International Journal of Science and Research (IJSR)
ISSN (Online): 2319-7064
Index Copernicus Value (2013): 6.14 | Impact Factor (2013): 4.438

A Robust Technique of Digital Watermarking Using Hybrid Method of DWT & SVD on RGB Color Space

Simranjeet Kaur[1], Rana Gill[2]

[1, 2]University Institute of Engineering (CU), Gharuan. (Pb), India

Abstract: ***The advancement in technologies has created threats to content nobility and copyright protection. So, digital watermarking is possibly good technique in empowering the content protection. Different techniques have been proposed by the researchers till now for the security of the host image by embedding watermark in it. But, still the algorithms are not that much secure. To increase the security or for the copyright protection, robust technique of digital watermarking using hybrid method of DWT and SVD has been proposed in this paper and tested on RGB color images. The algorithm shows the good correlation between embedded and extracted watermark and better image quality results in terms of PSNR and BER.***

Keywords: Digital Watermarking, DWT, SVD, RGB Color Space.

1. Introduction

Major section of multimedia content is images make up such as digital pictures, digital arts, explanatory diagrams, and cultural heritage paintings in digitized form. Advancement in technologies has created threats to copyright protection and content nobility. For example, images can be copied, altered and can be easily distributed. Digital watermarking is a possibly good tool in empowering the content protection. Copyright protection reviews the positive recognition of content ownership in order to protect the rights of the owner. [1, 2].

Digital Watermarking is a process in which data can be imperceptibly embedded or inserted into digital media. This embedded data should ideally be robust against common signal operations such as addition of noise, analog-to-digital conversion and intentional attacks to detach the embedded watermark [1].

Digital watermarking can be applied to various types of media to protect the media from illegal copying/piracy, which include text, image, audio and video content. So according to the type of media to be protected, watermarking is of four types: Text file watermarking, audio watermarking, image watermarking and video watermarking. And according to the human discernment it is of two types: visible watermarking and invisible watermarking. If the embedded watermark is visible to the human eye then it is said to be visible watermarking. And if watermark/information embedded to the media files is not visible to the human eye then it is said to be invisible watermarking [3]. According to the domains, watermarking can be classified into two categories: Spatial domain and transform-domain watermarking.

In spatial-domain watermarking techniques, watermark is directly embedded into the cover image by simply modifying the pixel values. The main advantages of spatial domain methods are that they are simple and have very low computing complexities and therefore are widely used in watermarking where real-time performance is a primary concern. But it has some major limitations that the spatial domain methods are not robust against common digital signal processing operations. On the other hand, Transform-domain techniques are the techniques in which the host image is firstly transformed into another domain before watermark embedding. Commonly used transforms are the Discrete Cosine Transform (DCT), the Fast Fourier Transform (FFT), the Discrete Wavelet Transform (DWT), and the Singular Value Decomposition (SVD).

Transform-domain watermarking techniques are more robust and imperceptible compared to spatial domain techniques since embedding the watermark in the transformed domain makes it very difficult to remove/detach the embedded watermark. The main benefit is that they can take advantage of properties of alternate domains to address the limitations of pixel-based methods or to support additional features. Generally, the main limitation of transform domain methods is their higher computational requirement.[4]

In this paper, hybrid method of DWT & SVD is proposed for the embedding and extraction of the watermark in RGB color space. For the security of the host image, 3-level DWT is used to decompose a host image of size 512*512 and block based SVD is applied for the modification of the singular values of watermark with the singular values of host image. Block based SVD is applied because if any attack affects the watermarked image, some of the watermark will survive.

2. Related Work

In recent years many techniques have been used in the field of digital watermarking for the security the digital information. *M. Khalili* et al proposed an algorithm which is tested over different color spaces and the algorithm use DWT and Arnold transform mapping [5] for embedding of scrambled binary watermark of size 15*64 using encryption key. *C. Pradhan* et al proposed a combined strategy of Arnold's Transform Map and Cross Chaos Map for the encryption of watermark and the final encrypted watermark [6] after applying both the methods, watermark is embedded in the coefficients of DCT domain. *R.A. Ghazi* et al proposed

a block based image watermarking technique based on SVD [7] in which the image of size 256*256 is first broken down into blocks and the watermark is embedded into the singular values of each block. *Ahmed. S* et al also proposed a DWT technique but at third level using Haar filter wavelet[8]. A binary watermark of size 20*50 is embedded over a cover image 512*512*8 using third level DWT and results have been compared on the basis of PSNR against sharper attack, Inverse attack, Compression, Gaussian attack. *Li. F* et al prove that LL sub-band shows more robust results as compared to other sub-bands[9]. For this large amount of tests over many approximate sub-band coefficients of nature images testify that LL is the smooth region. *R.V* et al proposed a entropy based watermarking scheme along with the Hadamard Transform Technique[10]. The host image is divided into blocks of size 8*8 and entropy is calculated for each block. The blocks with high entropy values are selected for the embedding of watermark. *Qingtang. S* et al have also proposed an watermarking algorithm which can be applied over color image[11]. The algorithm is based on YIQ color space and the IWT. YIQ is chosen to obtain the brightness information and IWT can map integer to integer without any error. Shaik K. proposed an algorithm based on PCA[12]. Principle Component Analysis is the compression technique which improves the quality of watermarked image and to provide secure communication by compressing the watermark image along with the use of DCT for watermarking which is applied on the host image for the embedding of PCA based compressed watermark into DCT coefficients of host image. To achieve high embedding ratio with more robustness and low levels of embedding induces distortion. *Nie. J.* et al proposed a new watermarking algorithm for RGB color images based on QIM[13] . This algorithm is designed for RGB color images in which the watermarking bits are embedded into the 8*8 block by applying DCT. *H.B.Kekre* et al proposed a perfect shuffle for image scrambling[14] and results are displayed using 1024*1024 Lena image In this paper, out shuffle and in shuffle both are applied to digital images and different factors for the size of digital image are used for generating combinations of patterns. Every pattern considered has 2^m rows and 2^n columns in out shuffle and vice versa in case of in shuffle. *F.keny* et al have proposed an watermarking scheme based on HIS color spacing. Firstly, the original image is converted into HIS color space , then divide the intensity layer of HIS into 8*8 blocks and computed variance for each block and select the top blocks with more variance values and apply DWT over it for the embedding of watermark which is a binary watermark and is encrypted using Arnold scrambling.

3. Proposed Techniques

DWT: Discrete Wavelet Transformation is the transformation which decomposes the original image into four frequency sub-bands which are LL, LH, HL and HH. LL is the lowest frequency level having approximation information; LH is the vertical information; HL is the horizontal information and HH is the diagonal information of an image. DWT has an advantage that any sub-band can further be decomposes into another sub-levels and can also be extended up to n-levels. Most of the approximation information is in the low frequency sub-band i.e. LL and other three high frequency components are having detailed information of an image like edge, textures etc. So, the watermark embedding is mostly done in LL sub-band as it is much more stable than higher sub-bands and gives better robust results.

SVD: Singular Value Decomposition is an efficient good technique that can be used for watermarking embedding and extracting. Due to its excellent properties, it becomes a very useful technique in the field of image processing. The SVD matrix has a good stability; if small amount of noise or disturbance is added to an image then large variations does not occur by applying SVD matrix to an image.
SVD decomposes a real matrix A as:

$$A = USV^T$$

Where U is a m*m unitary matrix, S is the m*n matrix having non zero numbers on its diagonal and zeros on the off diagonal. V^T is the transpose of n*n unitary matrix. The diagonal values of S represents the luminance value of an image and changes occur to these values do not affect the quality of an image.

4. Proposed Method

4.1 Embedding Process

1. Select original image (either color or grey scale image) and resize it into standard size of 512*512.
2. Similarly, select watermark image and resize it into size 128*128.
3. Choose any RGB color image and separate its layers.
4. Select any one layer from chosen color space for watermark embedding.
5. Apply 3-level DWT on the selected layer.
6. Divide the watermark image into four parts so that we can hide these four parts into the approximation and details.
7. Apply SVD on 3rd level approximation coefficients (A) and watermark1.
8. Add the singular value matrix of watermark1 into the singular value matrix "A" to get the watermarked S of "A".
9. Apply inverse SVD on watermarked S and original U and V of "A" to get watermarked approximation matrix (WA).
10. Similarly, repeat steps 8-10 for the detail coefficients H,V, D with watermarks W2, W3 and W4.
11. Use these watermarked approximations and details coefficients and apply 3rd level IDWT to get watermarked image.

4.2 Extraction Process

1. Select watermarked image.
2. Choose the layer in which watermark has been embedded.
3. Using 3-level DWT, decompose the watermarked image into four sub-bands for the extraction of the watermark
4. Apply SVD on the WAL3 sub band to extract the first watermark with the help of stored raw data.
5. Repeat step 4 for WHL3, WLH3 and WDL3 to extract the remaining watermarks.

6. Concatenate the all four extracted watermarks to obtain final extracted watermark.
7. Compare the extracted watermark with the original watermark in terms of BER, PSNR, MSE and CC.

5. Experimental Results

To achieve the imperceptibility and security of the host image; an algorithm has been proposed which uses the hybrid method of DWT and SVD. The Flow diagram has been shown in fig 1 which provides the basic overview of an algorithm. Fig 1a shows the embedding process in which an RGB color image is separated into three layers and watermark is embedded in the third layer of the RGB image using DWT and SVD.

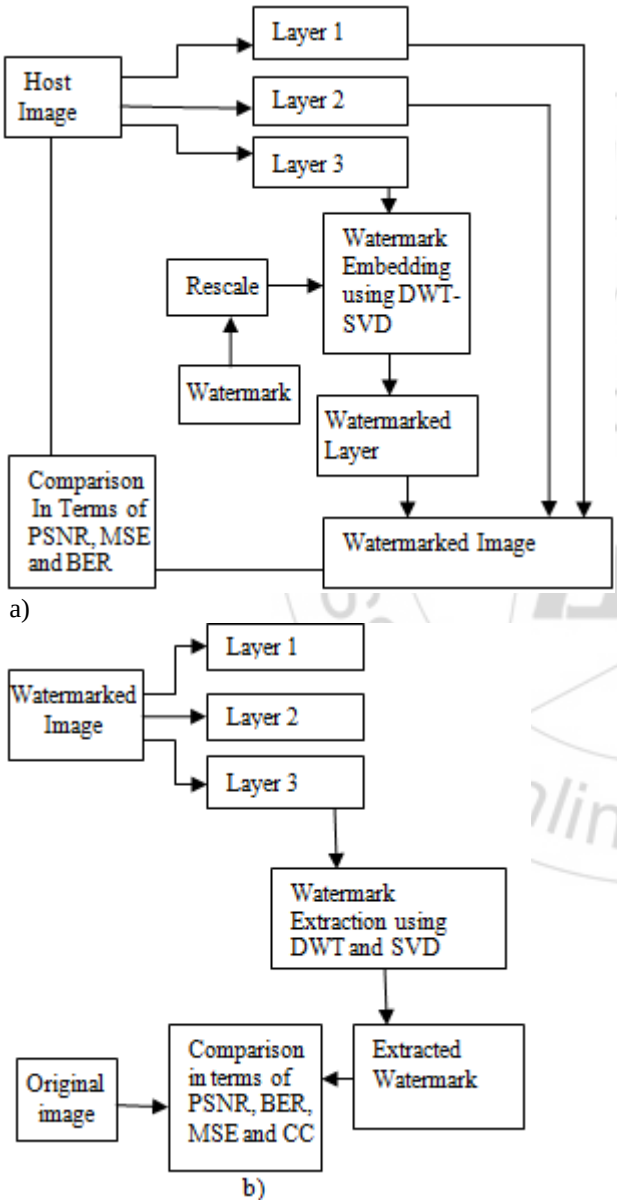


Figure 1: a) Embedding Process b) Extraction Process

Figure 1 b shows the extraction process for the extraction of watermark using DWT and SVD.

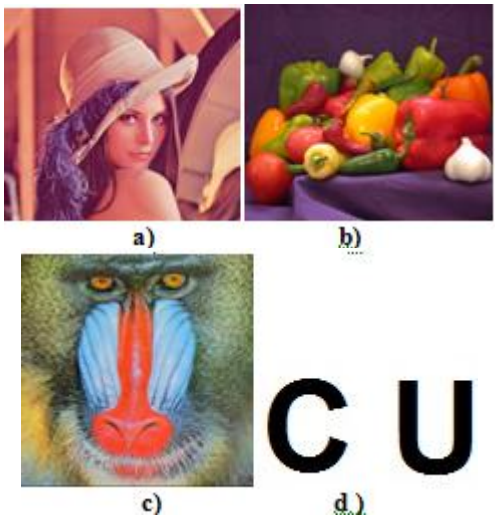
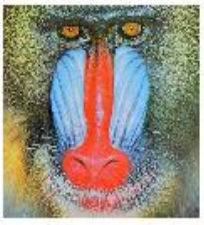


Figure 2: a-c): Host Lena, Pepper, And Baboon Image d) Watermark image

6. Embedding Results

For the embedding of watermark three famous color images shown in Fig 2 of standard size 512*512 has been taken to embed a grey scale watermark of size 128*128 with intensity factor k=0.05. And for the implementation of results MATLAB (R2010a) software has been used.

Watermarked Images		
Lena	Pepper	Baboon
		

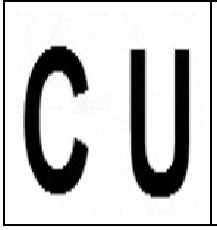
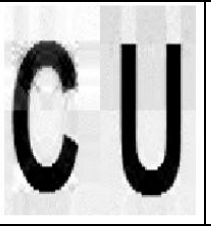
a)

Original Image	Watermark Image	PSNR	MSE	BER
Lena	CU	50.0570	0.6418	0.0200
Pepper	CU	50.8405	0.5358	0.0197
Baboon	CU	49.8157	0.6784	0.0201

b)

Table 1: a) Watermarked Images b) Embedding Results.

7. Extraction Results

Extracted Watermark		
For: Lena	Pepper	Baboon
		

a)

Host Image	PSNR	MSE	BER	CC
Lena	46.7121	1.3864	0.0214	0.9998

Pepper	37.2029	12.3820	0.0269	0.9919
Baboon	46.3669	1.5010	0.0216	0.9996

b)

Table 2: a) Extracted watermarks b) Extraction Results

8. Conclusion

In this paper, for the security of the host image and for the copyright protection, an algorithm has been proposed which uses the hybrid method of DWT and SVD and applied on the RGB color images. Third level DWT has been used in this method to decompose the host image and then SVD is applied on the watermark image and on each sub band of decomposed image to obtain the watermarked image. The proposed algorithm gives the successful results in terms of PSNR, MSE, BER and CC.

References

[1] Gupta, Manish, et al. "Digital image watermarking using uncorrelated color space." *Proceeding of International Symposium on. Computer Applications and Industrial Electronics (ISCAIE)*, IEEE, 2014:158-162.

[2] Abdullatif, Mohammad, et al. "Properties of digital image watermarking."*Proceeding of 9th International Colloquium on Signal Processing and its Applications (CSPA)*, IEEE, 2013:235-240.

[3] Majumder, Swanirbhar, KharibamJilenkumari Devi, and Subir Kumar Sarkar. "Singular value decomposition and wavelet-based iris biometric watermarking." *Biometrics, IET* 2.1 (2013): 21-27.

[4] Franklin, Rajkumar V., Manekandan GRS, and V. Santhi. "Entropy based robust watermarking scheme using Hadamard transformation technique."*International Journal of Computer Applications* 12.9 (2011): 14-21.

[5] Khalili, Mehdi, and David Asatryan. "Colour spaces effects on improved discrete wavelet transform-based digital image watermarking using Arnold transform map." *IET Signal Processing* 7.3 (2013): 177-187.

[6] Pradhan, Chittaranjan, Vilakshan Saxena, and Ajay Kumar Bisoi. "Imperceptible watermarking technique using Arnold's transform and cross chaos map in DCT domain." *International Journal of Computer Applications*55.15 (2012).

[7] Ghazy, R. A., et al. "An efficient block-by-block SVD-based image watermarking scheme." *National Radio Science Conference, 2007. NRSC 2007.*. IEEE:1-9.

[8] Salama, Ahmed, et al. "A robust digital image watermarking technique based on wavelet transform." *International Conference on. System Engineering and Technology (ICSET), 2011 IEEE* IEEE, 2011:100-105.

[9] Fan, Li, and Tiegang Gao. "A novel blind robust watermarking scheme based on statistic characteristic of wavelet domain coefficients." *Proceeding of International Conference on Signal Processing Systems*. IEEE, 2009:121-125.

[10] Su, Qingtang, Xianxi Liu, and Wenchao Yang. "A watermarking algorithm for color image based on YIQ color space and integer wavelet transform." *Proceeding of International Conference on Image Analysis and Signal Processing, IASP 2009.*. IEEE:70-73.

[11] Franklin, Rajkumar V., Manekandan GRS, and V. Santhi. "Entropy based robust watermarking scheme using Hadamard transformation technique."*International Journal of Computer Applications* 12.9 (2011): 14-21.

[12] Ayesha, Shaik K., and V. Masilamani. "An Imperceptible Digital Image Watermarking Technique by Compressed Watermark Using PCA." *Springer International Publishing Advances in Intelligent Informatics*., 2015. 287-295.

[13] Jie, Nie, and Wei Zhiqiang. "A new public watermarking algorithm for RGB color image based on Quantization Index Modulation." *International Conference on Information and Automation, 2009. ICIA'09.*. IEEE, 2009.:837-841.

[14] Kekre, H. B., Tanuja Sarode, and Pallavi N. Halarnkar. "Study of Perfect Shuffle for Image Scrambling." *International Journal of Scientific and Research Publications*: 227.

[15] Kong, Fanzhi, and Yizhun Peng. "Color image watermarking algorithm based on HSI color space." *2nd International Conference on Industrial and Information Systems (IIS), 2010*. Vol. 2. IEEE, 2010.:464-467.