Digital Watermarking using Discrete Wavelet Techniques with the help of Multilevel Decomposition Technique

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ABSTRACT
Digital watermarking plays an important role for securing data, providing authentication, confidentiality and even protects digital images from illegal distortion. In this paper, we are particular using discrete wavelet transform which is more prevalent than others. The watermark logo is inserted after compressing the image with the help of JPEG compression technique. First original image is taken; it is changed into multilevel decomposed with the help of HAAR wavelet, as it is a type of wavelet used for diet (discrete wavelet technique) technique. The algorithm has been tested under the presence of attacks like Gaussian noise, JPEG compression and we see how their BER and PSNR value varies. Further, compression before watermarking is done to ensure inaccessibility of information to unauthorized personnel.

Keywords
Digital watermarking, Watermark, Haar wavelet, PSNR, BER, JPEG, Gaussian noise, gray scale image.

1. INTRODUCTION
Digital watermark is a process of hiding information in a carrier signal the hidden information should not have any relation to the carrier signal. It is used to verify the identity or authenticity of its own. Digital watermarking adds a layer of protection to images by providing confidentiality, authentication, and we can easily detect when our image is tampered extracted and modified in any way. Watermarking has this capability that our image is copied or tampered by some third party. To protect our image by using by a third party, we use different watermarking techniques. Digital watermarking provides copyright protection for digital data [1], [12], [13], [14]. Digital watermarking is a covert security feature for identity documents that enables trusted authentication of the host image like the image of PAN card and other IDs. Watermarking involves the transformation of a digital artifact into another token of the same type. Watermarking is done at the object-level. Almost all watermarking methods, which have been proposed today, can provide robust and secret watermark and against various attacks such as Gaussian noise, data compression, wrapping, cropping etc. The watermark is robust and secret due to the owner keeps the algorithm private [6]. Current digital image watermarking techniques can be grouped into two major classes: spatial-domain and frequency-domain-watermarking techniques [3] Compared to spatial domain Techniques [4], frequency-domain watermarking techniques proved to be more effective with respect to achieving the imperceptibility and robustness requirements of digital watermarking algorithms [5]. Commonly used frequency-domain transform include the Discrete Wavelet Transform (DWT), the Discrete Cosine Transform (DCT) and Discrete Fourier Transform (DFT). Whoever DWT [8] has been used in digital image watermarking more frequently due to its spatial localization and multi-resolution characteristics, which are similar to the theoretical models of the human visual system [11]. Further performance improvements in the DWT-based digital image watermarking algorithms could be obtained by combining DWT with DCT [15]. Digital watermarking technology is emerging as a solution to a broad class of challenges. There has been great interest in applying watermark to digital multimedia Data for copyright protection, image authentication and proof of ownership etc. [9]. Image watermarking is finding more and more support as a possible solution for the protection of intellectual property rights. Any watermark signal is associated (one by one) with an integer number (or a set of integer numbers) which is the watermark key. This key is used to produce, embed and detect a watermark. The key is private and characterizes exclusively the legal owner of the digital product. The number of available keys is enormous [10]. Each watermark must correspond to a unique key. It thus serves to identify the owner of the watermarked image.

This paper is organized in the following sections. In section 2 we describe problem definition. In section 3 we describe proposed solution. In section 4 and 5 results are discussed.In section 6 Performance and evaluation is done. In section 7 concludes.In section VIII, references are defined

2. PROBLEM DEFINATION
Digital watermarking is hiding information into a host
An image in a perceptually invisible way [2], [7]. A more precise Explanation of it is as shown in figure 1.
We are trying to make an image after watermarking same as an original host image by using DWT technique, in which discrete sampling of waves are done, to make our watermarked image look similar to original one. As it will prevent us doing fraud and will, make our data more confidential;
The error between H (x, y) and W (x, y) should be minimum. It is noted that, for watermark embedding, the normalization is applied with respect to the original image, while, for watermark extraction, it is applied with respect to the watermarked image. Thus, it is important to design the

watermark signal so that it has minimal effect on the Normalized image.

3. PROPOSED SOLUTION

The purpose of the proposed project is to hide personal Information into a cover image in perceptually invisible Manner. To achieve this, a mathematical tool Wavelet Transform is selected [16], [17], [18]. Following are the steps. To hide a grayscale image (watermark) into cover image

3.1 Algorithm

- Consider any gray scale image having size 512 X 512
- As a host image. If the size of host image is not 512X512
- Then make it 512 X 512.

- Decompose the host image by using discrete Wavelet transform. Store the first level approximation coefficients, i.e. LL1, horizontal coefficient LH1, vertical coefficient HL1, diagonal coefficient HH1 as first level watermark key coefficients of host image.
- Computes Approximation coefficient of the first level is A, Horizontal coefficient is an H vertical coefficient is V, diagonal coefficient is D.
- Now we will perform multilevel decomposition on the original (Cover image) i.e. Lena uses Haar wavelet
- As Haar wavelet transform produces coefficients that are dyadic rational numbers, i.e. their denomination are power of 2 [54].
- Now will try to extract the coefficients Of Horizontal, vertical and diagonal part of an image.
- Now construct the decompose values using Haar wavelet, as it either performs addition or subtraction from them on a multiple of 2^l, where l is the decomposed level, which guarantees inverse discrete wavelet transform.

3.2 Compression

- Now we will compress the Lena image using different function of mat lab
- After compressing the image we can insert watermark in it and see the changes

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3.3 Embedding and Extraction

- For watermarking, we will use the least significant bit method, we will take LSB of compress image and && it, with the MSB of watermark as all the pixel values are converted from binary to decimal form [19]. So we will get a watermarked image with MSB OF Watermark in binary form, with less distortion as compared to the original image

- Now we will extract the watermark from watermarked image, making least significant bit of watermarked image zero's and swap it with MSB of watermarked image as all the pixel values are converted from binary to decimal form, so this is the way, a watermark is extracted using lab techniques [19]

- Now we will calculate the PSNR value of watermarked image and original image and see the difference

- PSNR and MSE are two metrics used to measure image compression quality. The MSE represents the cumulative squared error between the compressed and the original image, whereas PSNR represents a measure of the peak error.

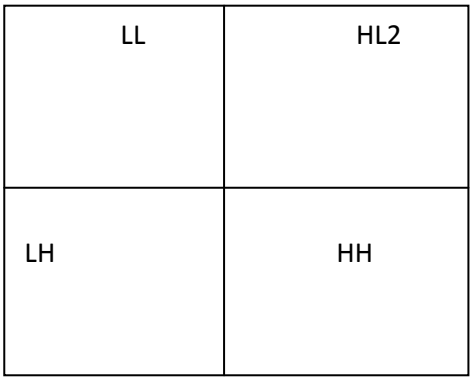
- The PSNR is defined as:

$$PSNR = 10\log_{10}\frac{255^2}{MSE}$$

$$\text{where } MSE = \frac{\sum_{i=0}^{N-1}\sum_{j=0}^{N-1}[I_1(i,j) - I_2'(i,j)]^2}{N \times N} \quad [20]$$

- Now the bit error rate is also calculated using hamming code, which is an error correcting code
- As a hamming code is a family of linear correcting code use to correct errors

Fig 2 (a)



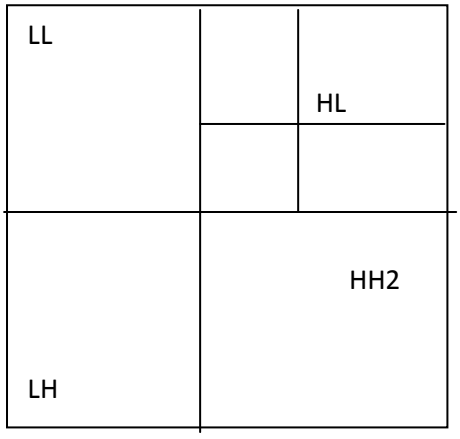


Fig 2(a) and 2(b): Shows Multi-resolution DWT sub-bands of the original image

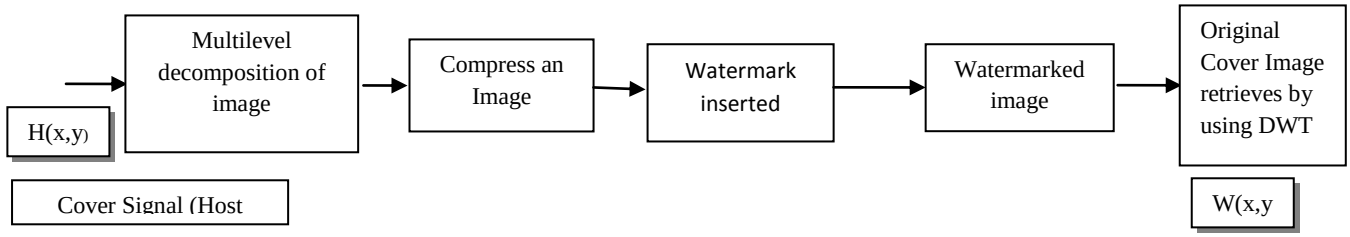


Figure 1 Basic Block Diagram

4 RESULTS AND SECTIONS

First, we took the original image, Lena which is shown:

Fig 3: Original image

After taking the original image of Lena, we make it multi-level decomposition using HAAR wavelet shown below

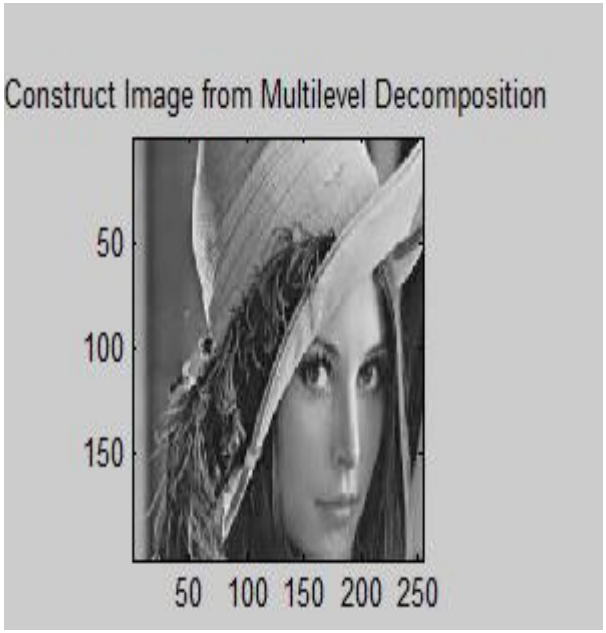


Fig 4: Multilevel decomposition of original image

Now, after constructing multi-level decomposition using her-wavelet, we can now produce compress image with the help of JPEG compression

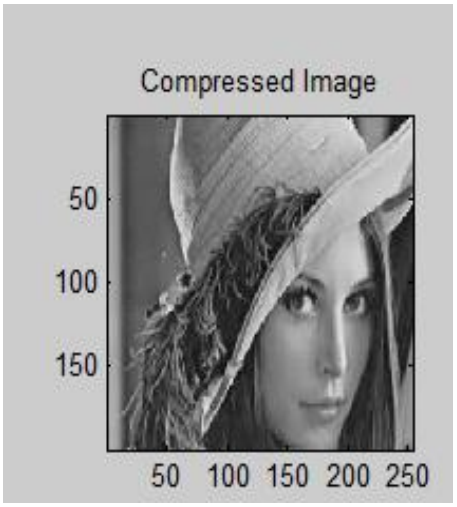


Fig 5: Compressed Image

Now watermark is taken in the form grayscale image having size 128*128. As shown in. This is the watermark to be inserted into the compressed Lena image. And will see the changes accordingly

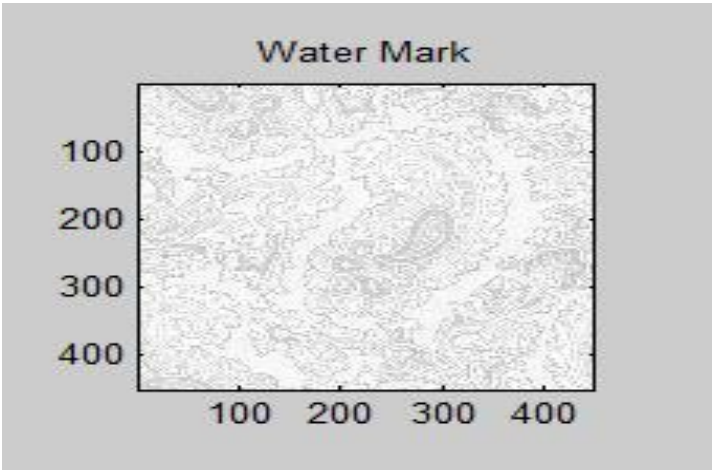


Fig 6: Watermark

Now watermark is inserted into a compressed image with the help of lab technique. And we will see there is little distortion between original and watermark image, we will embed some noise attacks like Gaussian attack and calculate PSNR values, and also evaluate error correcting codes

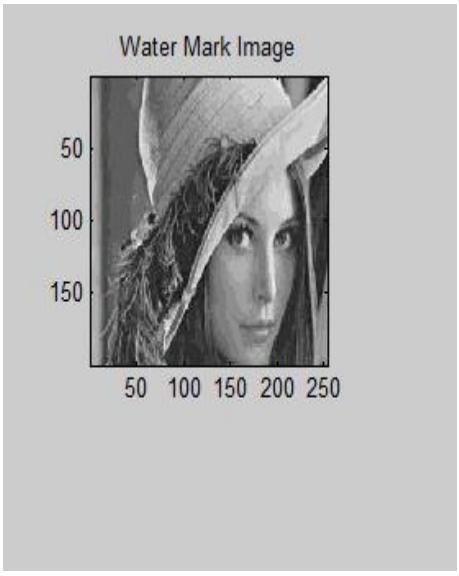


Fig 7: Watermark Image

Now watermark is removed using LSB technique already discussed, now removed watermark is shown .We recover removed watermark image seem like our original image

Fig 8: Removed watermarked image

Now watermark is also removed using LSB technique, then we will get the original watermark same as we have inserted in fig 9:

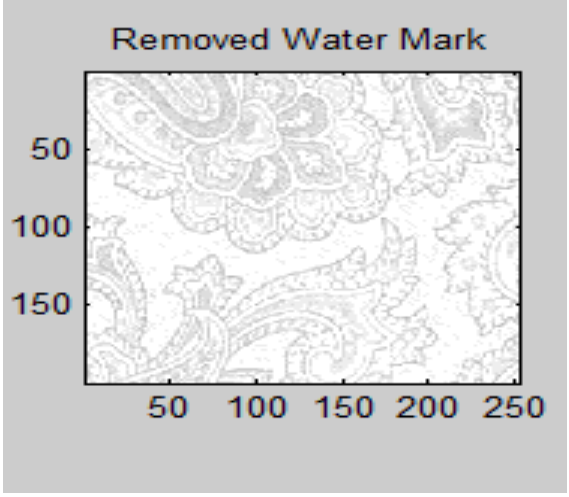


Fig 9: Removed watermark

5 RESULTS OF GIVEN FIGURES

When we calculate the bit error rate, which means change in no of bits Lena image using hamming code

Table 1: **Variation of PSNR, MSE, and BER**

INPUT IMAGE	PSNR	MSE	BER
LENA	66.64	6.0916e-005	0.125
Brain(Medical image)	66.13	6.0916e-004	0.120
PAN CARD	66.39	6.0916e-002	0.123

Now change in PSNR Values, and MSE, due to different attacks like, Cropping, JPEG Compression.

Table 2: Comparative study for different extracted watermark logos

ATTACKS	PSNR(dB)	MSE
JPEG Compression	400.4804	0.0046
Cropping	113.1899	0.0027

Cropping: In this method part of Lena image is cropped, shown in fig 10. It can even lose some confidential data which is present in it. So we avoid cropping of

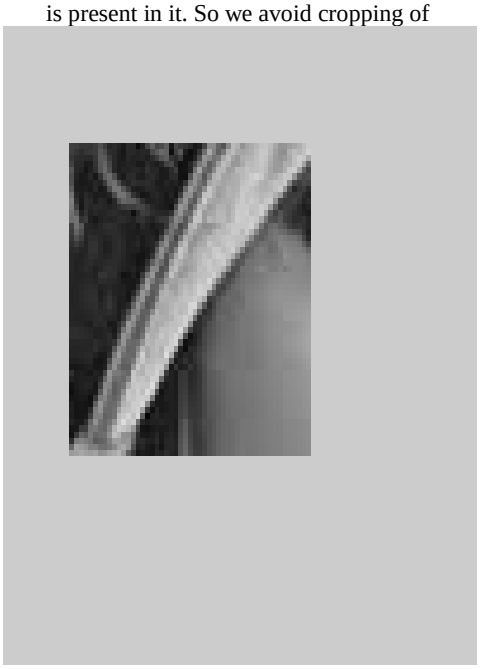


Fig 10: Cropped Lena image

6. PERFORMANCE AND EVALUATION

It shows all the performance of all the images in matlab:

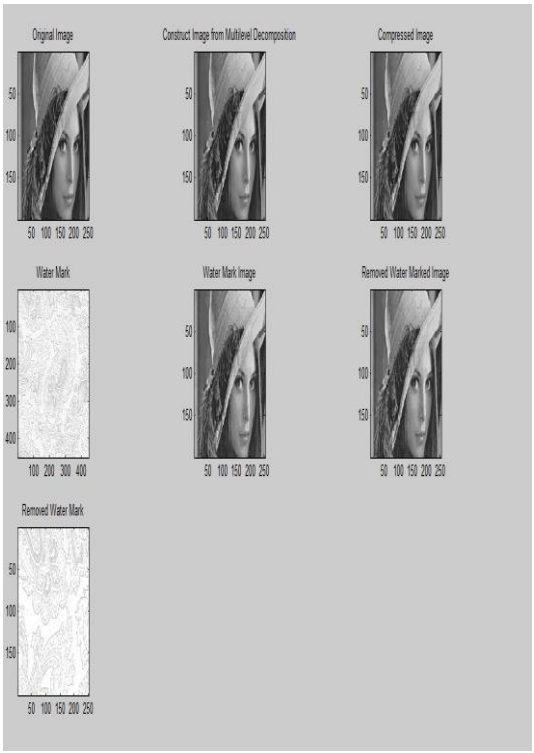


Fig 9: original image decomposed into multi-level decomposition and then watermark is inserted and extracted

7. CONCLUSION

We have designed the system for digital watermarking, using Discrete wavelet transformation and the wave filter, we have used is HAAR wavelet. This system also provides for an MSE, PSNR, and BER, which determines the robustness of the watermark on the digital image. This is necessary in fragile watermarking as they can be easily removed from the basic image transformation. In such a case imperceptibility present in watermark prevent it from malicious attack

The watermark is embedded after the compression of the image is done by using a JPEG compression technique, and making it resistant against various attacks, and malicious modifications

The given system provides good results against the attacks like Filtering, JPEG compression; cropping and we even have calculated bit error rates.

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