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BLIND WATERMARKING SCHEME BASED ON RDWT-DCT FOR COLOR IMAGES

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Abstract— **In Digital era sharing of images have become very common and raises the risk of using it for unethical and fraudulent purposes with the help of manipulation tools. Digital image watermarking is one way to protect the digital information (text, images, audio, and video) from fraudulent manipulations. Digital Image Watermarking is a process of implanting data in the original image for authentication. In this paper we are providing one such watermarking scheme for color images. The proposed method is designed to be robust for common attacks with the aid of redundant discrete wavelet transform (RDWT) and discrete cosine transform (DCT) properties. After applying two levels RDWT decomposition to the blue channel of cover image, we apply DCT to HH_LL subband i.e. 2nd level decomposed coefficient of HH band and to the watermark. Divided the HH_LL sub band into 4x4 subblocks and DCT coefficients of the last subblock of the cover image are replaced with the DCT coefficients of watermark. Inverse DCT and inverse RDWT is performed to get watermarked image. The performance of the proposed technique is measured using the parameters PSNR and NCC.**

Keywords— **RDWT, DCT, PSNR, NCC**

I. INTRODUCTION

Copyright protection of digital media is the very first application that comes to mind for digital watermarking. In the past, duplicating artwork was quite complicated and requires great efforts to create the work looks just like the original. However, nowadays in digital world, it is very simple for anyone to duplicate or manipulate digital data. The digital image watermarking allows the watermark to be embedded visibly or invisibly in the original image for identification of the owner. This concept can also be used for other media, such as digital video and audio. Visible watermarking inserts a discernible watermark for the immediate identification of the images. The insertion of a visible watermark should meet two contradictory conditions, the watermark should be strong enough to be visible, and also it should be light so that it is unnoticeable and not disturbing the appearance of the original image. On the other hand invisible watermarking inserts the watermark such that they are indiscernible with the original image.

Watermarking techniques are characterized with the following features.

1) Robustness: It is the tenacity of the watermark to detect accurately against various attacks on the watermarked image.
2) Imperceptibility: The essence of the original image should not be disturbed with the addition of watermark to it.
3) Capacity: Amount of data that can be embedded in the original image for authentication.

By embedding the watermark in the low frequencies increase the robustness of the watermarked image but it degrades or tampers the original image which in turn affects the imperceptibility. Thus robustness and imperceptibility are contradictory to each other. In this paper we proposed a method where in we are using the HH_LL band for embedding the watermark in the original image to balance between the robustness and imperceptibility. In addition to that DCT is used to separate out the low and high frequency components. We are embedding the watermark in the high frequency components that increases the imperceptibility.

The paper is organized as follows. Section II briefly overviews the used concepts. Section III outlines the proposed scheme for watermark embedding and extraction algorithm. Section IV contains experimental results followed by conclusion in section V.

II. BRIEF OVERVIEW OF CONCEPTS

A. Redundant Discrete Wavelet Transform

DWT family has remarkably become researchers first choice for Image watermarking algorithms. RDWT is one among that family which has same characteristics as DWT with an added advantage of Shift invariance. DWT decomposes an image using analysis filter and down samples the frequencies. Due to the presence of down sampler it removes the redundant data causing shift variance problems. RDWT decomposes an image using only analysis filter resulting in redundant data. With the aid of this redundant data even if there is any minor shift in the image, the coefficients will not vary causing shift invariant. The following figure depicts the RDWT decomposition into sub bands.

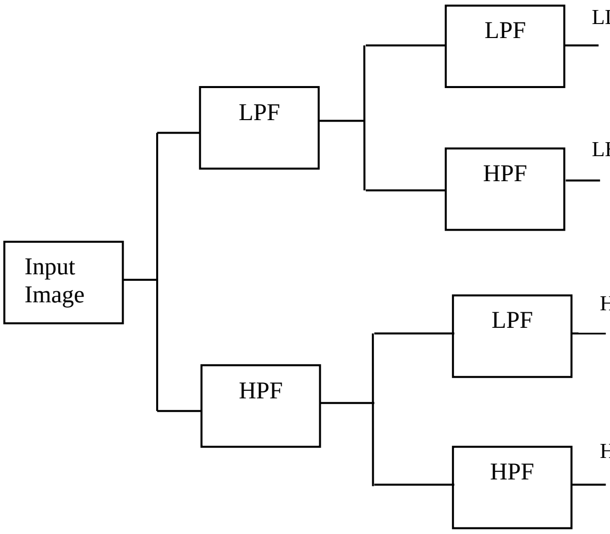

Fig. 1 RDWT analysis filter bank

B. Discrete Cosine Transform

The discrete cosine transform describes an image as a collection of sinusoids. In comparison with DFT, DCT is simple because it represents the image in cosine functions and is also faster. DCT transforms the original image into low frequency, midband frequency and high frequency coefficients. Most of the energy of the original image is concentrated in the lower frequency coefficients and it keeps decreasing as the frequency increases. Thus high frequency coefficients contains the least energy and can be neglected resulting in less number of coefficients for image. This property of DCT is known as energy compaction. The following figure shows how a DCT segregates the original image information into different bands.

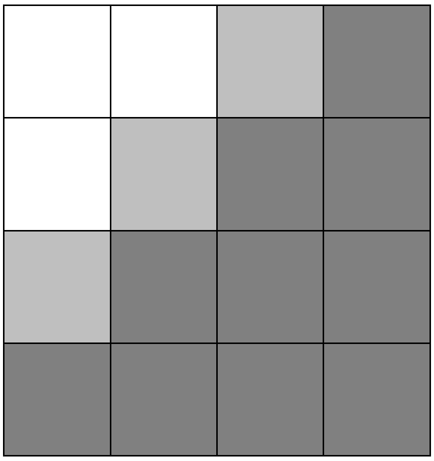

Fig. 2 DCT transformation of an image into DC and AC coefficients

The white blocks depicts the DC coefficients i.e.., they are the low frequency components containing high energy, the light gray are the midband frequency components while the dark blocks are the ac coefficients representing high frequencies and containing low energy.

Human eyes are insensitive to higher frequencies and any changes in this region will not be perceptual. Thus we are considering this advantage for our blind watermarking scheme.

III. PROPOSED METHOD

The proposed method consists of two steps. Watermark Embedding step and Watermark Extraction step.

A. Watermark Embedding Process

The process of adding owners identifier or logo in an invisible manner to the image is known as Watermark embedding. It is done for the purpose of authentication or for proving the ownership of the creator.

Following is the proposed procedure to embed a watermark in an image.

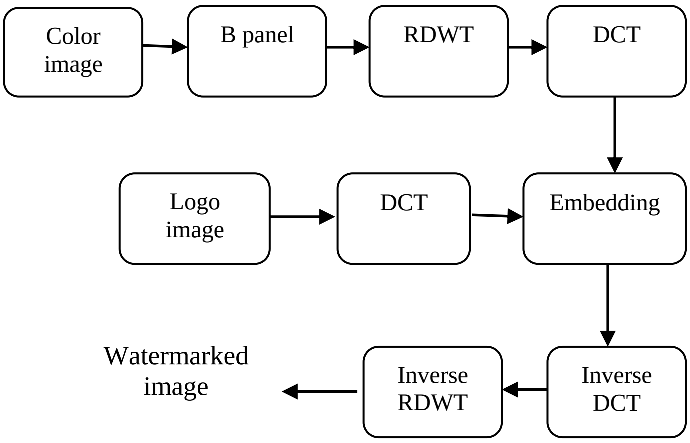

Fig. 3 Watermark Embedding block diagram

1) Select input color image of size NxN and is parted into red, green and blue images.

2) Using RDWT, the blue panel of the cover image disintegrated into four sub bands LL, LH, HL, HH each of same size.

3) Select the each band (lets say HH) and apply RDWT to decompose it into sub bands HH_LL, HH_LH, HH_HL, HH_HH of same size.

4) DCT is applied to the subband HH_HH and are then partitioned into 8x8 subblocks of size N/8x N/8 i.e., 8 rows and 8 columns.

5) The DCT coefficient matrix D is formed from the sub block of HH_HH sub band.

6) The logo of size N/8xN/8 is used for embedding and DCT is applied to form the coefficient matrix D_W.

7) The two dimensional matrices D and D_W each of size N/8xN/8 are converted to one dimensional matrices for embedding process.

8) The one dimensional matrix D is substituted with D_W.

9) Remodel the one dimensional coefficient matrix D back to two dimensional and combine it with the other sub blocks to form the subband HH_ HH*.

10) Inverse DCT and Inverse RDWT are applied to the transformed subband HH_ HH* and other subbands LH, HL, HH to form the HH* subband.

11) Second level Inverse RDWT is applied to the LL, LH, HL, HH* subbands to generate the blue panel of the watermarked image.

12) The red panel, green panel and transformed blue panels are integrated to form the Watermarked Color Image.

B. Watermark Extraction Process

The process of extricating the owners identifier or logo from the watermarked image is known as Watermark extraction. The extracted logo should resemble with the one which was added at the embedding process.

Following is the proposed procedure to extract a watermark from a watermarked image.

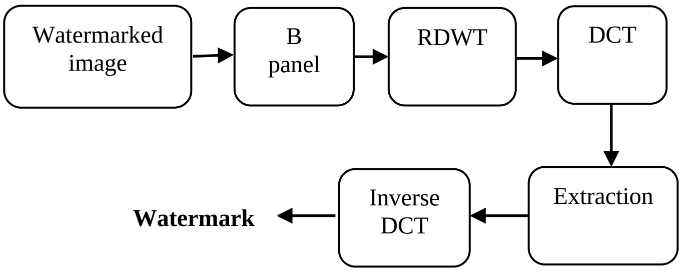

Fig. 4 Watermark Extraction block diagram

1) Select the blue panel from the watermarked color image for extraction process.

2) The blue panel watermarked image is disintegrated using RDWT, into 4 subbands: LL, LH, HL and HH.

3) Select the HH band to decompose it into HH_LL, HH_LH, HH_HL, HH_HH sub bands using RDWT.

4) Repeat the same process as done in embedding of applying DCT to the HH_HH subband and partition the subband into 8x8 subblocks.

5) Select the extreme bottom right sub block and apply Inverse DCT to extract the logo.

6) Thus the watermark is extracted from the input color image.

IV. Experimental Results

The proposed algorithm is tested with Lena image of size 512x 512 as original image and a watermark image with size 64x64. Following figure 6 and 7 shows the input color image and watermark image respectively. Figure 8 and figure 9 are the watermarked image and extracted watermark image respectively.

Fig. 5 Original Color image

Fig. 6 Watermark image

Fig. 7 Watermarked image

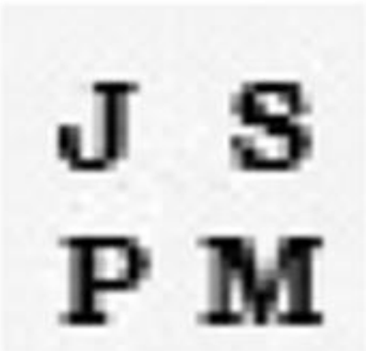

Fig. 8 Extracted Watermark image

The watermarked image was tested for Gaussian noise, salt & pepper noise, speckle noise, Poisson noise, blurring, and sharpening and rotation attacks. The PSNR and NCC values for each subband are tabulated below.

S.No	Attacks	LL_HH	Watermarked image
1	Without Attack	0.9033	51.2016
2	salt and pepper	0.0824	40.7829
3	Gaussian	0.0375	38.3065
4	Speckle noise	0.2174	41.1621
5	Poisson noise	0.1418	41.9451
6	Blurring attack	-0.505	47.9769
7	Sharpening	0.9007	41.67
8	Rotation by 90	-0.0657	32.0772

TABLE. 1 NCC AND PSNR VALUES FOR LL SUBBAND

S.No	Attacks	LH_HH	Watermarked image
1	Without Attack	0.967	54.529
2	salt and pepper	0.329	40.7269
3	Gaussian	0.1406	38.3186
4	Speckle noise	0.3845	41.1714
5	Poisson noise	0.4255	41.9575
6	Blurring attack	-0.8688	48.3768
7	Sharpening	0.9665	41.6708
8	Rotation by 90	0.0813	32.0775

TABLE. 2 NCC AND PSNR VALUES FOR LH SUBBAND

S.No	Attacks	HL_HH	Watermarked image
1	Without Attack	0.959	54.5405
2	salt and pepper	0.308	40.7549
3	Gaussian	0.2032	38.3185
4	Speckle noise	0.4293	41.1726
5	Poisson noise	0.3987	41.9739
6	Blurring attack	-0.8584	48.3755
7	Sharpening	0.9583	41.6714
8	Rotation by 90	-0.0796	32.0774

TABLE. 3 NCC AND PSNR VALUES FOR HL SUBBAND

S.No	Attacks	HH_HH	Watermarked image
1	Without Attack	0.9979	51.2058
2	salt and pepper	0.7606	40.6942

3	Gaussian	0.552	38.31
4	Speckle noise	0.8339	41.1603
5	Poisson noise	0.8468	41.9506
6	Blurring attack	-0.9883	48.3925
7	Sharpening	0.9951	41.0402
8	Rotation by 90	0.0695	32.0772

TABLE. 4 NCC AND PSNR VALUES FOR HH SUBBAND

The PSNR obtained with the proposed algorithm is 45.53 to ensure that the watermarked image closely resembles the input color image. The acceptable PSNR values are above 40.

NCC is the parameter to assess the correlation between the extracted watermark and the embedded watermark. We have achieved a NCC value of 0.999 which is approximated to 1 implies that extracted watermark and the input watermark are same.

V. CONCLUSIONS

Thus the blind color image watermarking based on RDWT-DCT scheme is proposed. From the results it is observed that by increasing the level of decomposition and using RDWT with DCT the robustness and imperceptibility is improved as compared to the existing techniques. It is observed that by implanting watermark in HH_LL subband the proposed algorithm became more robust to common attacks. It is affirmed from the results that watermark extracted from HH_LL subband is robust to salt and pepper noise, Gaussian noise, speckle noise, Poisson noise and sharpening attack. In the future we will extend our work by embedding the copy of watermark in all the four sub bands to increase the robustness to other attacks.

REFERENCES

[1] Samira Lagzian, Mohsen Soryani, Mahmood Fathy "Robust watermarking scheme based on RDWT-SVD: Embedding data in all subbands" AISP International 2011.

[2] V.Santhi Member, IACSIT, Prof. Arunkumar Thangavelu "DC Coefficients Based Watermarking Technique for color Images Using Singular Value Decomposition" IACSIT Int. J. of Computer and Electrical Engineering, Vol.3, No.1, February, 2011

[3] Nidhi Divecha Dr. N. N. Jani "Implementation and performance analysis of DCT-DWT-SVD based watermarking algorithms for color images" International Conference on ISSP 2013.

[4] Baisa L. Gunjal and Suresh N.Mali, "SECURED COLOR IMAGE WATERMARKING TECHNIQUE IN DWT-DCT DOMAIN," International Journal of Computer Science, Engineering and Information Technology (IJCSEIT), Vol.1, No.3, August 2011.

[5] D. Kundur, D. Hatzinakos, Digital watermarking using multiresolution wavelet decomposition, Proceedings of IEEE,

[6] Baisa L Gunjal and Dr. Suresh N Mali, "Handling Various Attacks in Image Watermarking" CSI communications 2013.

[7] The MathWorks, Inc., Getting Started with MATLAB. http:// www.mathworks.com/access/helpdesk/help/techdoc/learn_matlab/learn _matlab.shtml

[8] Y. Shantikumar Singh, B. Pushpa Devi, and Kh. Manglem Singh, "A Review of Different Techniques on Digital Image Watermarking Scheme", IJER Volume No.2, Issue No.3, pp : 193-199.

[9] Priyanka Singh, Suneeta Agarwal, Akanksha Pandey, "A Hybrid DWT-SVD Based Robust Watermarking Scheme for Color Images and its Comparative Performance in YIQ and YUV Color Spaces", IEEE IACC 2013.

[10] R. A. Ghazy , N. A. El-Fishawy,M. M. Hadhoud, M. I. Dessouky and F. E. Abd El-Samie, " An Efficient Block-By-Blocksvd-Based Image Watermarkingscheme" UBIC.