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SVD and Frequency Domain based Composite Robust Data hiding scheme for image watermarking

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***Abstract*-Image watermarking is a signal that is embedded in a image data permanently such that it can be extracted by dewater marking using some operations for checking the authenticity of data or user. The watermark is inseparable from the host image and it should be robust enough to resist any modifications along with preserving the image quality. In this way the watermarking helps in keeping intellectual properties accessible while being permanently water marked. In this paper we have focused on watermarking techniques and checked their robustness against environmental distortions during the storage and transmission of watermarked image. In this work we have applied a hybrid SVD-DCT-DWT watermarking approach in gray biomedical image watermarking to develop a robust algorithm against several image attack .We have also compared our algorithm with two different watermarking technique named as DCT-SVD, DWT-SVD.**

Keywords- De-watermarking, DCT, DWT, SVD, Watermarking.

1. Introduction:

Digital watermarking can be characterized as the procedure of inserting a certain bit of data (in fact known as watermark) into interactive media substance including content reports, pictures, sound or feature streams, such that the watermark can be distinguished or removed later to make an attestation about the information .A summed up watermark model comprises of watermark encoding and location forms as demonstrated. The inputs to the implanting procedure are the watermark, the spread item and a mystery key. The key is utilized for security and to ensure the watermark. The yield of the watermarking plan is the watermarked information. The yield of the watermark recuperation procedure is the recouped watermark. In Singular Value Decomposition, singular values correspond to the luminance of the image (i.e. image brightness) and the corresponding singular vector specifies the intrinsic geometry properties of the image [2]. Many singular values have small values compared to the first singular value. If these small singular values are ignored in the reconstruction of the image, the quality of the reconstructed image will degrade only slightly. Slight variations of the singular values do not affect the visual perception of the image, i.e., singular values do have a good stability. Based on these properties of SVD, diagonal matrix containing singular values is mainly used to embed watermark. The DCT has special property that most of the visually significant information of the image is concentrated in low frequency coefficient of the DCT.

Watermarking methods are based on the human visual system in which it cannot be recognized due to tiny difference. In these techniques, the cover-image is used to hide the secret information and the stego-image is the cover-image with the secret data embedded inside. It hides the secret information in general files secretly first and then transmits these files through network, because they look the same as general files, they can escape from the attention of illegal interceptors easily and therefore the secret information is not easy to be attacked.

One of the main applications of watermarking is copyright protection. Information about the copyright owner is embedded into the data to prevent other people from claiming to be the legal owners of the data. The watermarks used for that purpose are supposed to be very robust against various attacks intended to eliminate the watermark.

As per the watermarking language, an assault is any preparing that may botch up location of the watermark or correspondence of the data gave by the watermark. The prepared, watermarked information is then called assaulted information. Strength against assaults is an essential issue for watermarking plans. The convenience of an assaulted information can be measured by its perceptual quality and the measure of watermark devastation can be measured by criteria, for example, miss likelihood, likelihood of bit slip, or channel limit. An assault may succeed in overcoming a watermarking plan in the event that it misshapes the watermark past middle of as far as possible while keeping up the perceptual nature of the assaulted information [1]. The wide class of existing assaults can be separated into four principle bunches: evacuation assaults, geometrical assaults, cryptographic assaults and convention assaults [3].

Principle properties of the watermarks are vigor, loyalty, computational expense and false positive rate [4]. In any case, a watermark may not fulfill these properties. Besides, that may be not needed for a wide range of watermarks. For an unmistakable watermark, constancy is not a worry, in any case, for an imperceptible watermark it is a standout amongst the most critical issues. The watermark is intended to fulfill the obliged properties as per the sort of the application. Then again, one property may stand up to with another. Expanding the quality of the watermark can build the strength however it diminishes the constancy. There must be an exchange off between the necessities and properties of the watermarking plans relying upon the applications. In this area, those properties will be examined.

The objective of thesis is to develop composite DWT-DCT-SVD,DWT-SVD and DCT-SVD image watermarking

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techniques and compare these techniques in terms of Peak Signal To Noise Ratio (PSNR) and Normalized Correlation (NC). To complete our goal we have used MATLAB 2010 and developed DWT-DCT-SVD, DWT-SVD,DCT-SVD image watermarking techniques without attacks and with applying image attacks.

2. Related Work:

In **2007, Chin-Chen Chang et. Al.** [5] presented their work related to an SVD oriented watermark embedding scheme with high qualities for the restored images. In this work, they expressed that SVD-based watermarking plan, which effectively implants watermarks into pictures, and its concealed watermarks can oppose different assaults. In this work, we further expanded their thought so that the concealed watermarks can be uprooted to give approved clients better picture quality for later utilization after the responsibility for pictures has been checked. To accomplish our target, we altered their inserting method, and the additional data needed for later reclamation is installed into the slightest vital non-zero coefficients of the S networks in the picture. Trial results affirmed that our plan not just gave great picture nature of watermarked pictures additionally effectively restored pictures with high rebuilding quality.

In **2007 Ali Al-Haj et. Al** [6] proposed their work related to combined dwt-dct digital image watermarking. In this work, they expressed that the expansion of digitized media because of the fast development of arranged sight and sound frameworks has made a critical requirement for copyright authorization innovations that can ensure copyright responsibility for articles. Advanced picture watermarking is one such innovation that has been produced to shield computerized pictures from unlawful controls. Specifically, advanced picture watermarking calculations which are taking into account the discrete wavelet change have been broadly perceived to be more common than others. This is because of the wavelets' amazing spatial limitation, recurrence spread, and multi-determination qualities, which are like the hypothetical models of the human visual framework. In this work, we depicted an indistinct and a vigorous joined DWT-DCT advanced picture watermarking calculation. The calculation watermarks a given computerized picture utilizing a blend of the Discrete Wavelet Transform (DWT) and the Discrete Cosine Transform (DCT). Execution assessment results demonstrated that consolidating the two changes enhanced the execution of the watermarking calculations that are construct exclusively with respect to the DWT change.
The discrete wavelet changes (DWT) and the discrete cosine change (DCT) have been connected effectively in numerous advanced picture watermarking. In this work, we depicted a consolidated DWT-DCT computerized picture watermarking calculation. Embedding so as to water was finished the watermark in the first and second level DWT sub-groups of the host picture, trailed by the use of DCT on the chose DWT sub-groups. The blend of the two changes enhanced the watermarking execution significantly when contrasted with the DWT-Only watermarking methodology. Taking everything into account, in DWT-based computerized watermarking applications, consolidating proper changes with the DWT may have a positive effect on execution of the watermarking framework.

In **2008 B.Chandra Mohan et. Al.** [7] Proposed their work related to robust image watermarking scheme using singular value decomposition. In their work, they introduced a vigorous picture watermarking plan for sight and sound copyright insurance. In this work, host picture is parceled into four sub pictures. Watermark picture, for example, "logo" was inserted in the two of these sub pictures, in both D (solitary and inclining network) and U (left particular and orthogonal grid) segments of Singular Value Decomposition (SVD) of two sub pictures. Watermark picture was inserted in the D segment utilizing Dither quantization. A duplicate of the watermark was installed in the segments of U grid utilizing correlation of the coefficients of U network as for the watermark picture. On the off chance that extraction of watermark from D grid was not finish, there was a decent lot of likelihood that it can be extricated from U framework. The proposed calculation is more secured and powerful to different assaults, viz., JPEG2000 pressure, JPEG pressure, revolution, scaling, editing, line section blanking, line segment duplicating, salt and pepper commotion, separating and gamma rectification. Unrivaled trial results were seen with the proposed calculation over a late plan proposed by Chung et al. As far as Bit Error Rate (BER), Normalized Cross connection (NC) and Peak Signal to Noise Ratio (PSNR).

In **2009, Mei Jiansheng et. al** [8] proposed their work related to digital watermarking algorithm based on Dct and dwt This work introduced an algorithm of digital watermarking based on Discrete Cosine Transform (DCT) and Discrete Wavelet Transform (DWT). As indicated by the characters of human vision, in this calculation, the data of advanced watermarking which has been discrete Cosine changed, was put into the high recurrence band of the picture which has been wavelet changed. At that point refined the advanced watermarking with the assistance of the first picture and the watermarking picture. The reenactment results demonstrated that this calculation was undetectable and has great vigour for some basic picture preparing operations.

3. Methodology:

In this work the combined approach of image watermarking which have been used that satisfies two requirements i.e. imperceptibility and robustness. We have used combination of discrete wavelet transform (DWT), discrete cosine transform (DCT) and singular value decomposition to achieve the above requirements. As well as, the watermark image is embedded directly on the elements of singular values of the original image's DWT sub bands.

The proposed system is the combination of our different modules, they are as follows:

1. Watermark of image using DCT-SVD/ DWT-SVD/ DWT-DCT-SVD.
2. Application of attacks on watermarked image.

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3. Extraction of the watermark image from the original image.
4. Measurement of PSNR and normalization coefficient.

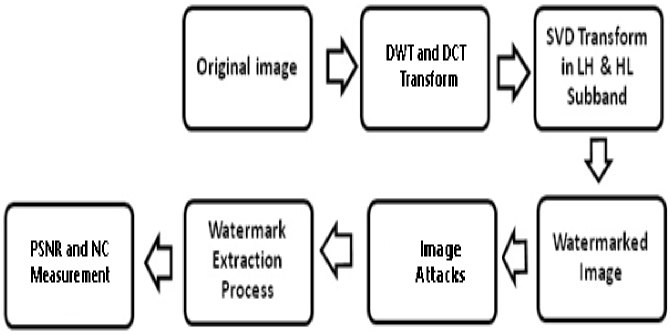

Fig 1: Proposed Model

DWT-DCT-SVD Algorithm:
STEP 1 to 6 same as DCT-DWT
STEP 7:- Collect all the DC values of the DCT matrices to form a new matrix named as [DC]
STEP 8:- Perform the SVD of DC matrix.
[U1,S1,V1]=svd[DC]
STEP 9:- Mix the value of watermarked pixel to the S1 component.
Sm=S1+a(*W)
STEP 10:- Again perform the svd[Sm] as given below:
[U2,S2,V2]=svd[Sm]
STEP 11:- Mixed the S2 with (U1,V1) to regenerate pdated DC matrix by following eqn:-
DCM=U1*S2*V1
STEP 12:- Now perform inverse dct for dct_block updated with DCm,to obtain [CD1w].
STEP 13:- Arrange the DCT blocks and apply IWT on [CA1,CH1,CV1 & CD1w] to generate water
Marked image Wm.
WM= idwt(CA1,CH1,CV1,CD1)

DE-WATERMARKING
STEP 1:- Take DWT of Wm as given below:-
[Cam1,CHm1,CVm1,CDm1]=dwt[Wm]
STEP 2:- Apply dct on CDm1 block.
dct[CDm1]□ dct_blockw
STEP 3:- Generate the DC value matrix from dct block W named as [DCW] and apply svd on this Matrix sing following eqn:
[Um,Sw,Vm]=svd[DCW]
STEP 4:- Combine U2 and V2 svd component with Sw as given below:-
E=U2*Sw*V2
STEP 5:- Generate extracted water marked image by following eqn:-
WME=E-S1/a.

4. Result and Discussion:
We have applied our DCTDWTSVD noise algorithm on host1 image (fig 2 (a)) to watermark the image wm1 (fig 2 (d)). The image obtained after watermarking that is watermarked image is shown on fig 2 (b). Then Gaussian image (fig 2 (c)) attacks is apply on watermark image and it is Dewater marked and its extracted watermarked image is shown in fig 2(e)

Fig 2(a): Original Image.

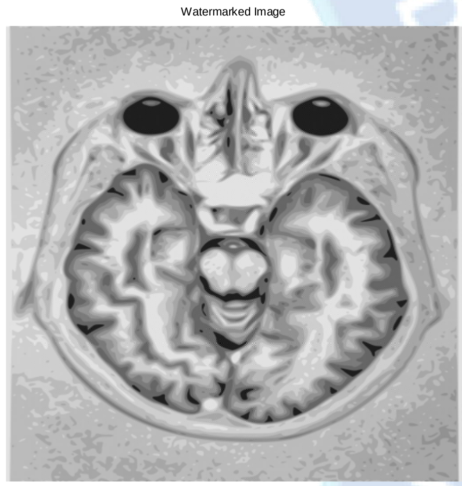

Fig 2(b): Watermarked Image.

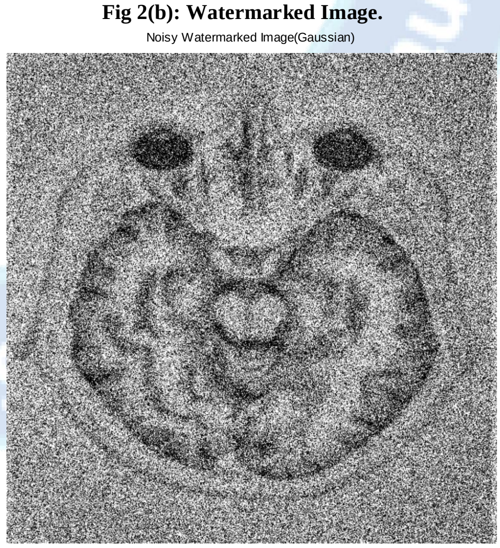

Fig 2(c): Noisy Watermarked Image

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Fig 2(d): Watermark Image.

Fig 2(e): Extracted Watermarked Image.

Table 1: Comparative PSNR for Gaussian Noise

		DWT DCT SVD Gaussian Noise (0.3)	DWT DCT SVD Gaussian Noise (0.2)	DWT DCT SVD Gaussian Noise (0.1)
Host image 1	PSNR 1	8.6614	9.3985	11.1203
	PSNR2	56.6976	56.6842	56.5791
	NC1	0.8252	0.8493	0.8943
	NC2	0.9157	0.9154	0.9132
Host image 2	PSNR 1	8.7828	9.9621	12.3081
	PSNR2	57.9248	57.8645	58.0478
	NC1	0.6359	0.6819	0.7689
	NC2	0.9334	0.9324	0.9353

We have applied our DCTDWTSVD salt noise algorithm on host1 image (fig 3 (a)) to watermark the image wm1 (fig 3 (d)). The image obtained after watermarking that is watermarked image is shown on fig 3 (b). Then Salt and paper image (fig 3 (c)) attacks is apply on watermark image and it is Dewater marked and its extracted watermarked image is shown in fig 3(e)

Fig 3(a): Original Image.

Fig 3(b): Watermarked Image.

Fig 3(c): Noisy Watermarked Image

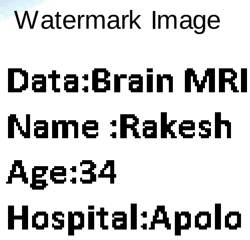

Fig 3(d): Watermark Image.

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Extracted Watermark Image

Fig 3(e): Extracted Watermarked Image.

Table 2: Comparative PSNR for Salt & Pepper Noise

		DWT DCT SVD Salt &Pepper Noise (0.3)	**DWT DCT SVD Salt &Pepper Noise (0.2)**	**DWT DCT SVD Salt &Pepper Noise (0.1)**
Host image 1	**PSNR 1**	5.0163	5.0193	5.0223
	PSNR2	53.4935	52.9551	51.8552
	NC1	0.9017	0.9284	0.9537
	NC2	0.8137	0.7858	0.7122
Host image 2	**PSNR 1**	10.9269	10.9306	10.9345
	PSNR2	60.7133	64.9730	69.2713
	NC1	0.5965	0.6134	0.6311
	NC2	0.9655	0.9872	0.9953

5. Conclusion:

The results suggests that DC-SVD-DWT based watermarking scheme is giving best performance in the presence of recovery of watermark image used to indicates the text based data of biomedical images. The results are verified analytically in terms of PSNR and normalization coefficients and both are found high for novel DCT-DWT-SVD watermarking scheme. In future the work can be extended for considering other image attacks effect and code parameter optimization in terms of additional image attacks. Presently we have considered the algorithm robustness for salt and pepper noise and Gaussian noise. In future effects of compression, transformation and cropping can also be considered for demonstrating the performance of developed watermarking scheme.

References:

[1] L. Autonne, "Sur les groupes linaires, rels et orthogonaux", Bulletin de la socit mathmatique de France,pp. 121-143, 1902.

[2] N.Nikolaidis and I.Pitas, "Robust image watermarking in the spatial domain," Signal Processing, Vol.1, No.66, pp.385-403, 1998.

[3] P. Waldemar and T. Ramstad, Image compression using singular value decomposition with bit allocation and scalar quantization, Proc. of Nordic Signal Processing Symposium, pp. 83-86, 1996.

[4] Chiou-Ting Hsu1 and Ja-Ling Wu2, "Image Watermarking By Wavelet Decomposition" Academy of Information and Management Sciences Journal, Vol. 3, No. 1, pp. 70-86, 2000

[5] Chin-Chen Chang "An Svd Oriented Watermark Embedding Scheme With High Qualities For The Restored Images" International Journal of Innovative Computing, Information and Control ICIC International °c 2007 ISSN 1349-4198 Volume 3, Number 3, June 2007

[6] Ali Al-Haj "Combined DWT-DCT Digital Image Watermarking" Journal of Computer Science 3 (9): 740-746, 2007 ISSN 1549-3636© 2007 Science Publications

[7] B.Chandra Mohan, S. Srinivas Kumar "A Robust Image Watermarking Scheme using Singular Value Decomposition" JOURNAL OF MULTIMEDIA, VOL. 3, NO. 1, MAY 2008

[8] Mei Jiansheng, Li Sukang and Tan Xiaomei "A Digital Watermarking Algorithm Based On DCT and DWT" International Symposium on Web Information Systems and Applications (WISA'09)2009