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Image Watermarking Using Hybrid Discrete Wavelet Transform (DWT) - Singular Value Decomposition (SVD) Algorithm

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ABSTRACT:- The use of images, text and video has become inevitable in today s rapidly advancing and growing digital world. It has been greatly assisted by the contributions of information technology in bringing about state of the art high speed and secure transmission and reception systems. Content transmission through e-mails, hard media like hard disk drives (HDD), compact discs (CD), digital video discs (DVD) etc., have made things simpler, safer and faster. Digital images can be captured easily with scanners, digital cameras and camcorders, and transmitted easily over the Internet.

With the advent of tele based services, numerous merits have been reported like cutting down of transportation time of patient to meet the doctor or hospital, cutting down of cost due to internet based transmission and reception and also efficient patient monitoring and treatment due to systematic and methodological secured storage of the patient information in the hospital s data base for future access.
"Watermarking" is a process of hiding digital information in original data, to increase robustness and security using the different technique like Discrete Wavelet Transform (DWT) and Singular Value Decomposition (SVD).Methods till date result in good security but they are not robust enough against different attacks. The aim of this research work is to develop a robust and secure watermarking scheme against various sorts of attacks. The robustness and security is increased by combining DWT and SVD. Accordingly an efficient scheme is developed that is having better MSE and PSNR against a wide range of attacks.

Keywords: Digital Wavelet Transform, Singular Value Decomposition, Digital Watermarking, Mean Square Error, Peak Signal to Noise Ratio, Noise Attacks

I. INTRODUCTION

The term water marks got its name at the end of the 18th century as it resembles the effects of water on paper. Emil Hembrooke filed a patent in 1954 which was for identifying music works was the first example of technology similar to digital water marking, Komatsu and Tominaga used the term “digital watermarking” in 1988 first. The term water marks got its name at the end of the 18th century as it resembles the effects of water on paper. Emil Hembrooke filed a patent in 1954 which was for identifying music works was the first example of technology similar to digital water marking, Komatsu and Tominaga used the term. Digital information and data are transmitted more often over the internet now than ever before. The availability and efficiency of global computer networks for the communication of digital information and data have enhanced the popularity of digital media [1]. Hence, information security is becoming more and more important for information intercommunication and transmission among people. In order to secure information against unauthorized illegal access, diverse methods such as symmetric and asymmetric encryption systems are used [2].
Traditionally, protection of digital data has been provided by a variety of encryption methods. However, encryption alone does not provide an adequate solution as it only provides for robust delivery of the content. Once the content is decrypted, it is no longer protected and the content may be illegally replicated or copied without any prevention. Thus, piracy in the presence of internet and computers is a major concern .

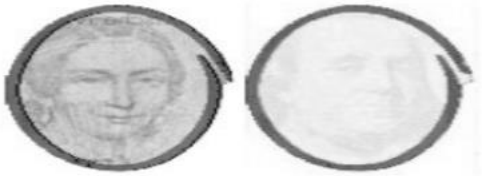

Figure 1.: Watermark in Mark and Dollar Bank Notes

To deal with piracy and counterfeiting of the multimedia data, digital watermarking technique has an edge over the other available techniques. As a result, a variety of algorithms, such as fragile watermarking, robust watermarking and reversible watermarking, have been proposed for the digital content. Out of these categories, robust watermarking is an important technique as it demands that the embedded watermark can be extracted and identified in presence of different attacks like JPEG encoding, noise, cropping etc.

II. DIGITAL WATER MARKING

Watermark is defined as a pattern in which bits are inserted into audio, digital image, text file or video which detects the copyright information of the file. These watermarks are the faintly visible imprints in the stationary and the digital watermarks protect fully the intellectual property available in the digital format. The Watermarking System can be compared to a communication system. Like the Communication System the watermarking system consists of three parts. The analogy of communication system and watermarking system is shown in table 3.1 and Figure 3.1. Digital image watermarking technique has two parts, namely watermark embedding algorithm and watermark extraction algorithm. The watermark embedding algorithm embeds watermark in original cover image giving watermarked image. The watermarked image is transmitted via communication media like internet or mobile phone.

The Code-breakers [4], D. Kahn recounts in their wonderful book, one of the stories in the Histories of Herodotus in which Histiaeus tattooed a message in the shaven head of a slave and waited for the new hair to grow before sending him to Aristagoras at Miletus with instructions to shave-again-the slaveís head. Though, the state-of-art in Digital Watermarking was not very difficult in earlier days but there is not much change in the method.

Useful information pertaining to the content creator or owner is hidden by Digital Watermarking for data copyright and authentication purpose [5]. Steganography was a more former Watermarking name. This word has its origin in Greek. This term, steganography, is not yet popular in literature. Digital watermarking is used by most people, information hiding and data embedding. Among them, watermarking is most recognized by general public and is by far, popularly used in commercial products. More specifically, digital watermarking, also called watermarking embedding or watermark insertion, where the hidden information is inserted into multimedia data also called cover media. The hidden information which is also referred to as watermark, may be random number sequence or the serial number (usually based on some distribution, such as uniform or Gaussian), ownership identifier, text, creator of work, copyright messages, gray or binary level image etc. After the watermark is embedded, the original cover media will be the modified content and slightly modified is called watermarked content.

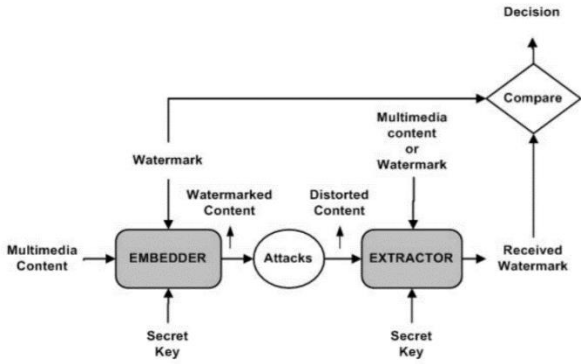

Fig 2 A Typical System of Watermarking

III. PROPOSED WORK

Embedding watermark in wavelet space is engaged by the vast majority of the analysts as watermarks in this area are exceptionally strong. The current wavelet based watermarking procedures are clarified underneath:

A watermarking plan in light of the DWT was proposed by Xia, Boncelet and Arce. Gaussian commotion watermark was added to the high and center recurrence groups of the picture. Taking the DWT of a possibly stamped picture is associated with the unraveling procedure. Segments of the watermark were separated and they were corresponded with segments of the first watermark. In the event that the cross-connection goes over an edge, at that point the watermark can be recognized. The fundamental highlights of the picture to implant the watermark are utilized by them. One of the principle measures to distinguish the watermark quality is utilized by them and later installs the watermark additively. They utilize standardized relationship is utilized to assess the vigor of the extricated watermark. Later the creators present another strategy named [4], which incorporates least difference combination for watermark extraction. It is proposed to utilize a watermark picture whose size is a factor of the host by 2xy.

This is a visually impaired watermarking strategy. The double watermarks are installed by this procedure. A

few assaults are opposed with this plan, and regardless of what sort of assault is connected, the aggressor can distinguish one of the watermarks. Further, this strategy is improved by them by utilizing the wavelet based JND esteems for picture validation and insurance. Thus, copyright security and also content confirmation is accomplished by this method at the very same time [5].

A multi-determination watermarking system was introduced by Zhu et al. for watermarking pictures and video. In all the high pass groups the watermark is installed in a settled way at different resolutions. The HVS perspective isn't considered by this method; be that as it may, the expansion of the HVS factor in account was finished by in change of this procedure. Systems to insert double logo as a watermark were given by, visual models and by factual means are utilized for the identification of them. In corruption instance of the picture excessively and the logo isn't noticeable, connection is utilized and it can be measurable location. A confused (blending) framework is the reason for the inserting of watermark.

Watermark discovery does not require the first picture. A comparative approach is exhibited for the wavelet space [9], where a watermarking calculation in light of confused encryption is proposed by the creators.

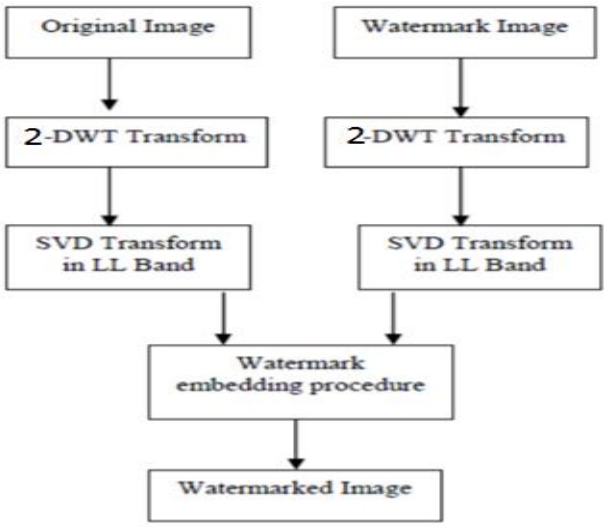

Fig. 2 The Watermarking embedding procedure

VI. Algorithm for DWT-SVD Technique

Step 1: Take host image as input and convert it into Rearrange image original (RIO).

Step 2: Apply 2-D DWT on rearranged image original (RIO) to decompose it into seven sub-bands.

Step 3: Select sub-band LL_2 of RI.

Step 4: Then apply SVD to sub-bands LL_2 to get UR, ΣR and V^TR.

Step 5: Take watermark image as input and convert it into Rearrange image watermark (RIW). Apply 2-D DWT on rearranged image watermark (RIO) to decompose into seven sub-bands.

Step 6: Select sub-bands LL_2 of Wi.

Step 7: Then apply SVD to sub-bands LL_2 to get UW, ΣW and V^TW.

Step 8: Modify UR, ΣR and V^TR by using equation

$UR^* = UR + (0.10*UW)$;

$\Sigma R^* = \Sigma R + (0.10^* \Sigma W)$;

$V^TR^* = V^TR + (0.10^* V^TW)$;

Step 9: Construct modified SVD matrix UR*, ΣR* and V^TR^*.

Step 10: Apply inverse SVD.

Step 11: Apply inverse DWT and finally get watermarked image WI.

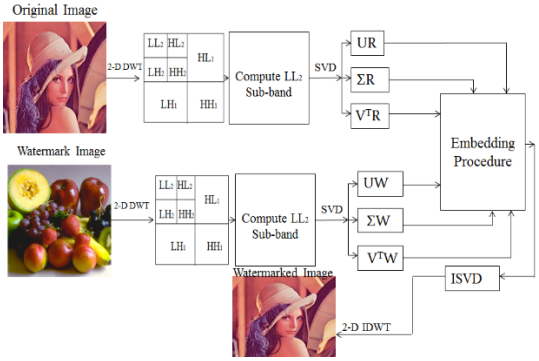

Fig 3 Flow Chart of Proposed Methodology

V. SIMULATION PARAMETER

The mean square error (MSE) and the peak signal to noise ratio (PSNR) are used to measure the resulting error of watermarking image.

$$MSE = \frac{1}{MN}\sum_{i=1}^{M}\sum_{j=1}^{N}[y(i,j) - x(i,j)]^2$$

Where y(i,j) is the watermark image and x(i,j) is the original image.

Peak signal to noise ratio, frequently shortened PSNR, is a designing term for the proportion between the most extreme conceivable energy of a flag and the energy of tainting commotion that influences the constancy of its portrayal. Since many signs have a wide powerful range, PSNR is generally communicated as far as the logarithmic decibel scale.

The peak signal to noise ratio (PSNR) is defined as

Where M is the number of row and N is the number of column in original image.

VI. RESULTS

The original image of 512×512 pixel value is shown in figure 5.1. This figure divided into five parts. In first part the original random image is resize of the 512×512, the resize image is passing through the 2-D discrete wavelet transform (DWT) and get low frequency image is shows in second part. Third part shows the watermark image 512×512 pixel value, the watermark image is passing through the 2-D discrete wavelet transform (DWT) and get low frequency watermark image is shows in fourth part. Original image and watermark image are passing through the embedding processing and get without noise attack watermarked image shown in firth part.

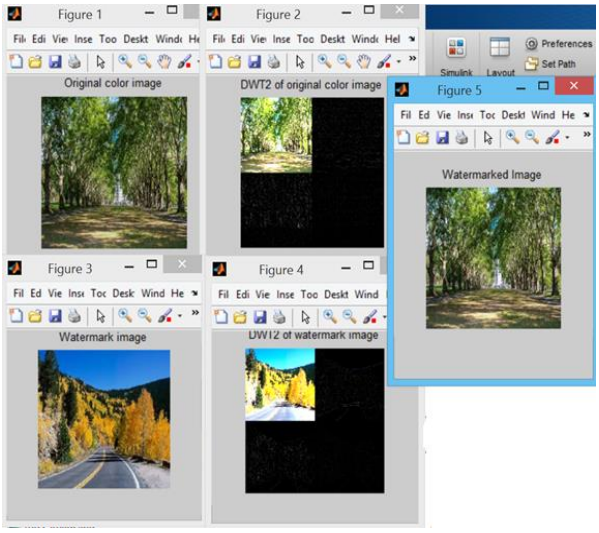

Fig. 4 Experiment Image without Noise Attack

The original tree image of 512×512 pixel value is shown in figure 5.2. This figure divided into six parts. In first part the original random image is resize of the 512×512, the resize image is passing through the 2-D discrete wavelet transform (DWT) and get low frequency image is shows in second part. Third part shows the watermark image 512×512 pixel value, the watermark image is passing through the 2-D discrete wavelet transform (DWT) and get low frequency watermark image is shows in fourth part. Original image and watermark image are passing through the embedding processing and get with Gaussian noise attack watermarked image shown in firth part. In Gaussian noise, each pixel in the image will be changed from its original value by a small amount. Remove the Gaussian noise attack in different filter and get noise free watermarked image is shown in part six.

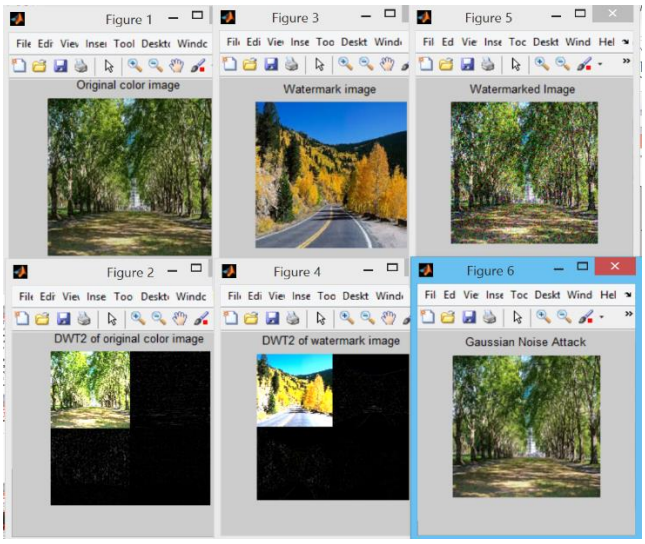

Fig 5 Experiment Image Gaussian Noise Attack

The original bird image of 512×512 pixel value is shown in figure 5.3. This figure divided into six parts. In first part the original random image is resize of the 512×512, the resize image is passing through the 2-D discrete wavelet transform (DWT) and get low frequency image is shows in second part. Third part shows the watermark image 512×512 pixel value, the watermark image is passing through the 2-D discrete wavelet transform (DWT) and get low frequency watermark image is shows in fourth part. Original image and watermark image are passing through the embedding processing and get with salt and pepper noise attack watermarked image shown in firth part. In salt and pepper noise, pixels in the image are very different in intensity from the surrounding pixels.Remove the salt and pepper noise attack in different filter and get noise free watermarked image is shown in part six.

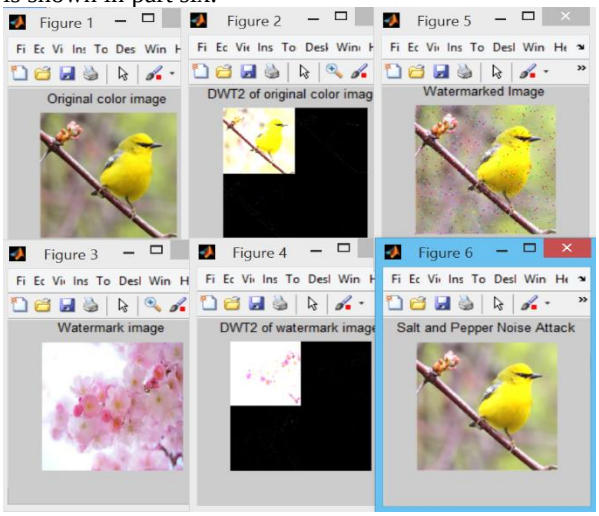

Fig 6 Experiment Image with Salt and Pepper Noise Attack

CONCLUSION

Proposed algorithm is more suitable for noisy channels and storage where watermark robustness against noise is needed. This processes selected the sub bands of Discrete Wavelet Transform which has low noise density to hide the data. However, perceptibility decreases with increase in noise, this is because of large number of pixels of cover image are effected in embedding watermark bits. The cover images that are preprocessed are decomposed into Vertical, Horizontal and Diagonal components using Discrete Wavelet Transform. The sub band which has lowest noise density is taken and it is further decomposed. This process is continued up to various levels such that noise density is equal for all sub bands. The information to hide is encoded using encryption methods. The encoded sample values are embedded directly into the sub bands which are having low noise density. It has been proved that the use of DWT-SVD with fusion method has improved the security of the watermarking scheme. Particular attention is given to the proposed scheme to guarantee secure watermark embedding and easy extraction. The watermark is imperceptible to the human eye and recoverable most of the time. The watermarked images were assessed for fidelity by using PSNR and MSE. The new techniques could offer significant advantages to the digital watermark field and provide additional benefits to the copyright protection industry. After examining the security of the scheme by applying practically some attacks are measured the robustness of the scheme by using Bit Error Rate, Normalize Absolute Error (NAE), Peak Signal to Noise Ratio (PSNR) of cover image with watermarking image are calculated.

REFERENCES

[1] Chiou-Yng Lee, Pramod Kumar Meher, Chia-Chen Fan, and Shyan-Ming Yuan, "Low-Complexity Digit-Serial Multiplier Over G F(2m) Based on Efficient Toeplitz Block Toeplitz Matrix–Vector Product Decomposition", IEEE Transactions on Very Large Scale Integration (VLSI) Systems 2016.

[2] K. Deergha Rao, Ch. Gangadhar and Praveen K Korrai, "FPGA Implementation of Complex Multiplier Using Minimum Delay Vedic Real Multiplier Architecture", IEEE Uttar Pradesh Section International Conference on Electrical, Computer and Electronics Engineering (UPCON) Indian Institute of Technology (Banaras Hindu University) Varanasi, India, Dec 9-11, 2016.

[3] Ms. S. V. Mogre and Mr. D. G. Bhalke"Implementation of High Speed Matrix Multiplier using Vedic Mathematics on FPGA", 2015 International Conference on Computing, Communication Control and Automation.

[4] Sushma R. Huddar and SudhirRao, "Novel High Speed Vedic Mathematics Multiplier using Compressors", 978-1-4673-5090-7/13/$31.00 ©2013 IEEE

[5] Franc and oisLe , "Faster Algorithms for Rectangular Matrix Multiplication", 2012 IEEE 53rd Annual Symposium on Foundations of Computer Science.

[6] S. Tugsinavisut, S. Jirayucharoensak and P. A. Beerelt, "An Asynchronous Pipeline Comparisons with Applications to DCT Matrix-vector Multiplication," in Proceedings of the 2003 International Symposium on Circuits and Systems(ISCAS), vol. 5, pp2015 International Conference on Computing Communication Control and Automation.

[7] XiaoxiaoJiang,JunTao,"Implementation of Effective Matrix Multiplication on FPGA",IEEE IC-BNMT2011

[8] Pramod Kumar Meher, "New Approach to Look-Up-Table Design and Memory-Based Realization of FIR Digital Filter," IEEE Transaction on Circuits and Systems, vol. 57, no. 3, pp. 592 - 603, 2010.

[9] J. Liu,Y. V. Zakharov, and B.Weaver, "Architecture andFPGA design of dichotomous coordinate descent algorithms," IEEE Trans. Circuits Syst. I, Reg. Papers, vol. 56, no. 11, pp. 2425–2438, Nov. 2009.

[10] M.-D. Shieh, J.-H. Chen, W.-C. Lin, and H.-H. Wu, "A new algorithm for high-speed modular multiplication design," IEEE Trans. Circuits Syst. I, Reg. Papers, vol. 56, no. 9, pp. 2009–2019, Sep. 2009.

[11] Ms. S. V. Mogre and Mr. D. G. Bhalke"Implementation of High Speed Matrix Multiplier using Vedic Mathematics on FPGA", 2015 International Conference on Computing Communication Control and Automation.

[12] Franc and ois Le , "Faster Algorithms for Rectangular Matrix Multiplication", 2012 IEEE 53rd Annual Symposium on Foundations of Computer Science Nibouche, S. Boussakta, and M. Darnell, "Pipeline

architectures for radix-2 new mersenne number transform," IEEE Trans. Circuits Syst. I, Reg. Papers, vol. 56, no. 8, pp. 1668–1680, Aug. 2009.

[13] Syed M. Qasim, Ahmed A. Telba and Abdulhameed Y. AlMazroo," FPGA Design and Implementation of Matrix Multiplier Architectures for Image and Signal Processing Applications", IJCSNS International Journal of Computer Science and Network Security, VOL.10 No.2, February 2010.

[14] Pramod Kumar Meher, "New Approach to Look-Up-Table Design and Memory-Based Realization of FIR Digital Filter," IEEE Transaction on Circuits and Systems, vol. 57, no. 3, pp. 592 - 603, 2010

[15] Pramod Kumar Meher, "Hardware-Efficient Systolization of DA-Based Calculation of Finite Digital Convolution," IEEE Transaction on Circuits and Systems, vol. 53, no. 8, pp. 707 - 711, 2006

[16] Ju-Wook Jang, Seonil B. Choi, and Viktor K. Prasanna," Energy- and Time-Efficient Matrix Multiplication on FPGAs", IEEE Transaction on Very Large Scale Integration (VLSI) Systems, vol. 13, no. 11, pp. 1305 – 1319, 2005

[17] S. Tugsinavisut, S. Jirayucharoensak and P. A. Beerelt, "An Asynchronous Pipeline Comparisons with Applications to DCT Matrix-vector Multiplication," in Proceedings of the 2003 International Symposium on Circuits and Systems(ISCAS), vol. 5, pp. V-361 - V-364, 2003.

[18] Sung- Mo Kang, Yusuf Leblebici, CMOS Digital Integrated Circuits: Analysis and Design. Tata McGraw – Hill, 2003.

[19] Amira, A. Bouridane, and P. Milligan, "Accelerating matrix product on reconfigurable hardware for signal processing," in Proceedings 11th International Conference on Field-Programmable Logic and Its Applications (FPL), pp. 101 – 111, 2001.

[20] L. Benini, G. De Micheli, E.Macii, "Designing Low-Power Circuits: Practical Recipes," IEEE Circuits and Systems Magazine, vol. 1, no. 1,pp. 6-25, 2001.

[21] K. K. Parhi, VLSI Digital Signal Processing Systems. John Wiley & Sons, Inc. 1999.

[22] O. Mencer, M. Morf, and M. J. Flynn, "PAM-Blox: High performance FPGA design for adaptive computing," in Field Programmable Custom Computing Machines (FCCM), pp. 167 – 174, 1998.

[23] M. Horowitz, T.Indermaur, R. Gonzalez, "Low Power Digital Design,"IEEE Symposium on Low Power Electronics, pp. 8-11, 1994.

[24] Pramod Kumar Meher, "Hardware-Efficient Systemization of DA-Based Calculation of Finite Digital Convolution," IEEE Transaction on Circuits and Systems, vol. 53, no. 8, pp. 707 - 711, 2006

[25] Ju-Wook Jang, Seonil B. Choi, and Viktor K. Prasanna, "Energy- and Time-Efficient Matrix Multiplication on FPGAs", IEEE Transaction on Very Large Scale Integration (VLSI) Systems, vol. 13, no. 11, pp. 1305 – 1319, 2005.