ISSN: 2278 – 909X
International Journal of Advanced Research in Electronics and Communication Engineering (IJARECE)
Volume 5, Issue 11, November 2016

THE IMPLEMENTATION OF WATERMARKING TECHNOLOGY FOR COLOUR IMAGES USING DWT-SVD

Shaik Naseema
Department of ECE
DR.KV Subba Reddy College of Engineering For Women,Kurnool
naseema.shk5@gmail.com

Mohammad Zubair
Asst. Professor,Head of ECE Department
DR.KV Subba Reddy College of Engineering For Women,Kurnool
mdzubair.1345@gmail.com

Shaik Wahid Basha
Department of ECE
wahidbasha435@gmail.com

***Abstract*— This paper presents a robust watermarking technique using biorthogonal wavelet transform. In proposed method the blue channel of the color host image is selected for embedding watermark because it is more resistant to changes compared to red and green channels. The blue channel is decomposed into n levels using biorthogonal wavelet transform because biorthogonal wavelet transform is an invertible transform and has the property of exact reconstruction and smoothness. This method is shown to be robust against many signal processing operations as well as geometrical attacks.**

Keywords- Digital Image Watermarking, Biorthogonal Wavelets Transform, Robust Watermarking, Copyright Protection, Attacks.

I. INTRODUCTION

In the present scenario the rapid growth of the internet and digital media manifests itself in widespread in the form of the digital image, audio, video and so on, because digital media are easy to copy and transmit. Issues related to digital media are copyright protected, content authentication, proof of ownership, etc. The watermarking technique provides the best solutions of these problems. This technique embeds information so that it is not easily perceptible; Human visual system not able to see any information embedded in the contents. The other important issues in the watermarking system are the watermark must be robust enough to resist common image processing attacks, geometric attacks.

The main objective of this paper is to present a novel watermarking technique that uses the biorthogonal wavelet transform. The technique makes use of DWT; it aims to improve the robustness of existing watermarking techniques. With proposed technique watermark is extracted even if the watermarked image is attacked. Another important goal is to keep the watermarked image imperceptible

AI. 2D DISCRETE WAVELET TRANSFORM

The 2D DWT is computed by performing low-pass and high-pass filtering of the image pixels as shown in Figure 1. In this figure, the low-pass and high-pass filters are denoted by h (n) and g (n), respectively. This figure depicts the one level of the 2D DWT decomposition. At each level, the high-pass filter generates detailed image pixel information, while the low-pass filter produces the coarse approximations of the input image .

At the end of each low-pass and high-pass filtering, the outputs are down-sampled by two (↓ 2). In order to compute 2D DWT, 1D DWT is applied twice in both horizontal and vertical dimension. In other words, a 2D DWT can be performed by first performing a 1D DWT on each row, which is referred to as horizontal filtering, of the image followed by a 1D DWT on each column, which is called vertical filtering as shown in figure 1. Figure 2 shows the structure of II level 2 D wavelet decomposition.

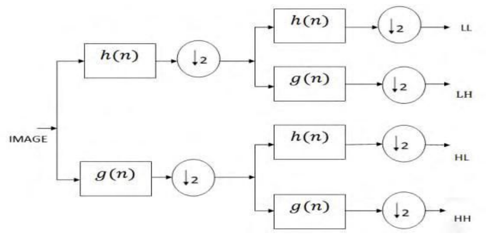

Figure 1. One level 2D DWT decomposition of an input image using filtering approach.

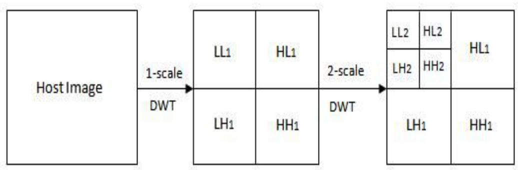

Figure 2. Two level 2D Wavelet based transforms

A. Selection of best Embeddable location

The higher level subbands are more significant than the lower level subbands. They contain most of the energy coefficients so embedded in higher level subbands is providing more robustness . On the other hand lower level subbands have minor energy coefficients so watermark in these subbands are defenseless to attacks. The higher level approximation subband (LL2 subband) is not suitable for embedding a watermark since it is a low-frequency band that contains important information about an image and easily causes image distortions. In second level, embedding a watermark in the diagonal subband (HH2 subband) is also not suitable, since the subband can easily be eliminated, for example by lossy compression as it has minor energy coefficient. So the middle frequency subbands (Vertical & Horizontal) of higher level are the best choice for embedding. Further the LH2 subband has more significant coefficients than the HL2 subband .

B. The Biorthogonal Wavelet Transform

Wavelets can be orthogonal (orthonormal) or biorthogonal. The biorthogonal wavelet transform is an invertible transform. The property of perfect reconstruction and symmetric wavelet functions exist in biorthogonal wavelets because they have two sets of low pass filters (for reconstruction), and high pass filters (for decomposition). One set is the dual of the other. On the contrary, there is only one set in orthogonal wavelets. In biorthogonal wavelets, the decomposition and reconstruction filters are obtained from two distinct scaling functions associated with two multiresolution analyses in duality. Another advantageous property of biorthogonal over orthogonal wavelets is that they have the higher embedding capacity if they are used to decompose the image into different channels [4]. All mentioned properties make biorthogonal wavelets promising in the watermarking domain. In 1998, Kundur and Hatzinakos suggested a watermarking model using biorthogonal wavelets based on embedding a watermark in detail wavelet coefficients of the host image.

III. PERFORMANCE EVALUATION

A. Peak Signal-to-Noise Ratio (PSNR): It is the ratio between the maximum possible power of a signal and the power of corrupting noise the affects the fidelity of its representation. It is the most easily defined via the Mean Squared Error (MSE) which for two m x n images I and K where one of the images is considered as a noisy approximation of the other. MSE and PSNR can be estimated equations (1) and (2).

i"JSE = ~LLIII(i,j) - K(i,j)112 m·1'l (1)

PSNR (dB) = lOloglD" (255 ^{2} jMSE) (2)

B. Normalized cross correlation (NCCR): It is the correlation between the watermark image Wand extracted watermark image W'. If the value ofNC is closer to 1, W and W' are more similar. NC can be estimated the following equation (3).

NC= *L i L jW(i, j)W'(i, j)* / *LiL)W(i,J)]^2* (3)

IV. PROPOSED WATERMARKING METHOD

In embedding process, first separate the R, G & B channels of the color image and the blue channel is selected for the embedding because this channel is more resistant to changes compared to red and green channels and the human eye is less sensitive to the blue channel, a perceptually invisible watermark embedded in the blue channel can contain more energy than a perceptually invisible watermark embedded in the luminance channel of a color image. The blue channel is decomposed into n-level using biorthogonal wavelet transform.

Let select a bmp image of size 64 x 64 as watermark and convert it into a 1-D vector. Two PN sequences are selected for embedding watermark bit 0 & 1 in mid frequency subbands of higher level decomposition of the channel. By using an additive watermarking technique to construct the image as:

LH2'=LH2+alpha * PN(O) (4)

HL2'=HL2+alpha * PN(l) (5)

Where, LH_2, and HL_2, watermarked, LH2 and HL_2 watermarked subbands and alpha is the embedding strength

Finally reconstruct the watermarked image using inverse biorthogonal wavelet transform. Now calculate the Mean Squared Error & Peak Signal to Noise Ratio between original host image and watermarked image to evaluate the perceptual similarity between these two images by using equation 1 & 2.

In extraction process the end user separates the R, G & B channels of the watermarked image. The blue channel is decomposed into n-level using biorthogonal wavelet transform. Generate the PN (0) & PN (1) signal similarly to the embedding process and select the threshold value. By using these signals extracts the original watermark from HL_2, and LH_2, subbands. At last the Normalized Cross correlation between original and extracted watermark is calculated using equation 3.

V.EXPERIMENTAL RESULTS

Baby.jpg colour image of size 256X256 is selected as a host and *best.bmp* bitmap image of size 64X64 is chosen as a watermark. Figure 3 shows the original host image & l-Ievel decomposed blue channel using biorthogonal wavelet transform. In Figure 4 host image, watermark, watermarked and extracted watermark on the receiver side are shown.

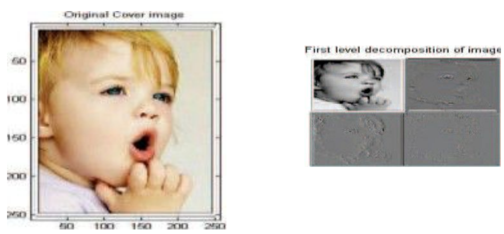

Figure 3. Original host image & I-level decomposed blue channel using bior 1.1 wavelet transform.

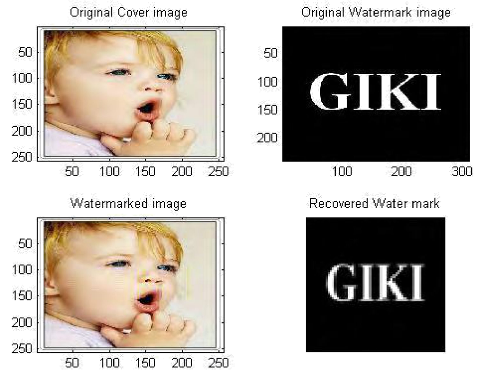

Figure 4 Original host image *baby.jpg*, original watermark *best.bmp*, watermarked image and extracted watermark

Another watermark image (*Logo-MNNIT.jpg*) is taken of size 64x64 and perform the same embedding algorithm is perform to get the results as shown in Figure 5. This figure shows host image, watermark, watermarked and extracted watermark at the receiver side.

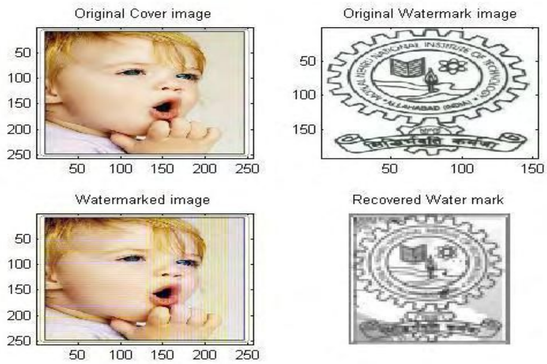

Figure 5. Original host image LogoMNNIT.jpg, original watermark best.bmp, watermarked image and extracted watermark

The Peak Signal to Noise Ratio (PSNR) and Mean Square Error (MSE) values obtained from original host images with two different watermark images at different embedding strength are studied and experimentally obtained. The comparison of PSNR measurements with different watermark image is shown in Figure 6. Figure 7 shows watermarked image at different embedding factor (alpha=0.1, 0.5, 1.0) with performance measurements PSNR and MSE.

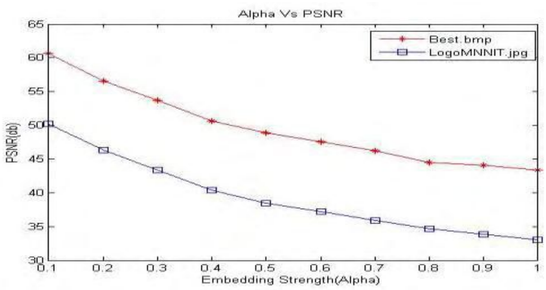

Figure 6 Embedding Factor Vs PSNR

Alpha=0.1	Alpha=0.5	Alpha=1.0
PSNR=60.70	PSNR=48.84	PSNR=43.42
MSE=0.055	MSE=0.848	MSE=3.025

Figure 7 shows watermarked image at a different embedding factor

The Normalized Cross Correlation (NCCR) values obtained between Original watermark and Extracted watermark are studied and experimentally obtained and comparison of NCCR with both watermarks, *best.bmp* (bitmap image) & *Logo-MNNIT.jpg* (gray scale image), is shown in Figure 8.

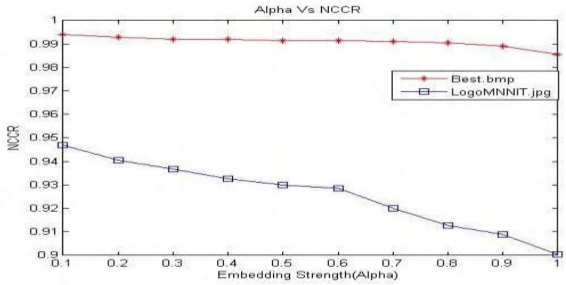

Figure 8 Comparison of NCCR with both watermarks

The performance of the proposed method for image processing operations such as Gaussian noise & Salt and pepper noise on watermarked image is studied and experimentally obtained with different noise density for *baby.jpg* with both watermarks, best.bmp(bitmap image) & *Logo-MNNIT.jpg* (gray scale image) at fixed embedding factor (Alpha= 0.6). The comparison of PSNR measurements with different watermark image is shown in Figure 9 in the presence of Noise with different noise density.

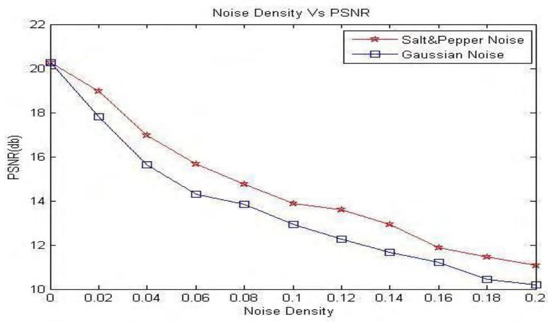

Figure 9 PSNR comparison against Salt & Pepper Noise & Gaussian Noise

The experimentally obtained results for NCCR after Gaussian noise & Salt and pepper noise is attacked on Watermarked image with different noise density. The comparison is shown in Figure 10.

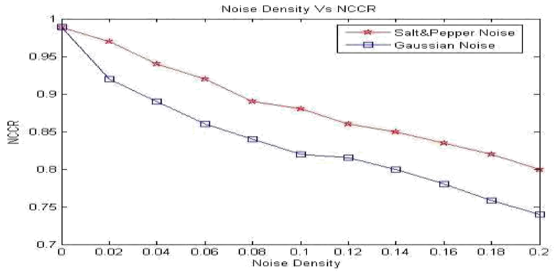

Figure 10. Comparison of quality of extracted watermark after Noise attacks

The JPEG quality factor is a number between 0 and 100 and associates a numerical value with a particular compression level. When the quality factor is decreased from 100, the image compression is improved, but the quality of the resulting image is significantly reduced. With the different quality factors of JPEG compression, the results are shown in figure 11. The proposed method can correctly extract the watermark while the quality factors are greater than 80 and NCCR is still greater than 0.68 even when the quality factor is down to 20.

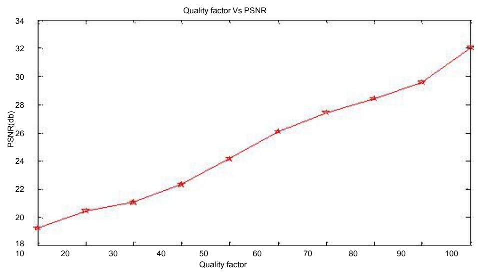

Figure 11 Quality factor Vs PSNR for JPEG Compression

Geometrical attacks such as Scaling, Rotation and Cropping is studied and experimentally obtained results are shown in figure 12 & 13 for scaling attack performance with watermark *Logo-MNNIT.jpg.*

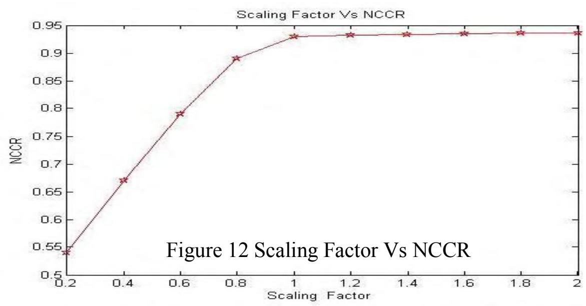

Figure 12 Scaling Factor Vs NCCR

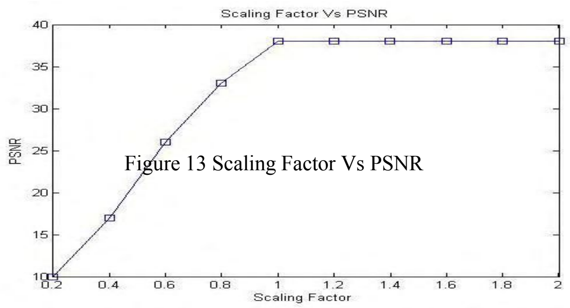

Figure 13 Scaling Factor Vs PSNR

VI. CONCLUSIONS

In this paper watermark is embedded into second level subband of DWT decomposition. Results show that when the embedding factor (Alpha) value increases then distortion in the watermarked image increases and quality of the extracted watermark also improves. This method is implemented using both bi-orthogonal wavelet and orthogonal wavelet transforms for analysis. If we use Bi-orthogonal wavelets for decomposition then distortion in the watermarked image is less compared with the Haar wavelet transform. The technique makes use of DWT; it aims to improve the robustness of other watermarking techniques. With this technique the watermark is extracted even if the watermarked image is attacked. First, the embedded watermark should not degrade the quality of the image and should be perceptually invisible to maintain its protective secrecy. Second, the watermark must be robust enough to resist common image processing attacks and not be easily removable; only the owner of the image is able to extract the watermark.

The performance of the proposed method is tested by applying different geometric and image processing attacks, such as salt and pepper noise, Gaussian noise, JPEG compression, scaling and cropping attack. The proposed method, with stands for all these attacks.

VII. REFERENCES

[1] Gonzalez, F.P., and J.R., Hern´andez, 1998. "A tutorial on digital watermarking", *Tech. Rep.*, University of Vigo, Spain.

[2] Wei-Hung Lin, Shi-Jinn Horng, Tzong-Wann Kao, Pingzhi Fan, "An Efficient Watermarking Method Based on Significant Difference of Wavelet Coefficient Quantization. IEEE TRANSACTIONS ON MULTIMEDIA, VOL. 10, NO. 5, AUGUST 2008. Pp 746-757.

[3] Kundur, D., and D., Hatzinakos, 1998. "Digital watermarking using multiresolution wavelet decomposition", *Tech. Rep.,* Dept. of Electrical and Computer Engineering, University of Toronto.

[4] Nikolaidis, N., and I., Pitas, 1996. "Copyright protection of images using robust digital signatures", in *Proc. IEEE ICASSP'96,* pp. 2168–2171.

[5] Hajjara, S., M., Abdallah, and A., Hudaib, 2006. "Image information hiding using second order biorthogonal wavelets", *ICIA Int. Conf.*, Sri Lanka, Colombo, pp. 403-406.

[6] S. Rawat and B. Raman, "A New Robust Watermarking Scheme For Color Images", 2010 IEEE 2nd International Advance Computing Conference, pp. 206- 209, 2010.

[7]C. Chang, F. Hwang, and M. Hwang. Robust authentication scheme for protecting copyrights of images and graphics. *IEE Proceedings: Vision, Image and Signal Processing*, 149(1):43–50, February 2002.

[8]M. Hu, D. Lou, and M. Chang. Dual-wrapped digital watermarking scheme for image copyright protection. *Computer and Security*, 26(4):319–330, June 2007.

[9] Chae, J.J., and B.S., Manjunath, 1997. "A robust embedded data from wavelet coefficients", *Tech. Rep.*, University of California, CA.

[10] Yang, S.H., 2002. "Wavelet filter evaluation for image watermarking", *Tech. Rep.*, Dept. of Computer Science and Information Engineering, National Taipei University of Technology, China.

[11] www.mathworks.com.

[12] www.dsprelated.com.