

Research Article

Digital Image Watermarking based on DWT using QR Code

Sumedha Nishane^{†*} and V. M. Umale[†]

[†]Department of Electronics and Telecommunication, SSGMCE, Shegaon, Maharashtra, India

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Abstract

In this science era with the development of technology and internet, the protection and authentication of data is essential. Watermarking techniques provide solution to this problem. QR code being so versatile because of its structural flexibility that it leads to so many diverse field for research such as increasing data capacity, security applications such as different kinds of watermarking. We have used QR code as cover image and as secret image to protect it from other users. This paper is representing a new watermarking technique with QR code to protect the secret image. In the method described here the image is first encrypted in random matrix, then it is invisibly watermarked in cover image and no information about the secret image and cover image is needed for extraction of secret image, so it more secure.

Keywords: Watermarking, DWT, QR code, Watermark embedding, Watermark extraction.

1. Introduction

Increase in use of Digital Media, raises the problem of data protection and authentication. Data can be easily copied. Digital Watermarking Technique gives the best solution to protect data.

In this technique the data is hidden within the cover image so stranger cannot get it without having proper guidance. Many methods used for the invisible Digital Watermarking required some information about the cover image. But we do not require it for secret image extraction, so it is more secure. We are using QR code which itself hide the information but which can be easily scanned. We can use this method to hide image in QR code and to hide QR code in an image. In both the cases the information is detectable under the influence of various attacks.

1.1 Discrete Wavelet Transform

It decomposes the image into different frequency ranges such as low frequency, middle frequency and high frequency. In same way the image can further be decomposed into n levels. Here we are using 3level decomposition for better result.

In two dimensional applications, for each level of decomposition, we first perform the DWT in the vertical direction, followed by the DWT in the horizontal direction. After the first level of decomposition, there are 4 sub-bands: LL, LH, HL, and

HH. For each successive level of decomposition, the LL sub-band of the previous level is used as the input. To perform second level decomposition, the DWT is applied to LL and so on.

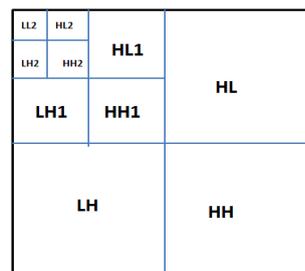


Fig.1 DWT decomposition

1.2 Quick Response Code

It is two dimensional barcode consists of black modules arranged in white background. It can store large alphanumeric information and easily readable by scanner. A QR code is capable of being read in 360 degree from any direction thus eliminating interference. The QR Code system has become admired outside the automotive industry due to its fast readability and greater storage capacity than that of the UPC barcode.

- It is higher information density.
- It is small in size than that of Barcode.
- Data can be restored even if the symbol is partially dirty or damaged.

*Corresponding author: Sumedha Nishane

Some features that describe how QR code is better in comparison with conventional barcodes have been listed out in following table

Table 1: Comparison of QR code and Barcode

QR Code	Barcode
	
Upto 7089 numeric digits	10-20 digits
40 digits Numeric (approx 5 mm 5mm)	10 digits numeric (approx.50 mm 20mm)
Supports 360 d reading	Horizontal reading

QR code is used for Advertising, Business cards, Social networking, Branding, registration.

2. Proposed Technique

The process of image embedding and image extraction is given as follows:

2.1 Image Embedding

- The cover image is 3 level DWT decomposed into HH3, HL3, LH3, LL3
- Select HH3 for image embedding
- Secret image (which is watermark) is encrypted with random matrix
- Encrypted secret image(watermark) is now embedded within the HH3
- Apply inverse DWT, to get cover image

2.2 Image Extraction

- Apply 3 level DWT to watermarked cover image, image is decomposed into HHW, HLW, LHW, LLW
- Predicted cover image is obtained by smoothing watermarked cover image
- Apply 3 level DWT to this predicted image , image is decomposed into HHP,HLP,LHP,LLP
- Subtract HHP from HHW
- Decrypt the image by using random matrix

3. Experiment Result

The above algorithm is implemented in MATLAB and the results are checked for various attacks.

In first case we use QR code as a cover image and logo as a secret image. In second case we are using QR code as a secret image. The results are compared for various attacks with their PSNR (Peak Signal to Noise Ratio and MSE (Mean Square Error).

$$PSNR = 10 \log 10 \left(\frac{255^2}{MSE} \right)$$

$$MSE = \frac{1}{M \times N} \sum_{i=1}^M \sum_{j=1}^N [f(i, j) - f'(i, j)]^2$$

The similarity between the original watermark and the extracted watermark is calculated using normalized correlation (NC):

$$NC = \frac{\sum_{i=1}^M f(i) \times f'(i)}{\sum_{i=1}^M f(i)^2}$$

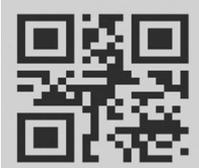
Table 2 Results for various noises

Type of noise	Extracted image
Salt and pepper (0.01)	
Gaussian 0.005	
Poisson	
Speckle 0.01	

Table3. Results comparison with MSE, PSNR, NC

Type of noise	MSE	PSNR	NC
Salt and pepper(0.01)	2.92	43.51	0.96
Gaussian (0.005)	4.34	41.79	0.97
Poisson	2.86	43.60	0.99
Speckle (0.01)	5.20	41.01	0.831

Table 4 Results for QR code as cover image and logo as a secret image

	Cover image with watermark	Extracted watermark
Original images		
Without noise		

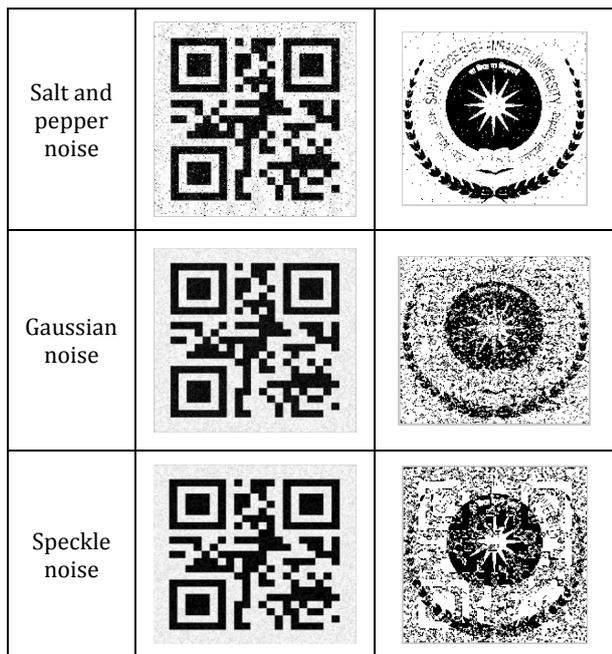


Table 5 PSNR for noise attacks

Noise type	PSNR
Salt and pepper noise	68.27
Gaussian noise	55.65
Speckle noise	55.37

QR code can store large amount of data but it can easily scan by anyone so if you want to transfer or store important information it is better to hide it in the other image. In next case we are going to watermark QR code in the logo. And from the result it is observed that extracted QR code is decodable under different attacks. The results observed are as follows:

Table 6. Results for logo as cover image and QR code as secret image

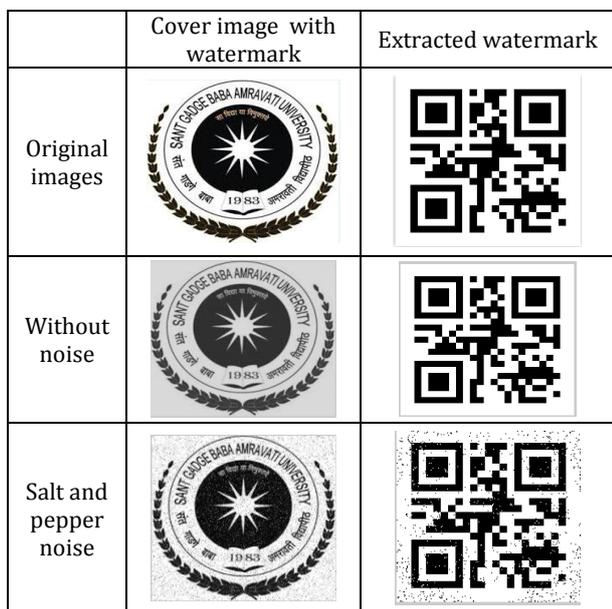


Table 7 PSNR for noise attacks

Noise type	PSNR
Salt and pepper noise	72
Gaussian noise	64.67
Speckle noise	61.79

Conclusions

The algorithm presented here gives us more secure watermarking for an image and the important data can be kept secure in watermarked QR code. It works under various noise attacks. It satisfies all the properties of the watermarking such as robustness, fidelity, computational cost, data Payload. In this way we can make QR code secure. With help of this one can make transmission more secure. This can be used for keeping organizational record secure and one can keep his personal information safe in QR code. For future work, further encryption can be added to the QR code so that it cannot scan by anyone without key.

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