JOURNAL OF INFORMATION, KNOWLEDGE AND RESEARCH IN ELECTRONICS AND COMMUNICATION ENGINEERING
ISSN: 0975 – 6779| NOV 16 TO OCT 17 | VOLUME – 04, ISSUE – 02

"WATERMARKING OF QR CODE"

DIGITAL IMAGE WATERMARKING BASED ON DWT USING QR CODE

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ABSTARCT:

In the digital world copyright protection and authentication have become more significant, in order to achieve this digital different watermarking techniques are introduced for the security. We propose an algorithm in wavelet domain using wavelet transformation for a digital invisible watermarking is to embed into a QR code image. In our method we embed a binary image logo considered as watermark embedded into one of selected wavelet sub band. The experimental results show that our method has more robustness to attacks in different considerations and it can achieve a viable copyright protection and authentication

KEYWORDS: *Watermarking , QR code, DFT, MATLAB.*

I. Introduction

Digital watermark is a pattern of bits inserted into a digital image, audio or video that identifies the copyright and authenticates information. The goal of watermark technique is to embed the secret information seamlessly hidden within into original message, which is robust against attacks. In recent years, some researchers have proposed the adoption of watermark techniques. The watermark can also be inserted in the original spatial domain of the image[1-2]. In [1], the main disadvantage of spatial domain was that it easy to be hacked and attacked.In [2], the proposed method embedded the copyright image into the original image using (N,N) secret sharing scheme. This method could resist contaminations such as JPEG compression, resize and noise addition. There are many techniques to embed the watermark into frequency domain of the original image. The techniques operating on a frequency domain use transformations such as Discrete Cosine Transform(DCT),DiscreteFourierTransform(DFT) and Discrete Wavelet Transform(DWT). In a watermark technique of multispectral image is performed in the wavelet transform. In this a proposed scheme for color images using wavelet transform based on texture properties and secret sharing. In this paper, we will propose the blind watermarking algorithm by means of two-level discrete wavelet transform(DWT) embedded in **a** QR code image. This paper is organized as follows. Some backgrounds on QR code and watermark are presented in and describes watermark embedding and extraction the objective and subjective evaluations are discussed.

II. Ease of Use

QR Code technique is versatile.

To easily use.

It is more efficient.

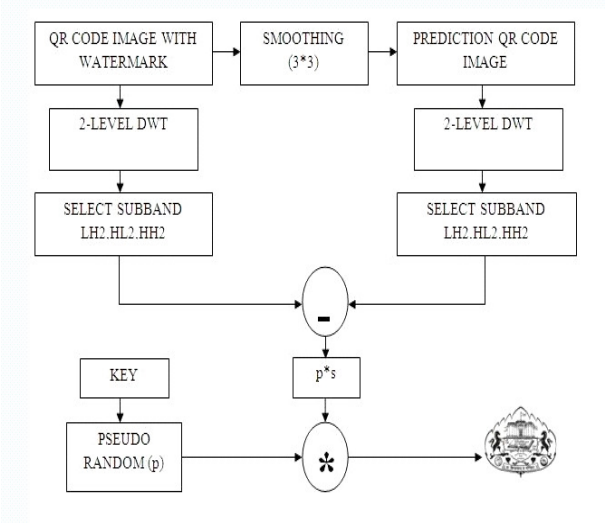
Overall aim is to design the system is to improve security of QR Code.

A. Watermark

A Watermark is the process of hiding digital information in the carrier signal such as voice, image, video etc. It is also found embedded into digital data for identifying ownership of the copyright. Digital watermarking techniques can be classified into two categories with respect to operational domains, which are: Spatial domain watermarking, the embedding process is done by directly modifying the pixel values .· Frequency domain watermarking, the embedding process is done by embedding the information in the transform space by modifying for example the frequency coefficients. Nevertheless, most signal processing paradigms found in recent literatures can be well characterized as the frequency domain operation. Moreover, several good perceptual models are developed in the frequency domain, with great successes reported.

III. THE PROCESS OF WATERMARKING

In this study, a binary image of PUNE University logo, is a chosen as the watermark. The process of embedding this watermark was performed on a QR code image on its frequency domain. The QR code image was first decomposed by a two-level two-dimensional wavelet transform as shown inFig.2. The subsequent watermark extraction, are blided in a sense that it did not require the original QR code image in order to recover the embedding watermark. There were two steps in our algorithm: watermark embedding and watermark extraction**.**



A. Watermark Embedding

The step of embedding process are outlined as follow *Step of watermark image with secret key*i. The watermark image was produced as a bit sequence of watermark S. The data and background values were set to 1 and –1, respectively..{ 1 ≤ ≤ }, ∈{-1,1} S = *si*, *i N si* (

1)where *N* is the total number of pixels in the watermark image.ii. The pseudo-random sequence (P) whose eachnumber can take a value either 1 or –1 was randomly generated with a secret key for embedding and extracting of the watermark P = {*pi* ,1 ≤*I* ≤ *M*}, *pi* ∈{-1,1} (2)*Step of QR code image* I. The two-level DWT of *M*x*M* image ( ) *it*wascomputed for QR code image

.II. A watermark was then embedded in subband LH2 orHL2 or HH2. According to the rule:= + , = 1, 2,...,N*′itti α.pi .si i* (3)where *t* is input image. *′ti* is output image with watermark. A is a magnitude factor which is constant determining the watermark strength.

III. After that, the inverse DWT (IDWT) was then applied to obtain the watermarked image.

IV. Compute PSN

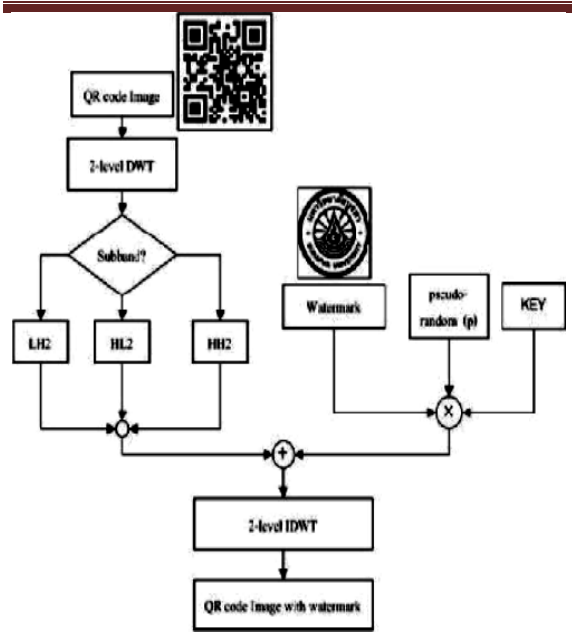


Fig.Flowchart

B. Watermark Extraction

The watermark extraction algorithm did not used the original QR code image. A prediction of the original value of the pixels is however needed. Thus, a prediction of the original value of the pixels was performed using noise elimination technique. In this paper, we use anaveraging3×3mask whose elements were fixed to 1/9. The extraction process are outlined as follows (Fig.4):I. The predicted image ⌢i t could be obtained by smoothing the input image*i t with a spatial

C.QR Code

QR code (Quick Response Code) is the trademark for a type of two-dimensional barcode. A barcode is an optically machine-readable label that is attached to an item and that records relevant information. The information encoded by a QR code may be made up of four standardized types("modes") of data (numeric, alphanumeric, byte / binary,Kanji) or, through supported extensions, virtually any type of data. The QR Code system has become popular outside the automotive industry due to its fast readability and greater storage capacity compared to standard UPC barcodes. Applications include product tracking, item identification, time tracking, document management, general marketing,

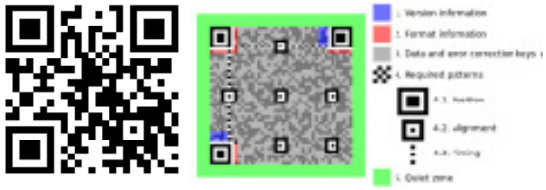


Fig. 1. (a) QR code (b) QR code Structure

Step of QR code image

I. The predicted image i t could be obtained by smoothing the input image*i t with a spatial convolution mask. The prediction of the original value can be defined as:

$$ti = \sum_{i}^{cXC} ti\text{^} *$$

where c is the size of the convolution mask. The watermarked image and the predicted image were DWT transformed independently.

II. The estimate of the watermark i s indicated by the difference between *i t and⌢i t as:*i

δ = t - ti = α.pi .si

III. The sign of the difference between the predicted and the actual value is the value of the embedded bit:

sgn(δi)= pi .si

IV. Compute NC :The watermark was then estimated by multiplying pseudo- random number to the embedded bit. If an incorrect pseudo random sequence was to be used, the scheme would not work.

$$\sum_{I=1}^{M} sis'i / \sum_{i=1}^{m} s\text{^}2i$$

In addition, the quality of the watermarked video compared to original video was measured based on the Peak Signal to Noise Ratio (PSNR). The PSNR formula is expressed as follows:

$$2b - \frac{1}{1}/mXn \sum_{i=0}^{m-1} \sum_{j=0}^{m-1} (0(i)j) - R(i,j))\text{^}2$$

b is the number of bits used to represent in the pixel. m×n is a size of image.O□i, j □ is the original pixel value.R□i, j□□is the reconstructed pixel value.

D.Simulation and Results

A QR code image, of size 400x400 pixel was used for the experiment in Fig 5(a). The water mark image was a binary image of Pune University logo, as depicted in Fig 5(b).The watermarking was tested with the following parameters: magnitude factor □□□□□are 5,10,15,…,50 and the key is 100. In Table 1, the PSNR and NC of the QR code image with difference magnitude factor in HH2 sub band. All case can be correct QR code. A high magnitude factor value on one hand could result in low PSNR,and hence significantly distorted watermark image (as shown in Fig 6). On the other hand, it increases NC value in watermark extraction (as shown in Fig7), thereby lowering the noise. Baring in mind, this trade off between PSNR and NC, we empirically chose the magnitude factor of 25. Subsequently, the watermark sub bands were changed to LH2 HL2 and HH2. The comparisons are illustrated in Table 2. It can be noted accordingly that the differences in PSNR are negligible, while the NC value of HH2 yeild the watermark that is most resemblant to the original image. The following experiment is therefore carried out with the watermark embedded in HH2. Once aplied with the DWT, the significant information is aggregate within the low-frequency subband. As a result, embeding the watermark in the higher frequency band does not destroy much of the information, hence resulting in higher NC than otherwise.Fig. 7 shows extracted watermark with difference magnitude factors. All extracted watermark images contain some visual noise because of the watermark extracting process did not employed the original QR code image. In practices, the transmission of an image can be corrupted by unpredictable noise contaminated in the network communication. We therefore tested the robustness of our algorithm with some attacks such as Salt and Pepper noise,

Subband	PSNR	NC	Extracted watermark
LH	43.0615	0.9525	
HL	43.1514	0.9611	
HH	44.2675	0.9916	

Attack Type	PSNR	NC	Decode QR code
Salt & Pepper Noise (0.02)	40.8837	0.9851	
Salt & Pepper Noise (0.05)	38.4989	0.9687	
Gaussian Noise (0.02)	37.2879	0.9945	
Gaussian Noise (0.05)	37.1402	0.9943	
JPEG (40)	39.3897	0.9942	
JPEG (50)	39.3897	0.9942	

		
Alpha 5	Alpha 10	Alpha 15

 Alpha 20	 Alpha 25	 Alpha 30
 Alpha 35	 Alpha 40	 Alpha 45

Table I: PSNR and NC of QR code Image

α	PSNR	NC	DECODE QR Code
5	47.1617	0.9826	•
10	44.1514	0.9934	•
15	42.3905	0.9961	•
20	41.1411	0.9967	•
25	40.1720	0.9975	•
30	39.3802	0.9980	•
35	38.7107	0.9986	•
40	38.1308	0.9991	•
45	37.6193	0.9995	•

Attack Type	Attacked QR code image	Extracted Watermark
Salt & Pepper noise (0.02)		
Salt & Pepper noise (0.05)		
Gaussian noise (0.02)		
Gaussian noise (0.05)		
JPEG (40)		
JPEG (50)		

IV. CONCLUSIONS AND FUTURE WORK

This paper presented a digital watermarking technique, whereby a binary image is watermarked an embedded in a QR code image . The embedding process is presented in a LH, HL or HH sub band based on wavelet transform. The experimental results demonstrated that the algorithm can be recover the watermark with an acceptable visual quality. The objective measures such as PSNR and

NC are subject to magnitude factor. As the future work, we are trying to find more efficient ways to withstand more severe attacks such as stronger noise, high compression, geometric distortion and occlusion etc.

V. References:

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