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DWT Based Watermarking for User Selection System as Visible and Invisible

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Abstract— ***Digital watermarking has become one of the most popular copyright protection methods. Addition of Watermark can be done in visible and invisible manner. Visible watermark places a watermark over an image in such way that it is visible to all the users about the owner of the image and invisible watermarking is done in such a way that watermark content is hidden from the user. In this paper, we present both visible and invisible watermarking methods applied on digital images for copyright protection. In our proposed scheme we apply DWT (Discrete Wavelet Transform) to both visible and invisible methods. The proposed scheme is implemented with the help of GUI (Graphical User Interface) in MATLAB. After this, we will compare the results of visible and invisible watermark on the basis of BER(Bit Error Rate), MSE(Mean Square Ratio) and PSNR(Peak Signal To Noise Ratio).***

Keywords— Digital Watermarking , Visible and Invisible watermarking , Discrete Wavelet Transform (DWT), Peak Signal To Noise Ratio (PSNR), Bit Error Rate (BER), Mean Square Ratio(MSE).

I. INTRODUCTION

In recent times, due to great developments in computer and internet technology, multimedia data i.e. audio, images and video have found wide applications. Digital watermarking is one of the best solutions to prevent illegal copying, modifying and redistributing multimedia data. Encryption of multimedia products prevents an intruder from accessing the contents without a proper decryption key. But once the data is decrypted, it can be duplicated and distributed illegally. To enforce IP rights and to prevent illegal duplication, interpolation and distribution of multimedia data, Digital watermarking is an effective solution. Copyright protection, data authentication, covert communication and content identification can be achieved by Digital watermarking.

Digital watermarking is a technique to embed copyright or other information into the underlying data. Watermarking is the process of embedding data called a watermark into a multimedia object such as images, video, or text for their copyright protection[1]. The embedded data should maintain the quality of the host signal.

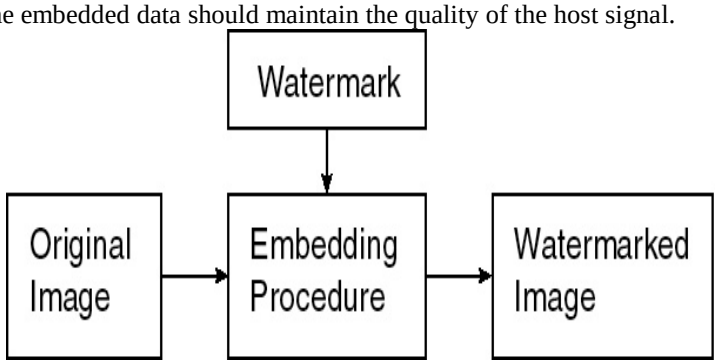

Fig 1. Watermarking algorithm general form

In order to achieve the copyright protection, the algorithm should meet few basic requirements:

i) Imperceptibility: The watermark should not affect the quality of the original signal, thus it should be invisible/inaudible to human eyes/ ears.
ii) Robustness: The watermarked data should not be removed or eliminated by unauthorized distributors, thus it should be robust to resist common signal processing manipulations such as filtering, compression, filtering with compression.
iii) Capacity: the number of bits that can be embedded in one second of the host signal.
iv) Security: The watermark should only be detected by authorized person.
v) Watermark detection should be done without referencing the original signals.
vi) The watermark should be undetectable without prior knowledge of the embedded watermark sequence.
vii) The watermark is directly embedded in the signals, not in a header of the signal.

In digital watermarking, watermarks can be classified as many types according to its properties[4].In terms of its visibility, digital watermark can be divided into both visible and invisible watermark. Invisible Watermarking hides the data inside the image. Visible watermark places watermark over an image in such a way that it is visible to all the users

about the owner of the image. The invisible watermark falls into two categories: fragile watermark and robust watermark. The fragile watermark is very easily modified. There are some built-in applications in some of the digital cameras. Each application allows the user to embed a fragile watermark into the photos produced by the digital camera. If anyone changes the photos by modifying the pixel values then this fragile watermark is broken. However, the robust watermark is used very often for copyright protection because it is not easily being attacked. In this paper we will develop a robust technique to these attacks and also discuss the quality factors that affect the quality of watermarking technique. Here we are using Discrete Wavelet Transformation technique for insertion and extraction of watermark from the image using invisible and visible watermarking methods.

There are a number of techniques have been developed for watermarking. Some of them the watermarks are applied on the spatial domain. The main disadvantage of spatial domain watermarking is that a frequent picture cropping operation may remove the watermark. Other than spatial domain watermarking, frequency domain approach have also been used. The spatial-domain techniques directly modify the intensity values of some selected pixels while the frequency-domain techniques modify the values of some transformed coefficients. The watermarking scheme which is based on the frequency domains can be classified into the Discrete Fourier Transform (DFT), Discrete Cosine Transform (DCT) and Discrete Wavelet Transform (DWT) domain methods. In this paper, we will develop a system in which firstly the user will select as what type of watermarking does it need. The visible and invisible watermarking is done with the help of DWT technique. In invisible watermarking, watermark image can also be extracted. After this, we will compare the results of visible and invisible watermarking on the basis of MSE (Mean Square Error), BER (Bit Error Rate) and PSNR (Peak Signal To Noise Ratio).

II. DISCRETE WAVELET TRANSFORM

The transform of a signal is just another form of representing the signal. It does not change the information content present in the signal. The Wavelet Transform provides a time-frequency representation of the signal. The DWT (Discrete Wavelet Transform) is a powerful and useful multi-resolution decomposition method in digital watermarking. The original image is decomposed into lower frequency sub band and higher frequency sub band using DWT. Each level of decomposition generate four bands of data, one can be low-low (LL), low-high(LH) vertical, high-low(HL) horizontal and high-high(HH) diagonal pass bands. In the lowest resolution low pass band shows approximation image and higher bands shows detail images. The low pass band is further decomposed to attain another level of decomposition. With DWT we can decompose an image more than once. Decomposition can be continued until the signal has been entirely decomposed or stopped before by the application at hand. The filter bank structure used in wavelet decomposition of an image is shown in Fig1.2. Where h[n] is low pass filter, g[n] is high pass filter and W is wavelet function. Here, we are using daubechies wavelet function. The low frequency image usually has better stability against the image distortion. DWT is easy to implement and can efficiently reduce the computation time. DWT has significant advantages over geometric attacks such as compression, scaling & cropping.

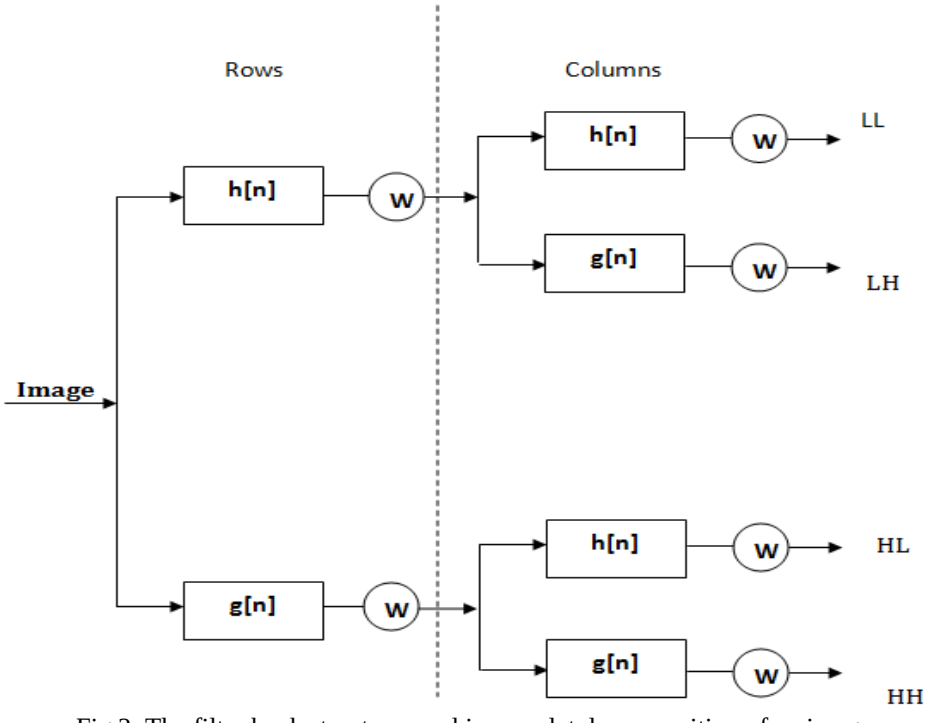

Fig 2. The filter bank structure used in wavelet decomposition of an image

III. PROPOSED ALGORITHM

In our proposed work, visible and invisible watermarking is done with the help of DWT(Discrete Wavelet Transform) technique. We are using dwt2 for 2D wavelet. Here the four components that are to be modified are approximation, horizontal, vertical and diagonal .Since we are using color images it means we have 3 layers for the colored image that are RGB (Red, Green and Blue). The watermark is applied to these layers one by one. In invisible watermarking, watermark image can also be extracted. The following steps are used:

Step 1-Firstly, user will select the type of watermarking either visible or invisible watermarking.
Step 2-After selecting the type of watermarking, visible algorithm and invisible algorithm will be implemented and we will compare results of both techniques on basis of PSNR, BER, MSE.

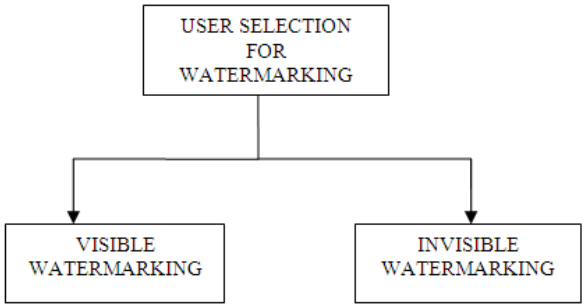

Fig 3. Block Diagram of main function

A.Visible Watermarking:
In this step, we will add visible watermark inside the image. Visible watermark places a watermark over an image in such a way that it is visible to all the users about the owner of the image.

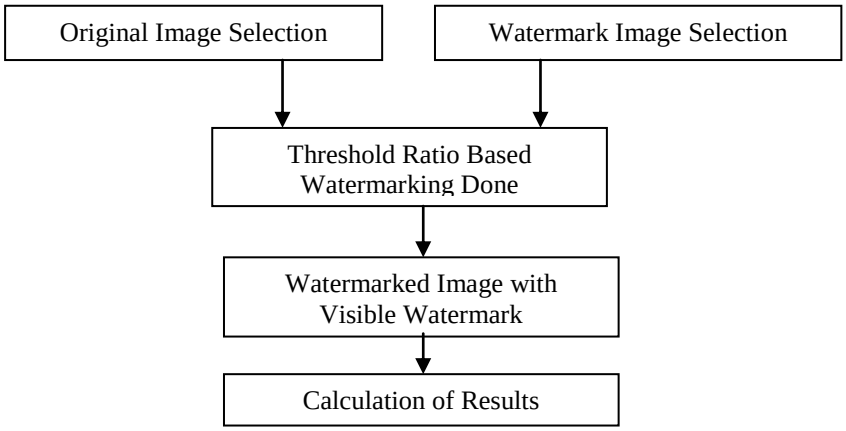

Fig 4 .Block diagram of visible watermarking

B.Invisible Watermarking:
In this Step, we will add watermark in the form of image and that watermark should be hidden from the intruder and can be later extracted.

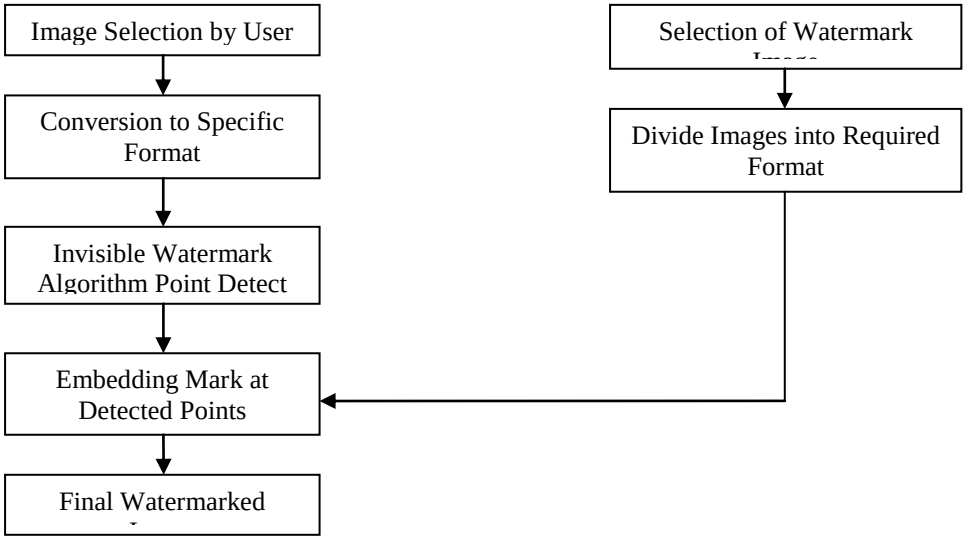

Fig 5. Block diagram of invisible watermarking

IV. RESULTS AND CALCULATIONS

We are performing calculations after successful implementation in MATLAB 7.5.0. The visual quality of watermarked and attacked images is measured using PSNR values. PSNR block computes the peak signal-to-noise ratio, in decibels. Higher the value of PSNR more will be efficiency of Watermarking. This ratio is frequently used as a quality measurement between the original and a watermarked image. It is given by equation:

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

Here MSE represents the cumulative squared error between the watermarked and the original image, whereas PSNR represents a measure of the peak error. The lower the value of MSE, then lower the error. To compute the PSNR, we first calculates the mean-squared error using the following equation:

$$MSE = \sum_{i=0\ j=0}^{M-1\ N-1} \left(\frac{[OI(i,j) - DI(i,j)]^2}{MxN} \right)$$

Bit Error Rate is determined by Inverse of PSNR values. The more is BER lesser will be the quality of Watermarking technique.

$$BER = \frac{1}{PSNR}$$

So BER is inversely proportional to PSNR. More the value of BER lesser will be PSNR value. Hence we will calculate PSNR, MSE and BER for visible and invisible methods and find out which one yields better results. The Results are shown in following tables where calculations have been made for the proposed Scheme.

Table 1 Result for Visible Image Watermarking

S.No.	Original Image	Watermark	MSE	PSNR	BER
1.	Koala.jpg	a.jpg	1.2582	47.1333	0.0212
2.	Penguins.jpg	b.jpg	1.7769	45.6341	0.0219
3.	Desert.jpg	c.jpg	3.8244	42.3052	0.0236
4.	Tulips.jpg	d.jpg	5.3379	40.8571	0.0245
5.	Jellyfish.jpg	e.jpg	3.2710	42.9840	0.0233

Table 2 Result for Invisible Image Watermarking

S.No.	Original Image	Watermark	MSE	PSNR	BER
1.	Koala.jpg	a.jpg	0.0740	59.4385	0.0168
2.	Penguins.jpg	b.jpg	0.0589	60.4281	0.0165
3.	Desert.jpg	c.jpg	0.1408	56.6457	0.0177
4.	Tulips.jpg	d.jpg	0.1541	56.2541	0.0178
5.	Jellyfish.jpg	e.jpg	0.0584	60.4701	0.0165

V. CONCLUSION

In this paper a new method of visible and invisible watermarking with the help of discrete wavelet transform technique has been proposed. In the visible watermarking, the watermark image is visible on the original image but in the invisible watermarking, the watermark image is hidden from the user. The proposed scheme is implemented with the help of GUI (Graphical User Interface) in MATLAB. After that, this process is analysed on the basis of MSE(Mean square error), BER(Bit error rate) and PSNR(Peak signal to noise ratio). Higher the value of PSNR more will be efficiency of Watermarking. The watermark image is also extracted in invisible watermarking. The quality of the image is not much degraded through this technique. The security, accuracy and robustness is increased through this method. Hence, the comparison of the results of visible and invisible watermarking is obtained. The results show that we are getting higher value of PSNR in invisible image watermarking as compared to visible Image Watermarking. Thus invisible watermarking is more robust than visible watermarking because of higher PSNR Values.

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