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Enhanced Watermarking Technique using Computational Wavelet and Cosine Transformation

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Abstract: ***Over the use of Internet, digital watermarking provides the protection for multimedia data. In the contemporary days, misuse of multimedia data is done at a huge level and encryption of the sensitive data flowing through the network or Internet is one of the most important factors for the copyright issues. So, in order to save the information from being stolen or misused, digital watermarking technique is proving to be a great invention in the field of information technology and multimedia. It comprises of general process of lodging the data in the original content. Where data can be in any form, whether audio, video, image or text. The text can be concealed in the image, audio or video as a watermark. Moreover, the fraud use of important data can be avoided using this type of encryption. In this research paper, an idea of watermark is proposed and implemented. To sum up, the PSNR, MSE, NC of the watermarked image would be calculated to check the quality of image and would be compared with others.***

Keywords: Digital image, DCT, DWT Wavelet families, Watermark Text.

1. Introduction

Watermarking is a concept which is used to save the document from the copyright issue. Watermark comes behind the original document and it is suppose not to harm the original content. Many software companies are using the concept of watermark for their documents. The best example is Microsoft's Word. To protect the digital data we need full security at a good level to embed the text such as major websites contents are like paper, legal document, letter, SMS etc. Digital watermarking is a process in which information can hide in form of image, audio, video etc. Hidden information extracted at the receiving end is known as decryption process. So to protect the data from outside world for illegal accessing of information watermarking is used. To protect data from illegal authorities many techniques like cryptography, watermarking, steganography are used. Encryption and decryption process of data comes under steganography. In case of encryption, data is encrypted and outside world or third parties cannot access it. Then on receiver side after decrypting there is no any provision to protect data from replications. So encryption exists on sender side and decryption exists on receiver side.

There are two types of digital watermarking: visible (perceptible) and invisible (imperceptible). In visible watermarking, watermarks are embedded in such a way that they are visible when the content is viewed. Invisible watermarks cannot be seen but recovering of watermark is possible with an appropriate decoding algorithm.

Watermarking can be considered as a special technique of steganography where a message is embedded in another and the two messages are related to each other in some way. The most common examples of watermarking are the presence of specific patterns in currency notes, which are visible only when the note is held to light, and logos in the background of printed text documents. The watermarking techniques prevent forgery and unauthorized replication of physical objects. Digital watermarking is similar to watermarking physical objects except that the watermarking technique is used for digital content instead of physical objects.

2. Related Work

Ali Al-Haj (2007) described a combined DWT-DCT digital image watermarking algorithm. Watermarking was done by embedding the watermark in the first and second level DWT sub-bands of the host image, followed by the application of DCT on the selected DWT sub-bands. The combination of the two transforms improved the watermarking performance considerably when compared to the DWT-Only watermarking approach. In conclusion, in DWT-based digital watermarking applications, combining appropriate transforms with the DWT may have a positive impact on performance of the watermarking system [1].

Navnidhi Chaturvedi (2012) introduced two major problems in handling digital multimedia for authenticity & copyright protection. The Image watermarking is most popular method for copyright protection by discrete Wavelet Transform (DWT) which performs 2 Level Decomposition of original (cover) image and watermark image is embedded in Lowest Level (LL) sub band of cover image. Inverse Discrete Wavelet Transform (IDWT) is used to recover original image from watermarked image. And Discrete Cosine Transform (DCT) which convert image into Blocks of M bits and then reconstruct using IDCT. The watermarking results using DWT & DWT-DCT methods performance analysis on basis of PSNR are compared. According to the results DWT-DCT method is best technique for level one watermark embedding [2].

Hung-Ju Lin et al. (2006) present a DWT Based Approach for Image Steganography. In this paper, he proposed a new steganography technique which embeds the secret messages in frequency domain. According to different user demands on the embedding capacity and image quality, the proposed

algorithm is divided into two modes and 5 cases. Unlike the space domain approaches, secret messages are embedded in the high frequency coefficients resulted from DWT. Coefficients in low frequency sub-band are preserved unaltered to improve the image quality. Some basic mathematical operations are preformed on the secret messages before embedding. These operations and a well-designed mapping table keep the messages away from stealing, destroying from unintended users on the internet and hence provide satisfactory security [4].

K.U Jaseena et al. (2011) described that digital watermarking provides authentication and copyright protection for multimedia contents over the internet. In addition to image, audio, and video, now a day's text is the most important medium travelling over the internet. Hence it needs to be protected. Text watermarking techniques that have been developed in past protects the text from illegal copying, forgery, and prevents copyright violations. In this paper, a new text watermarking technique that uses combined image and text watermark and encryption to protect the text document is proposed. The watermark is logically embedded in the text and the text is encrypted. Later the text is decrypted and then the watermark is extracted to prove authenticity [5].

Manjit Thapa (2011) proposed an algorithm for digital image watermarking technique based on singular value decomposition. This technique refers to the watermark embedding procedure and watermark extracting procedure. The experimental results prove that the quality of the watermarked image is good and that there is strong resistant against many attacks [8].

K.A. Navas et al. (2008) introduced some works are reported in the frequency domain watermarking using Single Value Decomposition. The two most commonly used methods are based on DCT-SVD and DWT-SVD. The commonly present disadvantages in traditional watermarking techniques such as inability to withstand attacks are absent in SVD based algorithms. They offer a robust method of watermarking with minimum or no distortion. In this paper, he introduced a method of non-blind transform domain watermarking based on DWT-DCT-SVD. The DCT coefficients of the DWT coefficients are used to embed the watermarking information. This method of watermarking is found to be robust and the visual watermark is recoverable without only reasonable amount of distortion even in the case of attacks [9].

V.Santhi (2009) Due to the advancement in Computer technology and readily available tools, it is very easy for the unknown users to produce illegal copies of multimedia data which are floating across the Internet. In order to protect those multimedia data on the Internet many techniques are available including various encryption techniques, steganography techniques, watermarking techniques and information hiding techniques. In this paper, he proposed new singular value decomposition (SVD) and DWT based technique is proposed for hiding watermark in full frequency band of color images. The quality of the watermarked image and extracted watermark is measured using peak signal to noise ratio and normalized correlation (NC) respectively. It is observed that the quality of the watermarked image is maintained with the value of 36dB. Robustness of proposed algorithm is tested for various attacks including salt and pepper noise and Gaussian noise, cropping and JPEG compression [10].

M.Mohamed Sathik (2012) proposed an innovative watermarking scheme which utilizes the perceptual information of an image content to generate watermark. According to this, the disparity values between low frequency sub band of wavelet domain and the rescaled version of original image are identified as the watermark and are disordered with the help of Arnold Transform. The operation of embedding and extraction of watermark is done in high frequency domain of Discrete Wavelet Transform since small modifications in this domain are not perceived by human eyes. This watermarking scheme deals with the extraction of the watermark information in the absence of original image, hence the blind scheme was obtained. Peak Signal to Noise Ratio (PSNR) and Similarity Ratio (SR) are computed to measure image quality. In addition, the competency of the proposed method is verified under common image processing operations and a comparative study is made against previous technique [11].

Abhay Sharma et al. (2012) presented a new proposal for hiding a logo-based watermark in color still image. This dodge is based on averaging of central frequency coefficients of block Discrete Cosine Transform (DCT) coefficients of an image. It is unique from earlier dodge based on middle frequency coefficient by mean of high redundancy, to nurture malicious attacks. Here algorithm of aliquot watermarking technique based on DCT (Discrete Cosine Transformation) using mid band for robustness is proposed. Through adjusting the block DCT coefficient of the image the watermarks are numbered [13].

Priyanka Sharma (2012) discusses about the quality management while the operation performance of watermarking. She studied that there are a lot of algorithms which can be useful for the watermarking but it is important to maintain the quality of the base content. She has used the term entropy to find the quality of the base image. Basically it is the disorder which occurs when so ever we perform the operation [14].

Nidhi Divecha (2012) presented a watermarking scheme based on the wavelet quantization method which is again an appreciable effort in this filed. DWT stands for Discrete Wavelet Transformation and it converts the entire data scenario into waves. Preceding the texts as wave is a unique method in this type of implementation. The effort done by Nidihi had only one drawback , she did not mention the type of wavelet transformation she is using as there are a lot of wavelet transformation like Dabuchi, Symlet and others and hence her method can be tried with the above mentioned wavelet family members [15].

3. Preliminaries

As stated earlier that transform domain based watermarking scheme is always a better choice than spatial domain based

watermarking scheme. In this section, the DCT, LSB, DWT wavelet family transformations are briefly described.

3.1 Discrete Cosine Transformation (DCT)

DCTs are used to convert data into the summation of a series of cosine waves oscillating at different frequencies. They are widely used in image and audio compression. They are very similar to Fourier Transforms, but DCT involves the use of just Cosine functions and real coefficients, whereas Fourier Transformations make use of both sine and cosine and require the use of complex numbers. DCTs are simpler to calculate. Both Fourier and DCT convert data from a spatial-domain into a frequency-domain and their respective inverse functions convert things back the other way. The JPEG (Joint Photographic Experts Group) format uses DCT to compress images. As DCT can be used to transform image to bits, this algorithm can be also used for text or word documents. Basically the best extenders are to use the **Least Significant Bit** of the base content for the merging of the content.

a) Least Significant Bit (LSB)

This is invisible digital watermarking technique, in which each 8-bit pixel's least significant bit is overwritten with a bit from the watermark. In a digital image, information can be inserted directly into every bit of image information or the more busy areas of an image can be calculated so as to hide such messages in less perceptible parts of an image. For example, assume the image uses a 24-bit RGB color model (Fig.1). The first image pixel has a teal green color (0x008080), while the first watermark byte is 0xDC. First, the image pixel is divided into its constituent bytes of red, green, and blue as shown in fig.2.

0x008080 => r: 0x00, g: 0x80, b: 0x80

Then the watermark byte is divided into pairs of bits. Next embed each bit pair into bits 1 and 0 of each color byte. So the red byte (0x00) becomes 0x03, the green byte (0x80) becomes 0x81, and the blue byte (0x80) becomes 0x83. Then use these modified bytes to recolor the image pixel. The new pixel color, however, seems to be the same teal color (Fig.2).

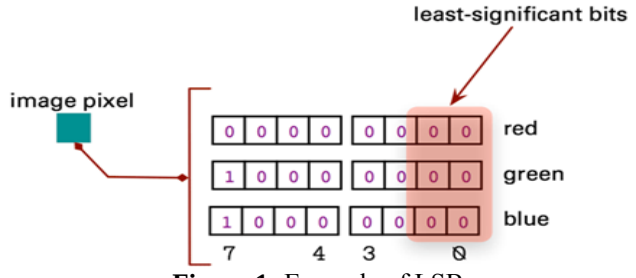

Figure 1: Example of LSB

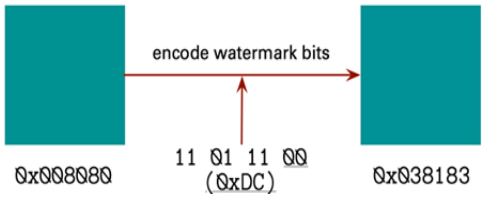

Figure 2: Encoding of watermark bits

3.2 Discrete Wavelet Transformation (DWT)

Wavelet transform provides both frequency and spatial description of an image. Unlike conventional Fourier transform, temporal information is retained in this transformation process. Wavelets are created by translations and dilations of a fixed function called mother wavelet. Some of the wavelet families which are used during the implementation are discussed below:

a) Coif lets: Coif lets have scaling functions with vanishing moments. Their wavelet functions have N/3 vanishing moments and scaling functions N/3-1. In coifN, N is the number of vanishing moments for both the wavelet and scaling functions.

b) Reverse Biorthogonal Wavelet Pairs: It is obtained from biorthogonal wavelet pairs. Biorthogonal wavelets feature a pair of scaling functions and associated scaling filters — one for analysis and one for synthesis. The analysis and synthesis wavelets can have different numbers of vanishing moments and regularity properties.

c) Shannon: This family is obtained from the frequency B-spline wavelets by setting *m* to 1. A complex Shannon wavelet is defined by

$$\Psi(x) = \sqrt{f_b}\,\mathrm{sinc}(f_b x) e^{2\pi i f_c x}$$

Depending on two parameters:

- f_b is a bandwidth parameter.
- f_c is a wavelet center frequency.

4. Proposed Methodology

To begin with the proposed work, the Discrete Cosine Transformation algorithm is combined with different wavelet family members of Discrete Wavelet Transformation. The image is considered as the basic input and the text to be the watermark. First of all the text would be encoded into bits so that it can be merged. Furthermore, the result obtained from the merging process is placing of the bits in the LSB's of the image bits. The respective encoded bits are going to be the wavelet transformation using Shannon, coif let and reverse biorthogonal methods.

To sum up, the PSNR (Peak Signal to Noise Remove) of the watermarked image would be calculated to check the quality of the image and would be compared with other algorithms. The PSNR is commonly used as a measure of quality of reconstruction of lossy compression. If the reconstructed image is close to the original image, then MSE is small and PSNR takes a large value. PSNR is dimensionless and is expressed in dB.

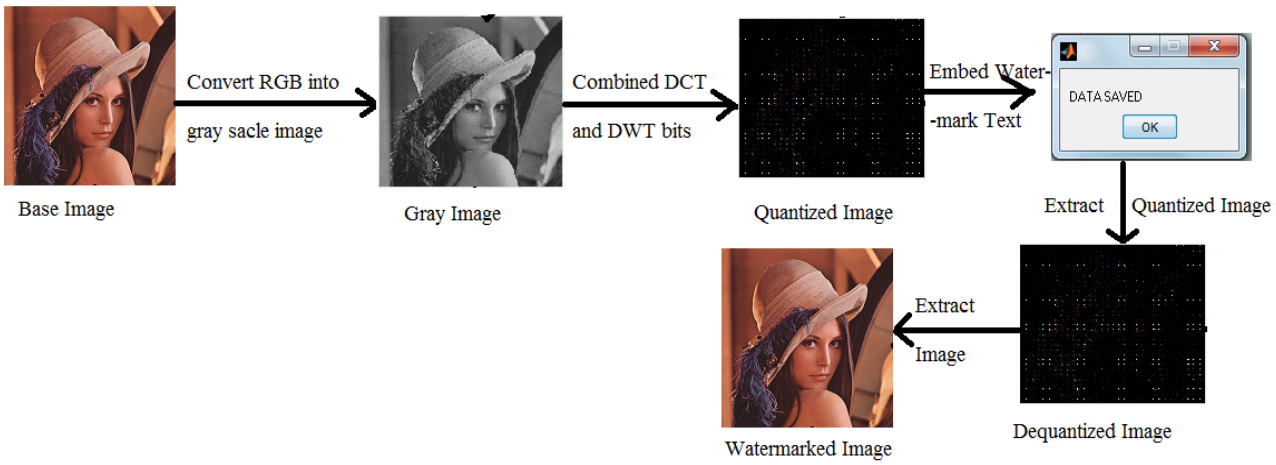

Figure 3: Work flow

5. Combinational Merging Algorithm

As the wavelet transformations can be used for the merging of bits and this particular context can be termed as watermarking hence the research can be extended by combining the algorithms as well. To combine two algorithms it is required to check out that how compatible can be two algorithms. Combining two algorithms means the output of one algorithm would be provided to another algorithm as an input.

Algorithm Steps

Step:1 find(bit.count(dct.image))
Step:2 sum=0
for (i=1:length(bitlength.dct))
{
sum=sum + bitval(dct(i));
}
Avg.threshold = sum/m;
Step:3 find (dwt(quantized.image))
find (length.dwt(Q.image))
{
If (dwt.Q(i) > threshold)
{
Ignore;
}
Else
{
Add (mapped bits);
}
}

6. Results and Discussions

For the working of image Lena; Coif let, Shannon, Reverse Biorthogonal operations were applied on it having different PSNR values. It is clear that image which will show more robustness with higher PSNR value will be more reliable. To sum up, Coif let and reverse bio are more robust than Shannon based on results. Moreover, same results are obtained by applying the same operations on other images. Here we have the results which give the different values of PSNR, MSE, NC.

Image Name	DWT Family	PSNR	MSE	NC
Lena	coif2	67.6848	0.097914	0.99219
Penguins	coif1	68.5806	0.098113	0.99218
Pepper	coif5	57.8572	0.16406	0.99224
Smile	coif3	60.8635	0.13853	0.99218

Figure 4: Values of Coif let

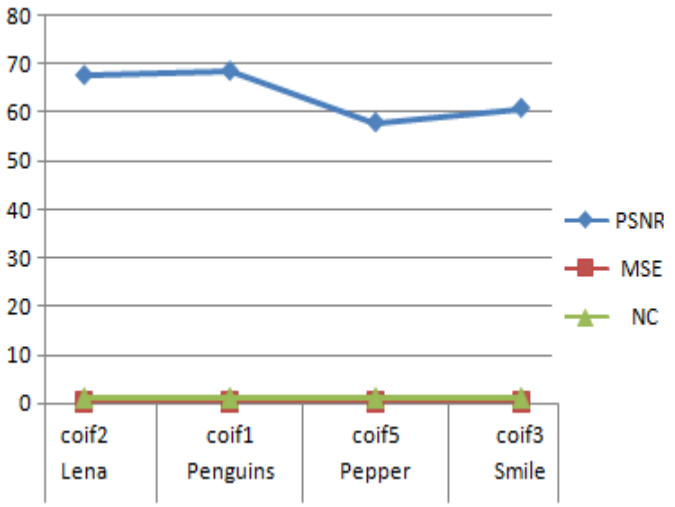

Figure 5: Graph of Coif let

Image Name	DWT Family	PSNR	MSE	NC
Lena	shan1-1.5	67.6335	0.072984	0.99219
Penguins	shan2-3	67.925	0.062707	0.99218
Pepper	shan**	56.1821	0.21047	0.99224
Smile	shan1-0.5	59.4425	0.17175	0.99218

Figure 6: Values of Shannon

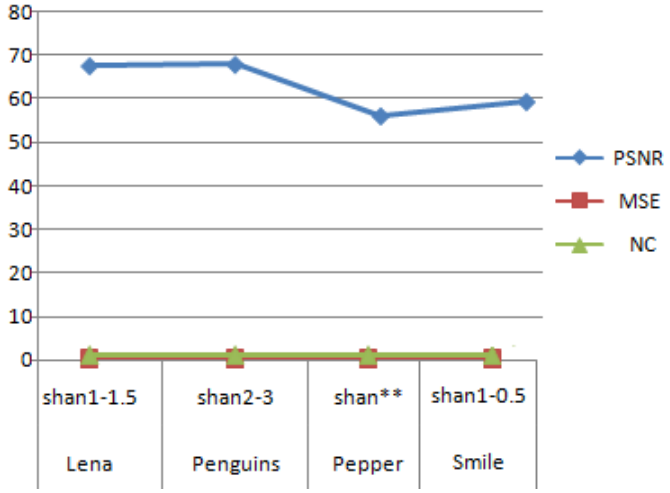

Figure 7: Graph of Shannon

Image Name	DWT Family	PSNR	MSE	NC
Lena	rbio1.3	67.6848	0.097914	0.99219
Penguins	rbio3.7	68.5806	0.098113	0.99219
Pepper	rbio4.4	57.8572	0.16406	0.99224
Smile	rbio6.8	60.8635	0.13853	0.99218

Figure 8: Values of Reverse biorthogonal

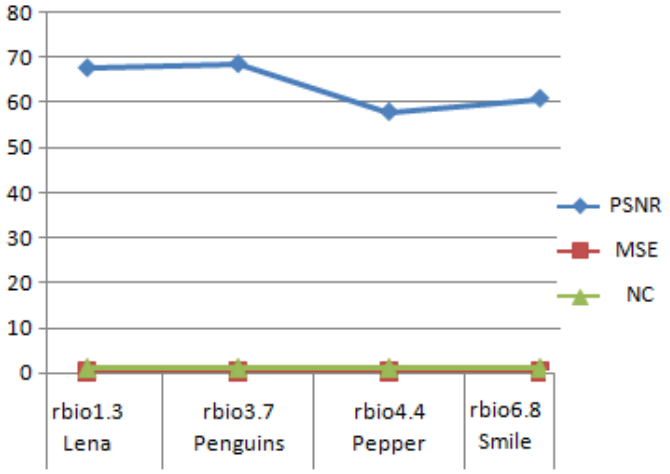

Figure 9: Graph of Reverse biorthogonal

All the above figures represent different DWT wavelet families which are coif let, Shannon, Reverse Biorthogonal. It shows the results of different images. We applied n-types of functions of each wavelet family on many images. It obtained the unique values of PSNR, MSE and NC which are shown above.

7. Conclusions

The DWT function of a two-dimensional signal has got the ability of implementing the embedding and extracting systems for the approach of the invisible watermarking technology based on two significant operations, encoding and decoding procedure. It is clear that which image will have the greater value of PSNR that will be more robust. On the basis of these values, it is concluded coif let and reverse bio are more robust as compared to Shannon because it gives the best PSNR value results. To sum up, coif let and reverse biorthogonal are more compatible DWT family members for watermarking technique, which gives better results.

8. Future Scope

The future research work can include bar on the size of the image that if the size of the image is very small, how much amount of data can be watermarked to it. The future aspects of the research work might involve optimization algorithm like BACTERIAL FORGING OPTIMIZATION to optimize the embedding procedure. The other enhancement in the current research work could be use of GENETIC algorithm to reduce the irrelevant bits where the data has to be merged.

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