IJCSE International Journal of Computer Sciences and Engineering Open Access
Research Paper Volume-5, Issue-8 E-ISSN: 2347-2693

Image Watermarking Scheme for CT and MRI Scan Images with DWT and SVD Transforms

V. Rajyalakshmi[1*], K.Ramesh[2],

[1*]Dept. of CSE, Chintalapudi Engineering College, JNTU Kakinada, Ponnur, India
[2]Dept. of CSE, Chintalapudi Engineering College, JNTU Kakinada, Ponnur, India

[*]*Corresponding Author: lakshmisrinivas225@gmail.com, Tel.: +91-9000455472*

Available online at: www.ijcseonline.org

Received: 09/Jul/2017, Revised: 18/Jul/2017, Accepted: 19/Aug/2017, Published: 30/Aug/2017

***Abstract*—** Watermarking is the process of hiding digital information in a cover image; the hidden information should, but does not need to, contain a relation to the cover image. The digital watermarking is a field of information hiding which hide the crucial information in the original data for protection illegal duplication and distribution of multimedia data. The discrete wavelet transform (DWT) is an implementation of the wavelet transform using a discrete set of the wavelet scales and translations obeying some defined rules. In this paper we are analyzing about different techniques like DWT, singular value decomposition (SVD) and combination of both with a scaling factor. Apart from all the cases prospective method will gives better output. In the prospective method for the cover image we are implementing SVD to LL band and altering the diagonal singular value coefficients with watermark image by using a scaling factor. The performance of this technique shows improvement in output, peak signal to noise ratio (PSNR) and mean square error (MSE).

***Keywords*—** Discrete Wavelet Transform (DWT), Singular Value Decomposition (SVD), Peak Signal to Noise Ratio (PSNR),Mean Square Error (MSE).

I. INTRODUCTION

Watermarking is the process of hiding original image in to water mark image. It is used to verify the identity of its owners. It is widely used in copyright protection, secure tracking, broadcast monitoring, and video authentication. In DWT wavelets are discretely sampled. The main advantage over Fourier transform is temporal resolution .it captures both frequency and location. These wavelet transforms have different applications in science, engineering, and mathematics and computer science. These are mostly used in signal coding, to represent a discrete signal in more redundant form. By using DWT, we are compositing the original image into four bands called LL LH HL HH. In these we are choosing the LL band to perform operations because most of the information existed in LL band itself.

In addition to DWT we are using SVD. It is a factorization of real or complex matrix. The factorization form is USV^I of real or complex value of A (mxn)

Where 'U' Is mxm real or complex unitary matrix
'S' Is mxn rectangular diagonal matrix

'V' Is nxn real or complex unitary matrix

The diagonal entries of 'S' are known as singular values of 'A'= USV^I.SVD is used for computing the pseudo inverse of a matrix, solving homogeneous linear equations, total least squares minimization, range, null space and rank of the matrix, near orthogonal matrix etc…

In this paper we are using DWT, and SVD techniques. We are improving image quality by using this technique... Section I contains the introduction of Watermarking Section II contain the related work of image watermarking and SVD, Section III contain the proposed work, Section IV contain the results and discussion, Section V contain the conclusion of research work with future directions.

II. LITERATURE WORK

We can perform two types of watermarking like spatial domain and transform domain. There are different techniques developed to improve image security, a few of them are LSB [1-4] embedding is very easy to implement but they are not robust for all attacks [5,6].

In DWT very useful to identify the coefficients to be watermarked [7]. To know about singular value decomposition, we have studied [8].

III. PROPOSED WORK

This digital watermarking is mainly used to provide security to images and also to improve the quality of obtained watermarked image. The proposed method is combination of

techniques like DWT, and SVD. The main theme of DWT is compositing the original image into four bands called LL LH HL HH. LL sub bands represents high scale low frequency coefficient set, sub band LH represents horizontal details of low scale high frequency set and HL sub band represents vertical details of low scale high frequency set and HH sub band is diagonal details low scale high frequency set of an image [1,2,5,9,10,11,12,13,14,15].

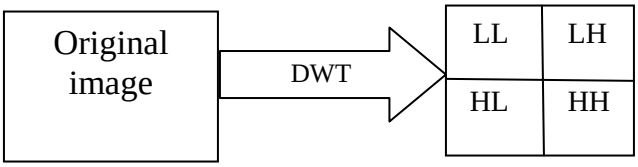

Figure 1: DWT decomposition

Watermark Embedding

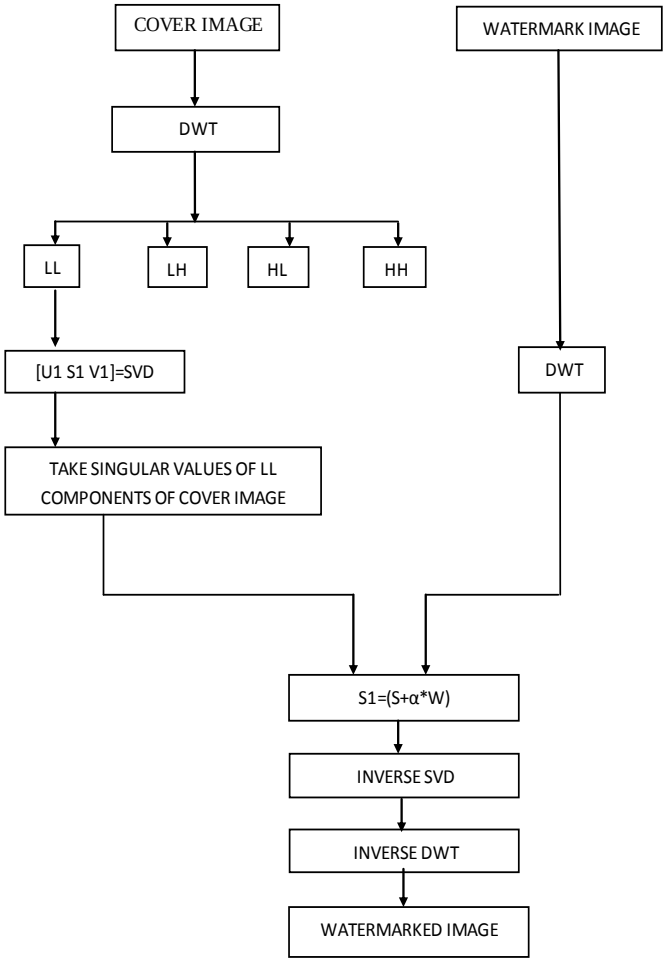

Figure 2: Watermark embedding block diagram

The steps to embed watermark are as below:

1) Apply DWT to cover image to decompose the input image into four sub bands LL, LH, HL and HH sub bands.
2) Apply SVD technique to LL sub band represents high scale low frequency coefficient set.
3) Apply DWT to watermark image and decompose it into sub bands.
4) Modify singular values of sub band by adding enhanced water mark image with a scaling factor α.
5) SVD technique is applied on LL sub band of the watermark image.
6) Then inverse singular value decomposition is applied on transformed host image.
7) Modified coefficients of high frequency LL sub band are used to apply inverse DWT results in obtaining watermarked image.

Watermark extraction

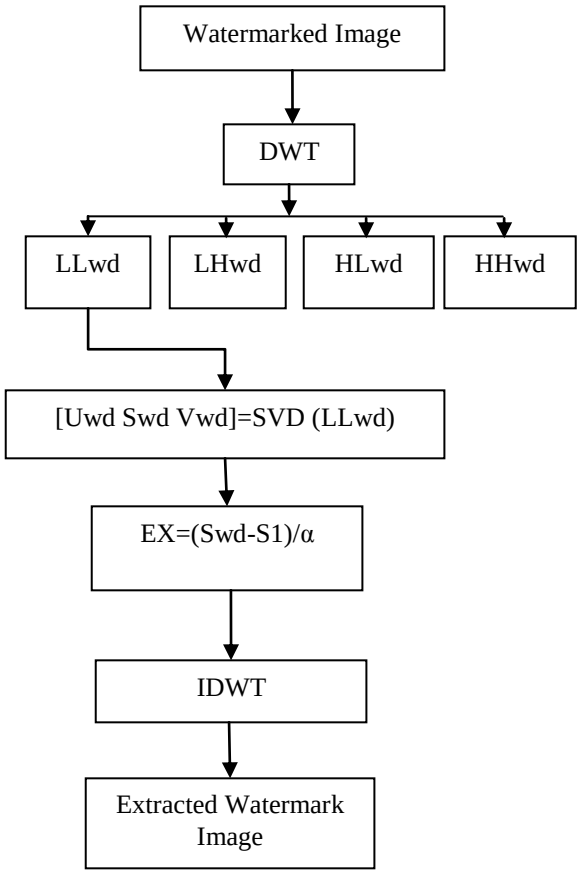

Figure 3: Watermark extraction block diagram

The steps to extraction watermark are as below:

1) In watermark extraction first discrete wavelet transform (DWT) is applied to the watermarked image to divide image into four sub bands.

2) Then singular value decomposition (SVD) is applied LL sub band represents high scale low frequency coefficient set of watermarked image.
3) Extract water mark image as w= (sw-s1)/ α.
4) Apply inverse discrete wavelet transform (IDWT) to obtain the embedded watermark image.

IV. RESULTS AND DISCUSSION

By performing operations on different images we will get better PSNR and MSE et al...

MEAN SQUARE ERROR

To measure the quality of watermark image some quality measure metrics are used such as peak signal to noise ratio(PSNR), mean square root (MSE) and structural similarity index measurement (SSIM). Mean Square Error (MSE) can be measured as average of square of errors.

$$MSE = \frac{1}{m \times n} \sum_{i=1}^{m} \sum_{j=1}^{n} [x(i,j) - y(i,j)]^2 \quad \ldots\ldots\ldots\ldots (1)$$

PEAK SIGNAL TO NOISE RATIO

Peak Signal to Noise Ratio defined as ratio between maximum power of signal and power of corrupting noise.

Generally, PSNR is defined in terms of MSE which for m*n images. It is defined as follows

$$PSNR(dB) = 10 * \log_{10}\left[\frac{(255)^2}{MSE}\right] \quad \ldots\ldots\ldots\ldots\ldots (2)$$

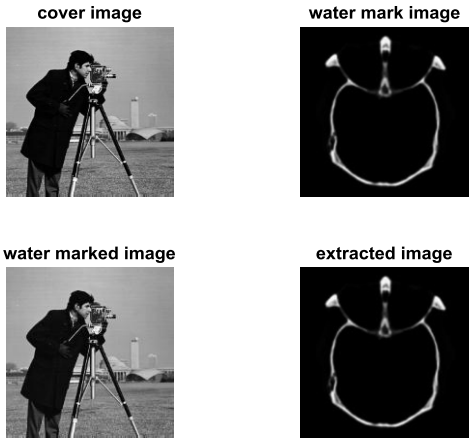

Figure 4: (a) Cover image (b) Water mark image
(c) Proposed water marked image
(d) Proposed extracted water mark image

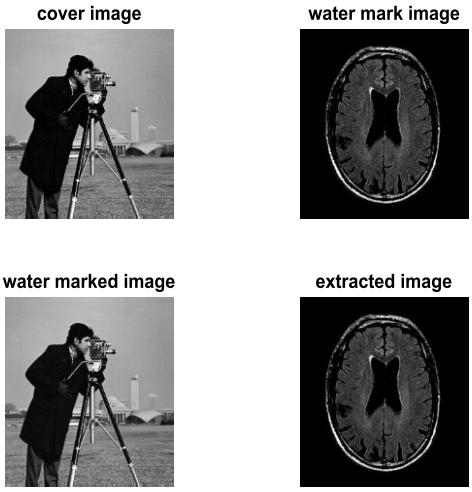

Figure 5: (a) Cover image (b) Water mark image
(c) Proposed water marked image
(d) Proposed extracted water mark image

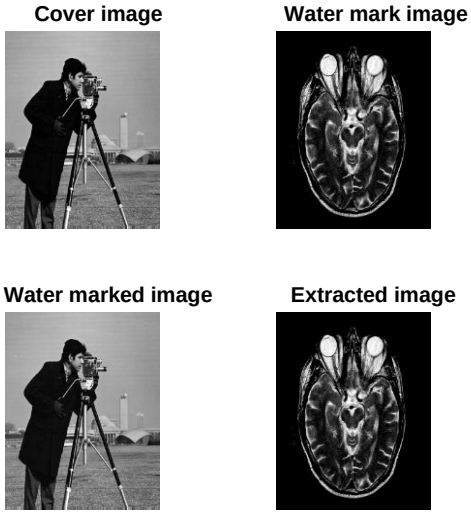

Figure 6: (a) Cover image (b) Water mark image
(c) Proposed water marked image
(d) Proposed extracted water mark image

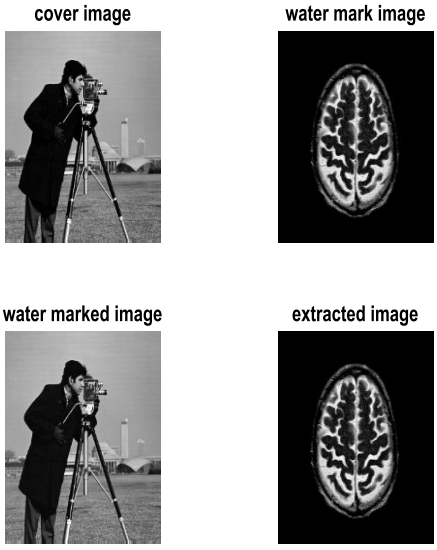

Figure 7: (a) Cover image (b) Water mark image
(c) Proposed water marked image
(d) Proposed extracted water mark image

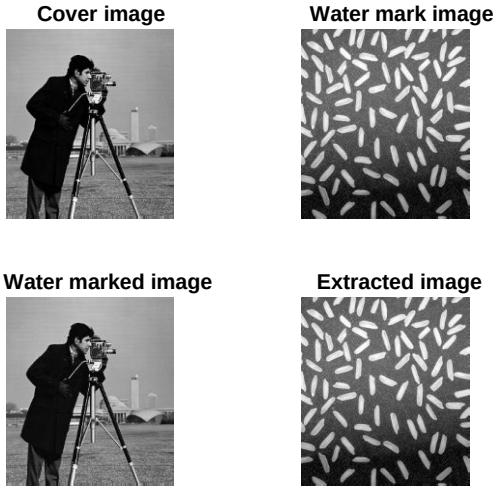

Figure 8: (a) Cover image (b) Water mark image
(c) Proposed water marked image
(d) Proposed extracted water mark image

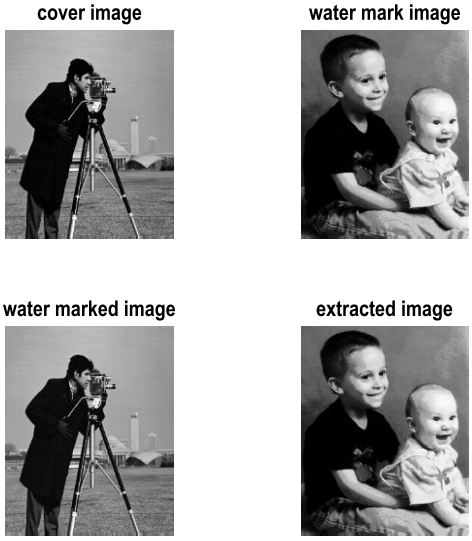

Figure 9: (a) Cover image (b) Water mark image
(c) Proposed water marked image
(d) Proposed extracted water mark image

Table 1. The Image watermarking performance evaluation parameters PSNR & MSE, ME, STD, NCC

Figures	Parameters	PSNR (db's)	MSE	ME	STD	NCC
ct.jpg (IM1)	Existed method	39.7686	6.8583	116.5521	61.0761	**1.0000**
	Proposed method	**74.2505**	**0.0024**	**118.7245**	**62.3474**	**1.0000**
mri1.png (IM2)	Existed method	40.2400	6.1529	116.8149	60.9559	**1.0000**
	Proposed method	**75.3505**	**0.0019**	**118.7245**	**62.3461**	**1.0000**
mri3.png (IM3)	Existed method	40.1731	6.2484	117.0290	60.9508	**1.0000**
	Proposed method	**70.5866**	**0.0057**	**118.7245**	**62.3498**	**1.0000**
mri6.png (IM4)	Existed method	39.7549	6.8800	116.9031	60.8493	1.0000
	Proposed method	**69.6190**	**0.0071**	**118.7245**	**62.3495**	**1.0000**
coins.png (IM5)	Existed method	43.3216	3.0264	118.4095	61.0531	**1.0000**
	Proposed	**64.8884**	**0.0211**	**118.7280**	**62.3801**	**1.0000**

	method					
rice.png (IM6)	Existed method	44.9210	2.0940	118.5749	61.1830	**1.0000**
	Proposed method	**65.6462**	**0.0177**	**118.7320**	**62.3909**	**1.0000**
kids.tif (IM7)	Existed method	41.2319	4.8966	116.8727	61.1892	**1.0000**
	Proposed method	**77.6313**	**0.0011**	**118.7263**	**62.3488**	**1.0000**

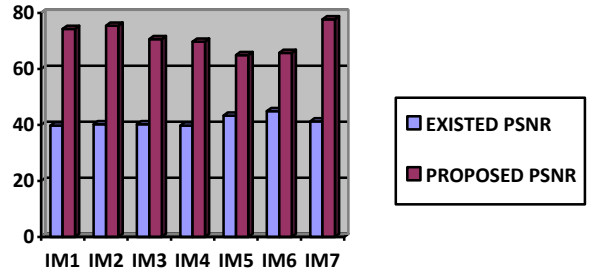

Figure 10**:** comparison between existed and proposed PSNR

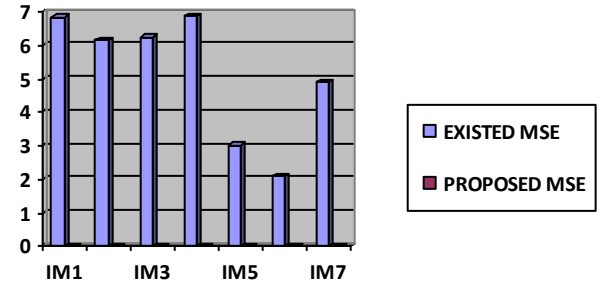

Figure 11: comparison between existed and proposed MSE

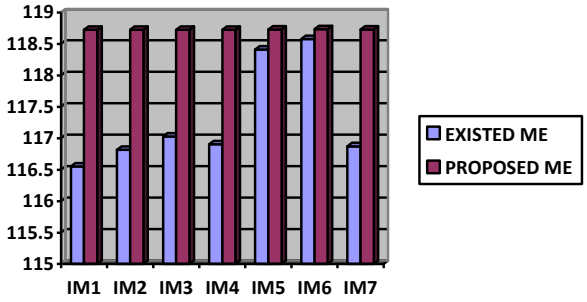

Figure 12: comparison between existed and proposed ME

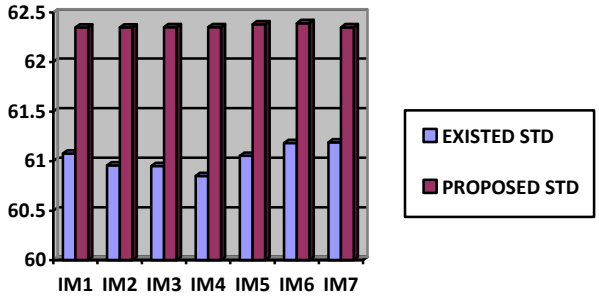

Figure 13: comparison between existed and proposed STD

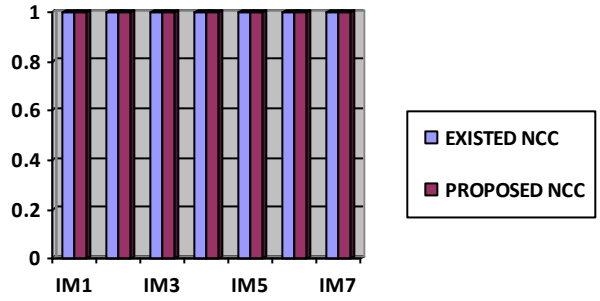

Figure 14: comparison between existed and proposed NCC

V. CONCLUSION

In this paper we are discussing about image watermarking scheme with DWT & SVD techniques by using a scaling factor. Here we are applying DWT to a watermark image and cover image. Now SVD is applied the coefficients of the LL sub band of cover image and watermarked image is added to the cover image with the help of a scaling factor. Based on scaling factor the watermark image is embedding into cover image to obtained watermarked image. The scaling factor is mainly used to find the strength of watermarking scheme. To extract original image, we have to use Extraction process. In this we are performing inverse SVD and inverse DWT to obtain original image. The quality measure (PSNR, MSE) values are showing the effectiveness of proposed method. Future work will focus on extending the proposed algorithm using advanced transformation techniques for better improvement.

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Authors Profile

Mrs. V.Rajyalakshmi received B.Tech in computer science engineering from GVR & S Women's Engineering College, Guntur in 2014.presently she is pursuing her M.Tech under the guidence of Mr.K.Ramesh at Chintalapudi Engineering College,ponnur.

Mr.K.Ramesh received M.Tech Acharya Nagarjuna University from in year 2010. He is currently working as Associate Professor & HOD, in the department of Computer Science Engineering in Chintalapudi Engineering College,ponnur.

