Image Watermarking In DCT, DWT and Their Hybridization Using SVD: A Survey

Ramandeep Kaur[1] and Harpal Singh[2]
[1]*Research Scholar, Department of Electronics and Communication Engineering*
[2]*Faculty, Department of Electronics and Communication Engineering*
[1,2]*Rayat Bahra Institute of Engineering & Bio-Technology, Kharar, Punjab, India*

Abstract- Digital watermarking is one of the vital solution for protecting the intellectual property rights, copy control and content verification. It involves lot of human efforts, cost and time for their protection. Digital watermarking by hybridizing the various transforms along with singular value decomposition (SVD) has gained substantial attention due to development of efficient techniques which increases the performance. In this paper, an exhaustive survey has been done on digital image watermarking based on Discrete Cosine Transform (DCT) and Discrete Wavelet Transform (DWT) hybridization with SVD. Although there are standard algorithms for watermarking which proves their robustness but still a lot of things like principal component analysis, redundant and feature extraction based hybridization of transform in place of SVD need to be explored in order to enhance the performance.

Keywords – Digital Watermarking, DCT, DWT, SVD, Hybrid Watermarking

I. INTRODUCTION

The internet technology has made the access of digital data very simple for communication and distribution. Digital multimedia contents like video, audio and images are conveniently available on internet which increases the unlawful operations like copyright violation, forgery, modification and duplication. Digital watermarking as one of the solution comes to our salvage for protecting these operations. In this technique, message such as image, audio, video or text can be embedded within the digital media in such a manner that it should not cause degradation to the original digital media. According to domain, watermarking techniques are distinguished into two classes: Spatial domain method and the Frequency domain method. In Spatial domain, the watermark is embedded into the host image by directly modifying the pixels value i.e. to embed the watermark into Least Significant bit (LSBs) of the host image. Spatial domain watermarking is easy to implement but it often fails under the attacks of signal processing such as filtering, cropping, compression, rescaling and having low bit capacity. In Frequency domain method, the watermark that embedded is more effective and is more robust to different attacks as compared to spatial domain method. The watermark is embedded into transform coefficients of host image after applying DFT, DCT and DWT transform.

The rest of the paper is organized as follows. An exhaustive Literature survey image watermarking are explained in section II. Based upon the literature survey, conclusions are given in section III.

II.LITERATURE SURVEY

In this section, work done in area of Digital Watermarking and also its techniques is reviewed. According to A. Abdulfetah et. al in [1], a robust quantization based digital image watermarking for copy right protection in DCT-SVD domain works well. They proposed watermarking algorithm which combines both merits of the algorithm based on DCT and algorithm based on SVD. The watermark was embedded by applying a quantization index modulation process on largest singular values of image blocks in the DCT domain.

Navas K A et. al discusses in [2] that about a method of non-blind transform domain watermarking based on DWT-DCT-SVD. In this method, the DCT coefficients of the DWT coefficients were used to embed the watermarking information. This method of watermarking was found to be robust and the visual watermark was recoverable without only reasonable amount of distortion even in the case of attacks. Thus the method can be used to embed copyright information in the form of a visual watermark or simple text.

Deepa Mathew describes in [3] regarding the Singular Value Decomposition (SVD) based image watermarking scheme. She claims that the output result of SVD is more secure and robust. In this scheme, D and U components are used for embedding the watermark. Unlike other transforms which uses fixed orthogonal bases, SVD uses non fixed orthogonal bases. The result of SVD gives good accuracy, good robustness and good imperceptibility in resolving rightful ownership of watermarked image.

In [4]a robust algorithm of digital image watermarking based on discrete wavelet transform is presented. Authors have used blind watermarking techniques. In particular, digital image watermarking algorithms which are based on the discrete wavelet transform have been widely recognized to be more prevalent than others.
In paper [5], Shikha Tripathi et.al proposed a DWT based dual watermarking technique wherein both blind and non-blind algorithms are used for the copyright protection of the cover/host image and the watermark respectively. They used the concept of embedded two watermarks into the cover image by actually embedded only one, to authenticate the source image and protect the watermark simultaneously. Here the DWT coefficients of the primary watermark (logo) are modified using another smaller secondary binary image (sign) and the mid frequency coefficients of the cover/host image.
According to SuraRamzi Sheriff [6] an applied theory of linear algebra called "Singular Value Decomposition (SVD)" is successfully applicable to digital image watermarking scheme, which embeds the watermark into image in imperceptible way. This method has been proposed an optimal SVD based watermarking scheme that embeds the watermark in two steps. In the first step, the cover image is divided into smaller blocks and a piece of the watermark is embedded in each block. In the second step, the watermark has extracted from the watermarked images.
An attempt is made to develop a new reference watermarking scheme based on Discrete Wavelet Transform (DWT) synchronized with singular value decomposition and Discrete Cosine Transform in [7]. DWT is a wavelet transform for which the wavelets are sampled discretely. SVD is a new and important transfer technique in robust digital watermarking due to its different properties from traditional transform techniques such as DCT and DWT. This paper analyzed the watermarking techniques of gray image on the basis of its peak signal to noise ratio (PSNR) value.
An another attempt has been made by AzamSabaghi Nadooshan et.al in [8] to develop a new semi-blind digital watermarking technique using demographic text data and iris code for identification as multiple watermarks. The original image is decomposed into two- level wavelet transform. They have done the experiments on four types of medical images which proved that these modifications are visually imperceptible while it has a good robustness against some common attacks such as Compression, Filtering, and Noise [8].
In paper [9] an efficient DWT based watermarking technique has been proposed that embedded gray-scale logos as watermark in images to attest the owner identification and discourage the unauthorized copying. This method transformed both the host image and watermark into the discrete wavelet domain where their coefficients are fused adaptively based on Human Visual System (HVS) model to hide a higher energy hidden watermark in salient image components.
Shaikh Rakhshan Anjum describes in [10] that if the logo is coded using error correcting codes before embedded into the watermarked images, the robustness of the watermark increases. Different codes that are taken into consideration in this paper are Hamming and Cyclic codes. Here the encoded and embedded watermarked image has considered to be encountering an AWG noise while transmission [10].
The [11] presents a new embedding and extraction method with DWT-SVD in order to improve the robustness and imperceptibleness of the algorithm. The approximation matrix of the third level of image in DWT domain was modified with SVD to embed the singular value of watermark to the singular value of DWT coefficient. This proposed embedding and extracting method was employed to accelerate the hybrid DWT-SVD watermarking and to avoid the leak of watermark.
The paper [12] described two different methods of image watermarking, using combined DCT-DWT transform. The host image is decomposed into four subbands using the first level DWT and then second level DWT is performed on the HL subband. In the first approach, the two smaller subbands of the HL sub band LH2 and HL2 are used to embed the watermark. In the second approach, all the four smaller subbands of the HL subband are used to embed the watermark. In both the cases, 8x8 DCT is carried out on the subbands and the middle frequency DCT coefficients are selected for embedding the watermark [12].
PrafulSaxena et.al in[13] presented a new SVD-DWT semi-blind composite image watermarking algorithm that is robust against various attacks. They used DWT and IDWT transform to obtain four different frequency images. Watermark is embedded in high-frequency band by SVD.
An attempt is made in [14] to develop a method of non- blind transform domain watermarking based on DWT-DCT-SVD. The DCT coefficients of the DWT coefficients are used to embed the watermarking information. They used the parameters to test the robustness of this algorithm, are Peak Signal to Noise Ratio (PSNR), Weighted Peak Signal to Noise Ratio (WPSNR) and Correlation Coefficients (ρ).
An another attempt has been made by Pooja Malhotra et.al in[15] to develop a new discrete wavelet transform-singular value decomposition (DWT-SVD) image watermarking algorithm that is robust against affine transformation and ordinary image processing. In this, they used DWT transforms to obtain four different frequency subbands. Watermarking is embedded in high frequency subbands by singular value decomposition (SVD). Peak Signal to Noise Ratio (PSNR) and Normal Correlation (NC) are computed to measure image quality and template matching.

Marjuni presented in [16], an improved discrete cosine transform (DCT) based image watermarking scheme using the fast Walsh Hadamard transform (FWHT) for image authentication. In this paper, the fast Walsh Hadamard transform has applied to the watermark signal before it embedded into the DCT coefficients.
In [17] Madhesiya presented a method of non- blind transform domain watermarking which is based on the Discrete Cosine Transform (DCT), Discrete Wavelet Transform (DWT) and Singular Value Decomposition (SVD) by using Arnold transform method. DCT based watermarking techniques offers compression while DWT based compression offers scalability. Thus all these desirable properties can be utilised to create a new robust watermarking technique.
A new concept of adding a code to digital image for developing an efficient watermarking technique is given in [18]. The method operates in the frequency domain embedding a pseudo-random sequence of real numbers in a selected set of DCT coefficient. The watermark is added in select coefficients with significant image energy in the transform domain in order to ensure non-erasability of the watermark [18].
In paper [19], a hybrid watermarking scheme for digital imaging based on Singular Value Decomposition (SVD) has been proposed to enhance the performance. The two key aspects of watermarking scheme are copyright protection and robustness. In this, they are embedded the principal component of the watermark in the DCT domain of DWT subband of post image, for providing copyright protection as well as reliability.
Pallavi Patel et.al in [20] presented the quantized DWT based method in which they embedded the secret data into the successive zero coefficients of the medium – High frequency components in reconstructed for 3- level 2-D DWT of cover image. In[21] the various watermarking techniques and the utility of wavelets in the decomposition and embedding of watermark in the image with various methods of wavelet transform are described.
A new semi blind algorithm using DWT-DCT and SVD technique is designed and developed in [22] which is robust against several attacks like cropping, noise, filtering, rotation, translation etc. In this algorithm, firstly DWT is applied on the host image which results in four frequency bands LL, LH, HL and HH.
The[23] describes watermarking scheme in which watermark extraction is compared with the original image for calculating SSIM. The effectiveness of the watermarking scheme using Hybrid transform (DCT-DWT) is demonstrated with the aid of experimental results.
According to Mohamed Radouane [24], an optimal block can be search for inserting the watermark in original image so that not much serious degradation occurs in watermarked image. They proposed a robust method for digital images watermarking in which watermark can be inserted in original image by modifying the singular value decomposition (SVD) in DWT combined with DCT. There are several other research papers that attempt to develop an efficient digital watermarking scheme by integrating the various transform with SVD which is robust against various image processing attacks.

III.CONCLUSION

It is concluded from the above discussion that a lot of work is going on in the field of hybridizing the transforms with SVD. Various digital image watermarking models in DCT-SVD, DWT-SVD and DCT-DWT-SVD domain are explored to minimize the mean square error and hence improving the PSNR. Enough research work has already been done and going on in the field of developing an efficient digital image watermarking technique. Still a lot of things like principal component analysis, redundant and feature extraction based hybridization of transform need to be explored in order to enhance the performance.

IV. REFERENCE

[1] A. Abdulfateh, X. Sun and H. Yanj, "Quantization Based Robust Image Watermarking in DCT-SVD domain", *Research Journal of Information Technology , ISSN: 1815-7432, pp. 107-114, 2009.*

[2] K.A. Navas, A.M. Cheriyan, M. Lekshmi, A. Tampy and M.Sasikumar**,**"DWT-DCT-SVD Based Watermarking", *IEEE, 2009*.

[3] D. Mathew, "SVD Based Image Watermarking Scheme", *IJCA, Special Issue on Evolutionary Computation for Optimization Techniques ECOT, 2010.*

[4] S. Gupta and Dr. S. Jain, "A Robust algorithm of Digital Image Watermarking based on Discrete Wavelet Transform", *IJCCT Vol.1, Issue 2,3,4; Aug 2010.*

[5] S. Tripathi, N. Ramesh and A. Bernito, "A DWT Based Dual Image Watermarking Techniques for Authenticity and Watermark Protection",*Signal and Image Processing : an International Journal (SIPIJ), Vol.1, No. 2, Dec 2010.*

[6] S.R. Sheriff, "Digital Image Watermarking using Singular Value Decomposition", *Raf. J. of Comp. & Math's, Vol.7, No.3, 2010.*

[7] J. Kaur, R. Khanna and D. Sandhu, "New Watermarking Scheme for Gray Image based on DWT and SVD- DCT ",*ISSN:0974-2166, Vol.5, No.4, pp. 389-397, 2012.*

[8] A.S. Needoshan, K. Yaghmaie and R.S. Nadooshan,"Medical Image Watermarking based on SVD-DWT technique",*International Congress on Informatics, Environment, Energy and Applications- IEEA 2012,IPCSIT Vol.38, 2010.*

[9] T.M. Kumari and J. Panda, "Ownership Identification Using Discrete Wavelet Transform (DWT) - Based LOGO watermarking",*Universal Association of Computer and Electronics Engineers, ISBN: 978-981-07-1403-1, 2012.*

[10] S.R. Anjum and P. Verma, "Performance Evaluation of DWT based Image Watermarking using Error Correcting Codes",*International Journal of Advanced Computer Research. ISSN: 2249-7277, Vol.2, No.4, Issue 7, Dec 2012.*

[11] Seema and S. Sharma, "DWT-SVD Based Efficient Image Watermarking algorithm to achieve High Robustness and Perceptual Quality", *International Journal of Advanced Research in Computer Science and Software engineering, ISSN: 2277-128X, Vol.2, Issue 4, April 2014.*

[12] A. Sharma and A. Ganguly, "Image Watermarking in DCT-DWT Domain",*IRNet Transactions on Electrical and Electronics Engineering (ITEEE), ISSN: 2319-2577, Vol.1 , Issue-2, 2012.*

[13] P. Saxsena, S. Garg and A. Srivastava, "DWT-SVD Semi-Blind Image Watermarking using High Frequency band", *2nd International Conference on Computer Science and Information Technology (ICCSIT), Singapore, April 28-29, 2012.*

[14] S.K. Prajapati, A. Naik and A. Yadav, "Robust Digital watermarking using DWT-DCT-SVD", *International Journal of Engineering Research and Applications (IJERA), ISSN: 2248-9622, Vol. 2, Issue 3, pp. 991-997, May-June 2012.*

[15] P. Malhotra, M. Moza and J. Verma, "A DWT-SVD based Watermarking techniques for Digital Images", *International Journal of Computational Engineering Research (IJCER), Vol. 3, Issue 6, June 2013.*

[16] A. Marjuni, M.F.A. Fauzi, R. Logeswaran and S.H. Heng, "An improved DCT-based Image watermarking scheme using Fast Walsh Hadamard Transform", *International Journal of Computer and Electrical Engineering, Vol. 5, No.3, June 2013.*

[17] S. Madheshiya and S. Ahmed, "Advanced technique of Digital Watermarking based on SVD-DWT-DCT & Arnold Transform", *International Journal of Advanced Research in Computer Engineering and Technology (IJARCET), ISSN: 2278-1323, Vol. 2, No. 5, May 2013.*

[18] B. Ram, "Digital Image Watermarking technique using Discrete Wavelet Transform and Discrete Cosine Transform", *International Journalof Advancements in Research & Technology (IJART), ISSN: 2278-7763, Vol. 2, issue 4, April 2013.*

[19] Harish N.J ,B.B.S. Kumar and A. Kusagur, "Hybrid Robust Watermarking technique based on DWT, DCT and SVD", *International Journal of Advanced Electrical and Electronics Engineering (IJAEEE), ISSN: 2278-8948, Vol. 2, Issue 5, 2013.*

[20] P. Patil and D.S. Bormane, "DWT based Invisible Watermarking technique for Digital Images", *International Journal of Engineering and Advanced Technology (IJEAT), ISSN: 2249-8958, Vol. 2, Issue 4, April 2013.*

[21] N. Chaturvedi and Dr. S.J. Basha, "DWT-SVD based Image Watermarking method using Arnold Key", *International Journal of Scientific Research, ISSN: 2277-8179, Vol. 2, Issue 5, May 2013.*

[22] A. Srivasatva and P. Saxena, "DWT-DCT-SVD based Semi-Blind Image Watermarking using Middle Frequency Band ", *IOSR Journal of Computer Engineering (IOSR-JCE), ISSN: 2278-8727, Vol. 12, Issue 2, pp. 63-66, May- June 2013.*

[23] B. Mathur, "Study on High performance and Effective watermarking scheme using Hybrid Transform (DCT-DWT)", *International Journal on Recent and Innovation trends in Computing and Communication (IJRITCC), ISSN: 2321-8169, Vol. 1, Issue 3, March 2013.*

[24] M. Radouane, T. Boujiha, R. Messoussi and R. Touahni, "A Robust method for digital images watermarking based on combination of SVD, DWT, and DCT using Optimal Block", *Journal of Theoretical and appliedInformation Technology (JATIT), ISSN: 1992-8645, Vol. 59, No. 2, 20 Jan 2014.*