image using improved Least Significant Bit (LSB) substitution process and transform domain (DCT& DWT) and generates distortion less Stego image. In reverse, De-Watermarking extracts and decrypts the color QR coded data image from the Stego-image to recover the original data. The proposed method has improving security, robustness and stego-image quality.

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**B. Decoding Process** The decoding process involves decryption of the secret message into color QR codes followed by:

- 1) Select the stego image.
- 2) Extract the quantized bits of the color QR code from the stego image.
- 3) Dequantized the bits into color QR code.
- 4) Using any color QR code scanner scan the secret message from the QR code. (Zxing"online coder/Decoder")



**Fig.4 decoding process**

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