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An Improved Image Watermarking Approach based on Un-decimated Wavelet Transform and Residual Number System

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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 transform, 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]

II. REVIEWED PAPER

Table 1. Summary of Reviewed paper

Papers	Techniques	Conclusion
A Hybrid Semi-Blind Gray Scale Image Watermarking Algorithm Based on DWT-SVD using Human Visual System Model .[1]	▪ Semi-blind watermarking scheme ▪ Copyright, ▪ Human visual Model ▪ DWT-SVD combine method	▪ Higher Inperceptibility ▪ Robustness ▪ LL sub-band used for embedding watermark. Higher PSNR-BCR
Robust Digital Watermarking for Colored Images using SVD and DWT Technique.[2]	▪ Authentication, ▪ Copyright Protection, ▪ Spatial –Transform Domain, ▪ DWT-SVD Schema	▪ PSNR-Maximum Fluctuation of Pixels with MSE.(Similarity of extracted watermark with original watermark image)
A Hybrid Block Based Watermarking Algorithm using DWT-DCT-SVD Techniques for	▪ DCT, ▪ Arnold Transform, ▪ DWT-DCT-SVD	▪ watermark is reversible without any image loss ▪ SVD →real matrix

Color Images. [3]	Combination. ▪ PSNR, ▪ MSE, ▪ NC.	representing the luminance value of the image.
Efficient hybrid Watermarking Approach by Using SVD, DWT, and Back Propagation Neural Network.[4]	▪ Multiple watermarks cooperative authentication algorithm. ▪ Safety. ▪ Security.	▪ Authentication . ▪ To determine the malicious tampering value & Forgery. Changes must be find by location

III. RELATED WORK

In Existing work 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.[5]

3.1 SWT(un-decimated wavelet transform) as an Enhance Approach.

- PSNR is improved since SWT is designed to overcome the lack of translation invariance of DWT.
- SWT,translation-invariance is achieved by removing the down-samplers and up-samplers by inserting zeros in filter.
- SWT is an inherently redundant scheme as output of each level of SWT contains the same number of samples as input.

3.2 Residual number system

→Ex=5,3,2 for instance ,if the no 8 is divided by base 5 ,the residue is 3.

[2,1,1] represents decimal value no 7.

R5=7 mod 5=2 (calculation)

R3=7 mod 3=1

R2=7 mod 2=1

N	Residue to base 5	3	2	N	Residue to base 5	3	2
0	0	0	0	10	0	1	0
1	1	1	1	11	1	2	1
2	2	2	0	12	2	0	0
3	3	0	1	13	3	1	1
4	4	1	0	14	4	2	0
5	0	2	1	15	0	0	1
6	1	0	0	16	1	1	0
7	2	1	1	17	2	2	1
8	3	2	0	18	3	0	0
9	4	0	1	19	4	1	1

Table 1: Residual number system

IV. PROBLEM DEFINITION

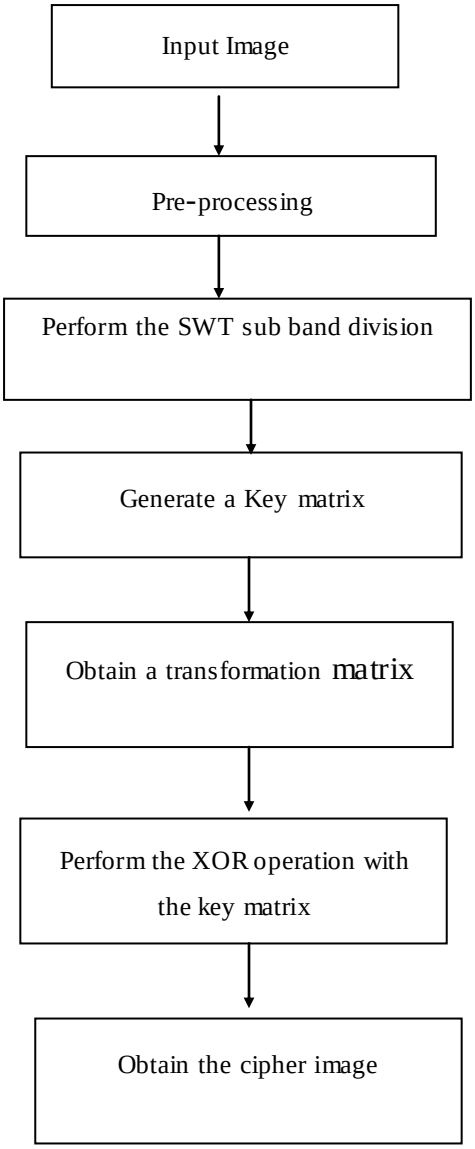
- The DWT is not a time invariant transform i.e., with the periodic signal extension, the translated version of the signal is not exact.
- FT does not provide any information regarding time localization of the components.
- In SVD, the singular values volumes to the robustness of the image and increases time computation.
- Classical DWT is not shift invariant: This means that DWT of a translated version of a signal x is not the same as the DWT of the original signal.

V. PROPOSED METHODOLOGY

5.1. Methodology

The image pre-processing is done by removing the noise present in the image using the median filter. The processed image is decomposed into four subbands namely Low-Low sub band, Low-High sub band, High-Low Sub band and High-High sub band. The filters are sub sampled at each level of decomposition. DWT is not translation invariant which leads to block artifacts and aliasing during the fusion process between the wavelet coefficients. In the SWT scheme the output signals at each stage are redundant because there is no signal down-sampling; insertion of zeros between taps of the filters are used instead of decimation. The encryption process is carried out with the modulo operation on the obtained image. The image is partitioned into defined row X column matrices. The transformation matrix is multiplied with these image matrices to obtain cipher image matrix.

Now, the flow of proposed work is given in below:



VI. IMPLEMENTATION METHODOLOGY

5.1 Performance Evaluation Parameter:

For evolution of algorithm, visual quality is the best parameter still we have chosen PSNR and MSE as parameter to evaluate algorithm.

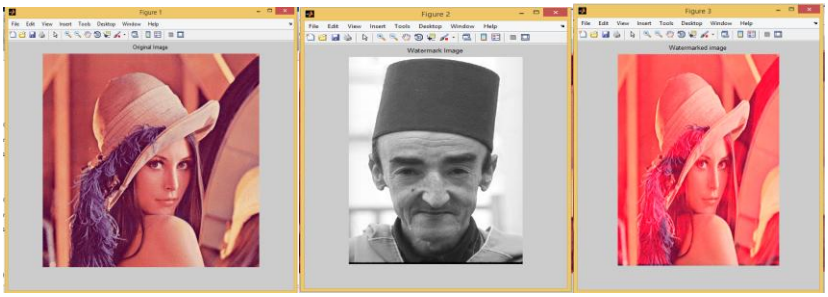
The term peak signal-to-noise ratio (PSNR) is an expression for the ratio between maximum possible value (power) of a signal and the power of distorting noise that affects the quality of its representation. The PSNR is usually expressed in terms of the logarithmic decibel scale.

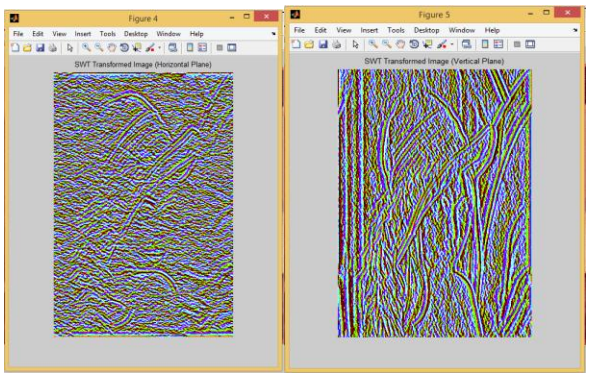
Image enhancement or improving the visual quality of a digital image can be subjective. It is necessary to establish quantitative/empirical measures to compare the effects of image algorithms on image quality.

- The mathematical representation of the PSNR is as follow:

$$PSNR = 20.\log_{10}\left(\frac{\mathrm{MAX}_I^2}{\sqrt{MSE}}\right)$$

RESULTS





In Existing approach I achieved low PSNR value (5.33) and with using SWT we can achieve higher PSNR value (8.55)

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 achieve 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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