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Algorithm of QR code based Digital Image Watermarking

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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 .

Keywords—QR Code, Wavelet Transform, 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. 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.

In this technique the data is hidden within the cover image so stranger cannot get it without having proper guidance. 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. 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.

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2. BACKGROUND

2.1QR Code

QR code (Quick Response Code) is the trademark for a type of two-dimensional barcode.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. A QR code consists of black modules (square dots) arranged in a square grid on a white background, which can be read by an imaging device, such as a camera or mobile, and processed using Reed-Solomon error correction until the image can be appropriately interpreted. Data is then extracted from the patterns present in both horizontal and vertical components of the image.

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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.

2.2 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.

2.2.1 Digital watermarking is based on two techniques:

A) Spatial domain based: The most common spatial domain based technique is done by directly modifying the pixel values.

B) Transform domain based: The proposed technique is based on transform domain.Again the transform domain based digital watermarking can be classified into discrete wavelet transforms (DWT),discrete Cosine transforms (DCT), Multi resolution properties is the most important characteristics of DWT based digital watermarking, as for the specified region can be selected for data embedding.

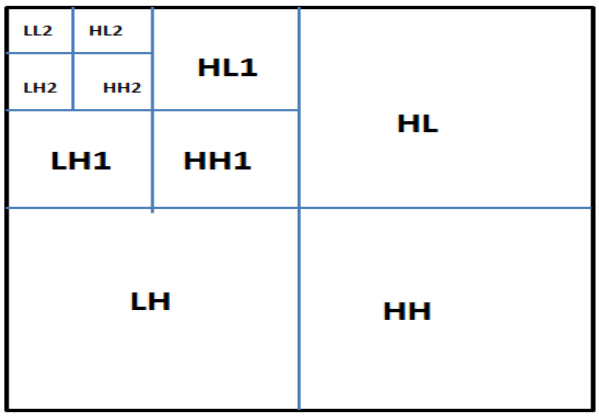
Every image can be divided into two specific regions: (1) low frequency region and (2) high frequency region, and these regions can be sub-divided in case of DWT based digital watermarking. DCT divide the image in three regions: (1) low frequency region, (2) mid-frequency region and (3) high frequency region. It is easy to select a distinct region to embed a data in case of DCT based digital watermarking.

2.3 Discrete Wavelet Transform

In the last few years wavelet transform has been widely used in signal processing. In watermarking general and image compression schemes .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 3 level 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.



3. PROPERTIES OF DIGITAL WATERMARKING

There are three main Properties of digital watermarking technique:

3.1 Transparency or Fidelity: The digital watermark should not affect the quality of the original image after it is watermarked. Watermarking should not introduce visible distortions because if such distortions are introduced it reduces the commercial value of the image.

3.2 Robustness: Watermarks could be removed intentionally or unintentionally by simple image processing operations like contrast or brightness enhancement, gamma correction etc. Hence watermarks should be robust against variety of such attack

3.3 Capacity or Data Payload: This property describes how much data should be embedded as a watermark to successfully detect during extraction. Watermark should be able to carry enough information to represent the uniqueness of the image. Different application has different payload requirements

4. PROPOSED TECHNIQUE

Digital watermarking technique is discussed in two steps:

- Digital watermarking embedding technique.
- Digital watermarking extracting technique.

Both steps are discussed as follows:

4.1 Digital Watermarking Embedding Technique:

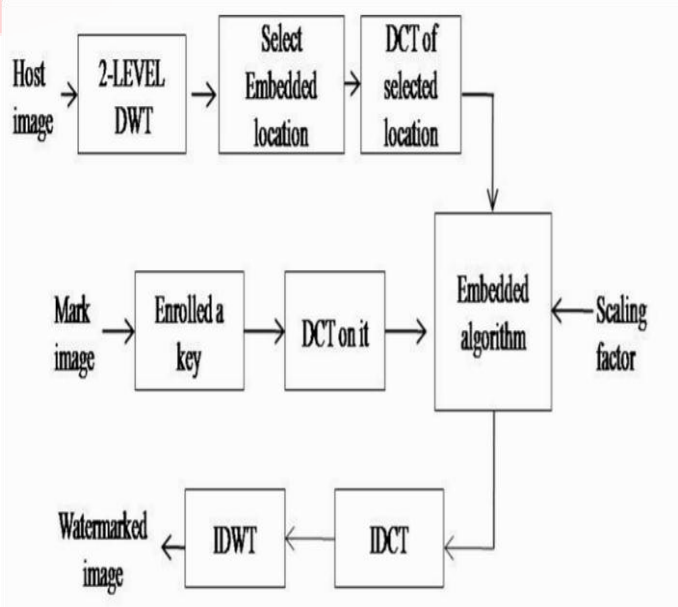


Figure4.1.1: Flow chart of the embedding procedure.

- The host image is 2 level DWT decomposed into HH, HL, LH, LL
- Select HH 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

4.2 Digital Watermarking Extraction Technique:

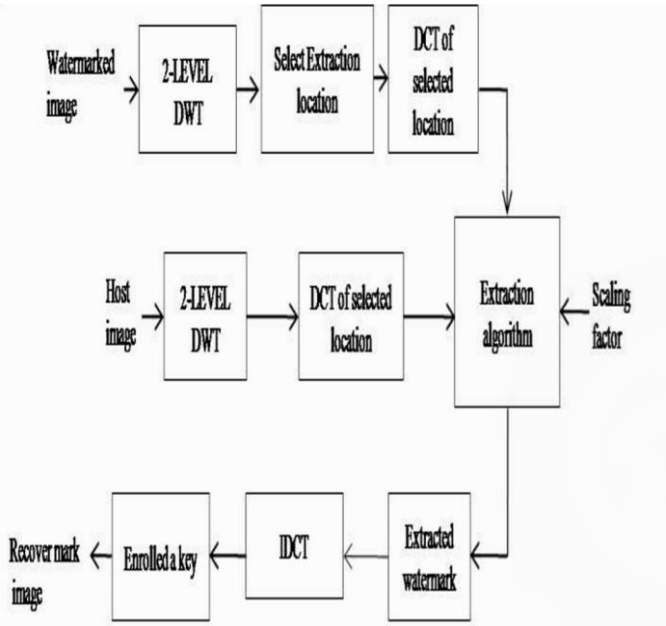


Figure4.2.1: Flowchart of extracting procedure

- Apply 2 level DWT to watermarked host image, image is decomposed into HHW, HLW, LHW, LLW
- Predicted cover image is obtained by smoothing watermarked cover image
- Apply 2 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

5. PERFORMANCE MEASURE

Digital watermarking has certain requirements. To measure these requirements different image quality metrics are used. peak signal to noise ratio (PSNR) to measure the amount of visual quality degradation between original and watermarked image.

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

MSE can be defined by the equation

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

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

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

6. 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. The experimental results demonstrated that the algorithm can be recover the watermark with an acceptable visual quality. With help of this one can make transmission more secure .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.

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