A Mixture of DWT-DCT based Digital Watermarking Algorithm against various Attacks and its Application

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Abstract: ***The present paper focuses on the mixture of Discrete Wavelet Transform and Discrete Cosine Transform used in the purpose of Digital Image Watermarking. People nowadays need Digital media as an alternate of paper media. With the growth of technology, digital media while transferring requires protection through internet or other mediums. Process of hiding information in any form image, text, audio and video in original image without corrupting its perceptual quality is called Digital Image Watermarking. Watermarking is useful method for protection of integrity of the original data, it is done by computing statistical values like Peak signal to noise ratio (PSNR) & Mean square error (MSE) for various attacks like image cropping, noise and resize.***

Index Terms: Application, Attacks, DCT, DWT, MSE, PNSR, Watermarking.

I. INTRODUCTION

Watermarking on host information proves to be a remarkable technique of concealing digital information onto virtual data such as video, audio, image etc for avoiding unlawful replication of information and to guarantee copyright security & conservation. The origin of digital watermarking was introduced as a variant of steganography. Steganography can be classified as the study of corresponding in such a manner which conceals secret information onto the core information. Previously the method of watermarking has been utilized to embed unique brand identification of the manufacturer on their respective products to attain authenticity. In the present scenario as a part of internet technology, it is essential to create a copy, pass on & share digital data.

Digital image watermarking is a useful technique by which the owner can verify and authenticate his ownership accurately. In the Digital image watermarking technique by the secret images watermark can be hidden in an original image by allowing smallest amount of perceptual disturbance in the original image [10]. There are several parameters like robustness, transparency, capacity & blind watermarking by which the quality of the watermarking can be determined. The watermarking can either be done in spatial domains where the intensity values are modified or in frequency domain where the image coefficients are modified.

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DWT is extensively utilized in digital image watermarking just for the reason that its multi resolution features which are just alike practical replicas of human vision, whereas DCT has a property of concentrating the helpful information of digital image in just few coefficients. Furthermore, while using DCT for watermarking; it compresses the image and DWT gives the scalability. Therefore, thorough these two different transformation it is said that the fact that joint transformation could overcome the boundaries of one another, resulting in efficient watermarking [11,12].

In general sense watermark techniques can be categorized into two categories. The first one can be classified as human perceptible watermarking which is performed if embedded watermark is to be made detectable and perceptible by human perception, for e.g., a symbol placed in one of the sections of picture or bitmap. The second one can be classified as imperceptible or undetectable watermarking which is performed when the watermark embedded onto the original picture using well-structured techniques and helps keep the watermark imperceptible to any individual's perception.

This paper intense a Mixture of DWT – DCT based digital watermarking algorithm. Here different images are tested against various attacks like cropping, noise and resize attack.

II. RELATED WORK

In the initial stage, the technique of watermarking was developed by using special domain which was simple to easy & comparatively less complex. Shyndel [1] proposed LSB implanting as an important watermarking technique. As per this method, the lowest relevant bit of the binary transformed pixel of the test image is marked and it was substituted by the pixel value of the imprint image. By doing this, unnecessary individuals may not make out the fact that the watermark is embedded in the image itself. The amalgamation of DWT with DCT to implant a binary mark was also suggested by Kasmani & Naghsh-Nilchi.[2]. They executed 3-levels of DWT decomposition and then performed DCT to it, which presented a better watermark retrieval after applying various attacks however this technique undergoes through increased time complication. Nikita and Sinha [3] have introduced Digital Watermark Embedding Technique of Discrete wavelet transform using 3 levels. According to them, in this approach, a multiple bit mark is implanted into the inferior frequency sub band of a test image by utilizing α combination method by using statistical parameter. Authors have revealed that the watermarks

embedded using the suggested processes are imperceptible and clarity of watermarked are improved.

In 1997, Cox et al. [4] made use of the one of its kind DCT established spread spectrum communication regarding media watermarking, a group of methods that have become very well-known and have also been used by a lot of researchers. This method makes use of a group of free and identically dispensed Gaussian random orders are implanted in huge quantity visually effective frequencies of bitmap. As spread spectrum communication suggests, the indication power in whichever occurrence is invisible if it is the contracted band signal is conveyed through even larger bandwidth of frequencies, which will make the watermark to spread all over the frequencies so, potential in every frequency is minimal. However the Cox approach is still unfinished, because it needs the original picture in order to perform the extraction.

In S Sahar Afshan Indrabi & Sheenam's paper [5] they make use of the frequency domain amalgam of DCT with DWT watermarking techniques. They have compared DCT, DWT and DCT-DWT with Different types of attacks.

In 2010 [6], Thi Hoang Ngan Le, Kim Hung Nyugen & Hoai Bac Le's paper, They work on creating a huge list of watermarking tools, benchmarking tools & how to use them to your advantage. They also list various types of attacks done to direct the original image and the watermark itself.

Arfoja akter , Ulha [7], come up with a novel approach for digital watermarking algorithm named as NEA (New Embedding Algorithm). This new approach is non-blind and based on amalgamation of DWT & DCT transforms. This algorithm can be applied 2, 3 or 4 level of DWT which also give relative analysis for all levels. Further, authors have also compared the performance of NEA with the I.J. cox's additive technique. Two parameters have been tested as imperceptibility & robustness for performance analysis. According to Authors imperceptibility as the attained quality of the test image must never be altered by the existence of the secret message. Robustness must be calculated by applying attacks on the watermark implanted image & calculate the similarity between original watermark and extracted watermark using correlation value.

Al-Haj [8] projected the amalgamation of DCT with DWT transforms. According to this technique, watermark implanting is undertaken by performing 2 levels of DWT transform, splitting the middle frequency sub-band into 4x4 blocks and performing DCT on every block. In a way, implanting is done on the middle frequency DCT coefficient. The research results have proved that the mixed domain watermarking algorithm's non visibility is better than DWT algorithm.

Xiao-Ping Zhang Li-Sheng Tian and Ying-Ning Peng [9] explained the idea of the initialization from the Wavelet Series to Discrete Wavelet Transform. They claimed that they have formulated the question and debated the methods to explain the problem by suggesting 2 algorithms for initialization.

III. IMPLEMENTATION

In this algorithm, for inserting watermark and extracting watermark two popular methods are used in a mixture of DWT & DCT this method shown in Figure 1 and Figure 2.

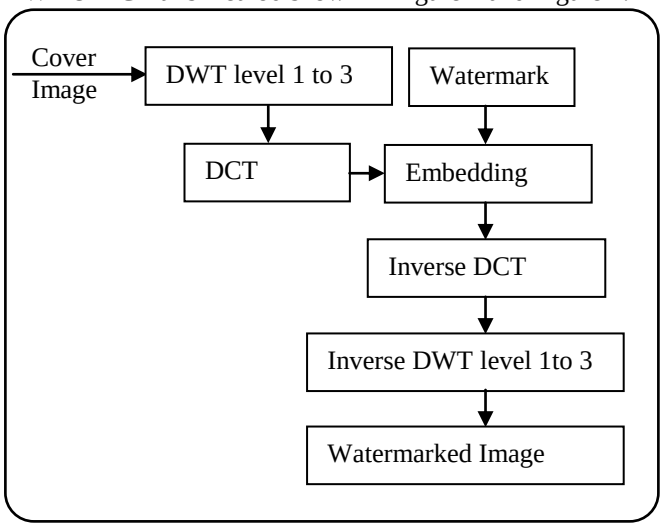


Fig 1. Block Diagram for Watermark Embedding

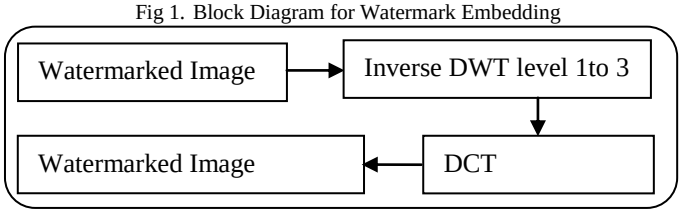


Fig 2. Block Diagram for Watermark Extraction

IV. RESULT ANAYLSIS WITH DISCUSSIONS

We have experimented with the Mixture of DWT-DCT watermarking algorithm on different cover image (shown in Figure 3) and watermarked image (shown in Figure 4).

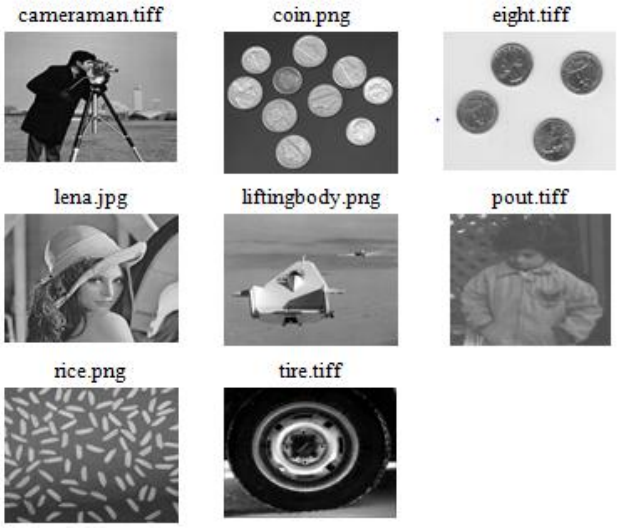


Fig 3. Different Cover Image

The performance is calculated by measuring PSNR & MSE Through this simulation results it can be seen that mixture method is not visible and robust on variety of attacks.

Fig 4. Watermarked Image

A. Compare Different Image Processing Resize Attack

Table I Reflects collective test results for Resize Attack done to subject images embedded with their respected watermark images. The readings for MSE and PSNR are included.

Table I. Reflects collective test results for Resize Attack

Original Cover Image	Water-mark image	Image After Attack	Extracted Water-mark	MSE	PSNR
lena.jpg	rice.png			0.082	24.98
lena.jpg	coin.png			0.0396	32.27
liftingbody.png	eight.png			0.0349	33.5536
cameraman.tiff	coin.png			0.0394	32.3442
tire.tiff	eight.png			0.0408	31.9977
pout.tiff	rice.png			0.1026	22.7736
rice.png	coin.png			0.0394	32.3326
eight.png	coin.png			0.0396	32.2978
cameraman.tiff	rice.png			0.0822	24.9898
liftingbody.png	rice.png			0.1060	22.4415

B. Compare Different Image Processing Cropping

Table II Reflects collective test results for Gaussian Noise Attack done to subject images embedded with their respected watermark images. The readings for MSE and PSNR are included.

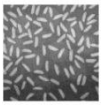
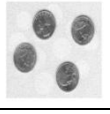
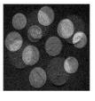
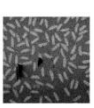
Table II. Reflects collective test results for Resize Attack

Original Cover Image	Water-mark Image	Image After Attack	Extracted Watermark	MSE	PSNR
lena.jpg	rice.png			0.08	25.20
lena.jpg	coin.png			0.0394	32.3481
liftingbody.png	eight.png			0.0343	33.7211
cameraman.tiff	coin.png			0.0394	32.3481
tire.tiff	eight.png			0.0343	33.7211
pout.tiff	rice.png			0.0804	25.2057
rice.png	coin.png			0.0394	32.3481
eight.png	coin.png			0.0804	25.2057
cameraman.tiff	rice.png			0.0804	25.2057
liftingbody.png	rice.png			0.0804	25.2057

C. Compare for Attack on Different Image Processing Gaussian Noise

Table-III reflects collective test outcome for the attack of Gaussian noise done to subject images embedded with their respected watermark images. The readings for MSE and PSNR are included.

Table III. Reflects collective test results for Gaussian Attack

Original Cover Image	Water-mark Image	Image After Attack	Extracted Watermark	MSE	PSNR
lena.jpg	rice.png			0.10	22.44
lena.jpg	coin.png			0.0854	24.6037
liftingbody.png	eight.png			0.0523	29.5150
cameraman.tiff	coin.png			0.0706	26.5047
tire.tiff	eight.png			0.0444	31.1445
pout.tiff	rice.png			0.1030	22.7276
rice.png	coin.png			0.0822	24.9917
eight.png	coin.png			0.2100	15.6054
cameraman.tiff	rice.png			0.0944	23.6047
liftingbody.png	rice.png			0.1066	22.3883

We have tested the mixture DWT-DCT watermarking algorithm on various original cover images and with different images are used as watermark image.

The robustness of DCT combined with DWT method, separating the watermarked image is evaluated by determining the Peak signal to noise ratio and Mean square error. Similarity Index parameters are recorded after attacking the watermarked image. Attacks like resize, crop & noise are applied.

The Comparative results for all the respective different images are shown in Figure .5 and Figure 6. PSNR means Peak Signal-to-Noise Ratio, it is better when ratio of PSNR gets higher. MSE means Mean Square Error. Also it is better if MSE is to be observed minimal.

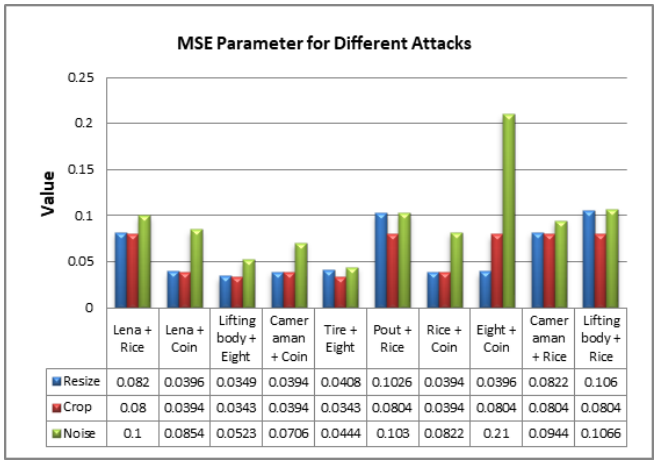


Fig 5. Mean Square Error

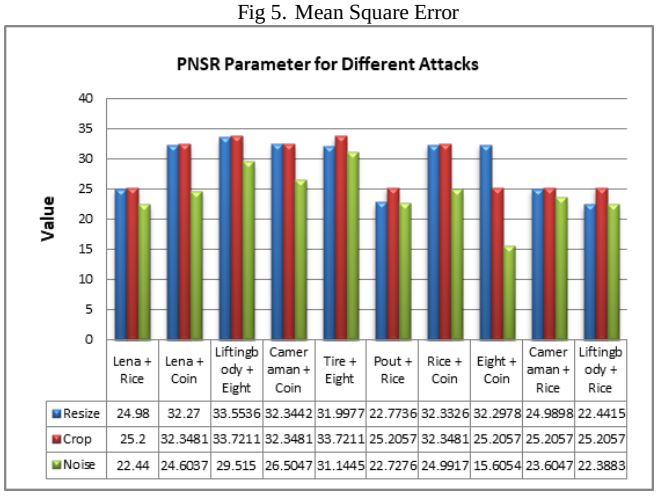


Fig 6. Peak Signal to Noise Ratio

V. DIGITAL IMAGE WATERMARKING APPLICATIONS

In the recent years, the growing interest in watermarking encourages researchers. It is observed that the last decade, the increasing number of research on watermarking has been essentially run by its significant application in digital copyright management and security. In the today's rapid changing technological world, the applications of watermarking become fundamental tool for managing digital copyright and security. The major applications of watermarking are listed below.

1) *Copyright Protection:* In this process, the owner of the data can implant a unique mark onto the data for the defense of the personal property. In a way, the embedded watermark can be utilized as evidence. For example, in a hearings when someone decisively violates the rights [14].

2) *Fingerprinting:* The proprietor uses fingerprinting technology to find out the resource of untruthful replicas. On such occasions, the proprietor can implant dissimilar unique trademarks or symbols onto the distributable media of the information that are provided to diverse clients [13,14].

3) *Duplication Control:* The media implanted with the watermark or the authentication mark may straightforwardly govern virtual footage devices for duplicate safety intentions. So, the watermark

indicates do-not-copy prohibition information and a watermark fetching algorithms in the watermark extractor concludes that the information which is supplied to the application can or cannot be stored.

4) *Monitoring the Transmission:* It is used to track the broadcast of a given file over a channel where watermark embedded into advertisement division..
5) *Medical Application:* patient's name and data embedded with the medical images as watermark for convenient safety measure [14].
6) *Hiding of Data:* to transmit secret messages, watermark technique can be used It is seen that different governments limits the usage of encryption services, an individual can cover their media on other media format.
7) *Authentication of Data:* A few breakable watermarks may be utilized in order to ensure originality of the media. A delicate unique mark suggests is useful to identify if the data has been altered or not. Moreover, it also points out in which part the data is being altered or changed [14].

VI. CONCLUSION

The Mixture of DWT-DCT approach performed strongly against different attacks like Resize, Noise and Crop. All the tests result show better and higher Peak Signal to Noise Ratio (PSNR) value, also minimal Mean Square Error (MSE) value. All these factors prove that proposed algorithm is a powerful approach that helps to embed and extract a watermark from an image which has gone through different attacks.

Comparison of proposed method (DCT-DWT) with other applied method, our proposed method is directly compared with I.J. Cox Method [4] and arfoja akter method [8]. We state this fact by comparing the PSNR and MSE values achieved after applying various attacks on watermarked images. Hands the proposed algorithm has improved greatly keeping robustness in mind.

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