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A Review paper on Hybrid Watermarking Approach for Higher Imperceptibility and Robustness by using DWT-SVD-SWT

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Abstract: ***To achieve good imperceptibility and robustness, a hybrid image watermarking algorithm based on discrete wavelet transform (DWT) and singular value decomposition (SVD) is proposed using the characteristics of human visual system model for copyright protection and authenticity. In the proposed watermarking process, one level DWT is applied to selected image blocks to obtain four sub-bands of each block and then the SVD is also used for selection of singular coefficient for embedding the data. Stationery wavelet transform (SWT) is also known as "Un-decimated wavelet transform" introduced as a enhance technique for better imperceptibility and higher robustness. The experimental results show model based hybrid image watermarking scheme is imperceptible and robust against several image processing operations like JPEG compression, median filtering, sharpening, cropping and addition of Gaussian noise. Peak signal to noise ratio (PSNR) and bit correction rate (BCR) are used to measure the quality of watermarked image and extracted watermark respectively.***

Keywords: Discrete wavelet transforms, Singular value decomposition, Stationery wavelet transform, PSNR, BCR, Copyright protection, Robustness.

I. INTRODUCTION

Digital watermark insertion is in the specific domain, i.e. either in the spatial domain or the transform domain. The diversity in these domains is that, in case of spatial domain the embedding of the watermark is a straightforward method. The spatial-domain components of the original image are embedded with the digital watermark; due to the straightforward acting behaviour the spatial domain has a low complexity and easy implementation as its plus points. But on the contrary, spatial domain method is not immune to image processing operations and other attacks.

Whereas, the transform domain (frequency domain) carries the embedding of the watermark by modulating the magnitude of the coefficients of the image in the desired transform domain, for instance: discrete cosine transform (DCT), discrete wavelet transform (DWT), and singular value decomposition (SVD).The positives of a transform domain is its ability to yield maximum information after embedding the watermark and improved robustness against various attacks, but it has a flaw of increased computational cost in comparison to spatial-domain.

On taking into account the DWT, it has its spatial frequency localization property which sectors the entire image into different frequency coefficients and the areas where the watermark can be embedded imperceptibly are easily accessible. SVD has a mathematical property where minute amendments in the singular values do not cause much havoc on the visual perception of the cover image, thereby improving the robustness and transparency.[6]

The paper is organized as follows: Section II gives a review of Hybrid Semi-Blind Gray Scale Image Watermarking Algorithm and Robust Digital Watermarking for Coloured Image Using SVD-DWT technique and Hybrid Block Based DWT-DCT-SVD Techniques. In Section III, Contains introduction of Efficient Hybrid Watermarking Approach Based on SVD-

DWT-BPNN, Section IV, Contains another research on multiple watermarks algorithm for Image content authentication. Section V, Define the Enhance Technique of Watermark Approach and Section VI, Define Conclusion of this paper.

II. HYBRID SEMI-BLIND GRAY SCALE IMAGE WATERMARKING ALGORITHM

In 2013, **Rajesh Mehta, Navin Rajpal**..[1]**HYBRID SEMI-BLIND GRAY SCALE IMAGE WATERMARKING ALGORITHM**, it presents the watermarking algorithm based on DWT and SVD using Human Visual System Model. The method makes use of scaling and transformation characteristics of wavelet domain for obtaining the low-frequency subband with different threshold values.Robustness of the proposed algorithm is verified by the extraction of watermark against image operations such as addition of noise.DWT and SVD combined approach used to determine the Signal Analysis and also used the characteristic of Human Visual.watermarking algorithm on different textures of gray scale images of size 512*512 like Lena ,pepper, using Matlab platform. The results of two gray scale host images Lena and pepper are presented and a comparison is made to prove the superiority.PSNR(peak signal-to-noise ratio) to achieving high Imperceptibility and Robustness by Comparising.The Extracted Image With including Various Operations (1)Sharping.(2)GaussionNoise.(3)Compression.(4) Cropping shown in TABLE-1.By testing with **BCR** (Bet Correlation ratio) to achieve higher visual Quality.To Select low Frequency Band for embedding Image as well as Extraction algorith for Better capacity of hiding the image and trasmission of maximum data.We are consider the threshold values (1)T=0.002(2)T=0.012(3)T=0.04 shown in TABLE-2.

PSNR=10 $\log_{10}$ (R^2/MSE)

Where R is the maximum fluctuation of pixels and MSE(mean square error) of images and helps in easy analysis of the image degradations and variations being caused on the image by comparing the peaking pixel values.

Attacks	Lena.bmp (watermarked image)BCR	BCR	Pepper.bmp(watermark after extraction) BCR	BCR
GaussionNoise.	0.5928	0.6572	0.5908	0.6162
Sharping.	0.9990	0.9990	0.9316	0.9678
Cropping	0.8476	0.9268	0.7969	0.9033

TABLE 1-: Image Processing Operation

Threshold	Lena.bmp (watermarked image)PSNR	PSNR	Pepper.bmp(watermark after extraction) PSNR	PSNR
0.002	61.69	62.0861	56.20	60.0818
0.012	49.34	52.2112	50.20	52.1603
0.04	38.51	42.0212	39.61	42.4164

TABLE 2-: Comparison PSNR including different threshold value

Advantage

1. The algorithm achieves good imperceptibility and robustness.
2. Higher Visibility to human eye by higher PSNR and BCR.
3. Extracted Image from LL is also acceptable with Visual quality.

In 2014,**Preeti Sharma,Tapan Jain**[2], Robust Digital Watermarking for Coloured Image Using SVD-DWT technique presents hybrid watermarking scheme using SVD and DWT has been introduced, where the watermark is embedded in the singular values of the red component of the cover image's DWT sub-bands and then combined with the other two i.e. green and blue components to yield the watermarked image. The methods adopted fully exploit the features of the SVD and DWT

transform. The intrinsic algebraic properties of the image represented by SVD and the spatio-frequency localization of DWT are well utilized. Experimental results are made available which depict the improved imperceptibility and robustness under attacks and preserve copyrights by using this technique.

Advantage

1. The algorithm achieves good imperceptibility and robustness.
2. Higher Visibility to human eye by higher PSNR and BCS.
3. Extracted Image from LL is also acceptable with Visual quality.

In the Fig. 1 illustrates the PSNR of the extracted image, and of the watermarked image. It is clear from the presented graph that the robustness of the watermark is maintained at a perpetually high level.

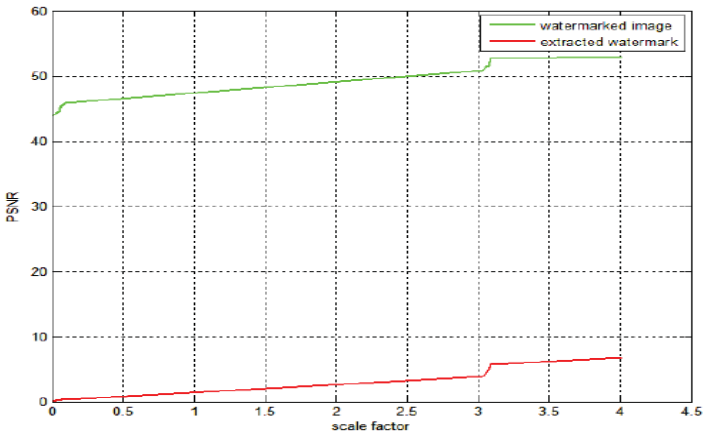

Figure:1. PSNR of the Watermarked Image and Extracted Watermark

V.Shanti, N.Rekha, S.Tharini are with VIT University, Vellore [3]**,** This algorithm combines the properties of DWT, DCT and SVD. DWT is used to decompose the original image in to four band of frequency. DCT technique is applied on each band to collect significant coefficients in which watermark is to be hidden. SVD technique is applied to the watermark and it is hidden into the host image by adding the singular values of host image and singular values of watermark. In this algorithm watermark is added to the SV□s of whole image, which may lost due to attacks. To avoid this disadvantage, we propose an approach in which DWT coefficients are converted into 4×4 blocks. Each block is DCT transformed followed by SVD to get singular values of each block. Maximum Singular value is extracted from each block to form a new matrix called singular block. SVD is applied to the singular block to embed the watermark. **The three main properties of SVD from the view point of image processing applications.**(1)The singular values of an image have very good stability, that is, when a small perturbation is added to an image, its singular values do not change significantly.(2)Each Singular value specifies the luminance of an image layer while the corresponding pair of singular vectors specifies the geometry of the image.(3)Singular values represent intrinsic algebraic properties. Thus based on applications low, middle or high frequency band is selected for hiding watermark. Algorithm outperforms in YIQ color space rather than RGB color space.

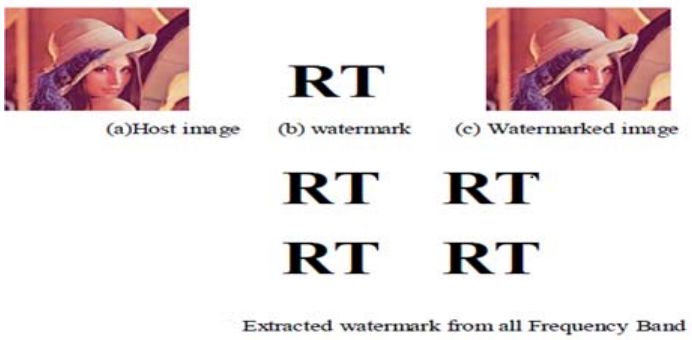

Figure:2-Extracted Watermark from all frequency band

III. Efficient Watermarking Approach by using SVD-DWT-BPNN

In 2014,Hemraj Saini, Department of computer science and engineering [4]. Proposed a combined DWT and SVD methods for watermark embedding. As the DWT has high compression efficiency and lossless encoding can be done it is used in place of DCT.The watermark extraction is done with the help of the **Back Propagation Neural Network** (BPNN). The BPNN is a powerful learning tool based on the structure of neuron. BPNN is utilized to establish the relationship among the singular values of original image, attacked image and watermarked image. BPNN is to be used to establish a relationship among the singular values of original image, attacked image and extracted watermark image.

Advantages

1. High compression efficiency
2. Error resilience and lossless color transformations
3. Lossless encoding
4. Embedded lossy to lossless encoding

IV. A Multiple Watermarks Algorithms for Content Authentication

In CAI Li-jun,Li Rui, YI Ye-qung[5]**..**This paper proposed a method for image content authentication. The method is on multiple watermarks cooperative authentication algorithm. Initially the multiple feature selection is done from the image features. The attacks on the image can be done to change the content of the image or it may get accidentally changed. The algorithm is performed to identify the tampering as well as content of image that was tampered. These selected features are combined together for complete tampering location so that the change in image content can be detected easily. The image embedding and extraction is done without any help of other means for embedding. Hence, the no additional information is required while authenticating the image contents, thereby, the security and safety of the system gets enhanced.

Advantages

1. The problem of watermarking influencing the authentication is resolved.
2. The system has enhanced safety and security.

V. Enhance Technique of Watermark Approach

We have conclude that embedding of watermark in transform domain is such as Discrete Wavelet Transform (DWT), Singular Value Decomposition (SVD) and Fourier Transform (FT) has ability to maximize the information and improve robustness against attack but these methods suffer from some problem like DWT is not a time invariant transform i.e., with the periodic signal extension, the translated version of the signal is not exact. In SVD, the singular values volumes to the robustness of the image. Any perturbation added to the image increases time computation. We can use Stationery wavelet transform (SWT) as an enhance technique instant of DWT,DCT,SVD.SWT is better technique which is used for overcome the disadvantages of DWT. In Embedding Phase the image is decomposed into the sub bands with SWT. Here, the LL (Low-Low sub band) is considered for embedding as this band contains more information. The selection of the bits for the embedding is done randomly .In Encryption Phase two positive integers are obtained. These values help in embedding procedure. With unique coefficient value the embedding procedure is repeated until the unique value exists. In Extraction Phase the watermarked image is fed with the unique integer value. The SWT is again performed to get the LL sub band .The XOR is performed with the bit and the key value for obtaining the watermark.

VI. Conclusion

In the Image Watermarking, the practical implementation of image with respect to embedding the watermark into cover image by using DWT and SVD which are most important part to achieve higher imperceptibility, security, better visibility. Now the different image processing operation apply on watermarked image even after using stationery wavelet transfer SWT (Un-decimated wavelet transform) method and compare the original watermark image and extracted watermark image and determine the degradation of image even after extraction process by testing some parameters. Compare all the methods they give the accurate results. SWT is use as an enhance technique of DWT. Un-decimated Wavelet Transform is used to overcome the lack of time invariant with the analysis of signal. After Extracting Watermarked Image, Result of Watermark image will give maximum hidden Information also achieves Higher Robustness and Better Visual Quality.

Image similarity measures were used to measure the efficiency of the algorithms. And lastly different image quality metrics reviewed as measure the original image and extracted watermark image.

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Solanki Shital D, received the B.E. degree in Computer Engineering from Sigma Institute of Engineering, Gujarat Technological University in 2013.

Currently she is doing her M.E. Degree from Parul Institute of Technology of Gujarat Technological University and her interesting area of research is in Image Watermarking which is refer as a sub-area of Image Processing.

