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An Efficient Implementation of IWT-DCT-SVD for Copyright Protection in Digital Watermarking Algorithm

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Abstract-Digital Watermarking is utilized to mask the information identical to text, picture, video, multimedia within itself and also it protects the possessor of the signal which is being set up by the unlawful distribution and duplication. A combination of IWT, SVD and DCT is proposed to preserve replication of signals successfully and used for Digital Watermarking pictures and improving image protection SVD is submitted to approximate and the vertical coefficient of Wavelet Transform. The Investigational outcome shows that the IWT-DCT-SVD algorithm yields better imperceptibility for images and imparts watermarked images with acceptable condition.

Keywords: Watermarking, DCT, SVD, IWT

I. INTRODUCTION

In current scenario, the significance of protecting the digital multimedia data from illicit issues turns into most considerable [1]. The technology of Watermarking is used to solve the issues like message hiding, copyright guarding, evidence possession and so on in both spatial domain and transform domain [2].In transform domain basic transforms are used DCT, DWT, SVD and their cross relation [3]. Before the growth of watermarking in digital pictures, it was very challenging to achieve a message hiding, copyright guarding and evidence possession and it's simple in current status using Watermarking techniques [4]. Watermarking scheme includes embedding and extraction process. Watermarking technique has main two parameters of robustness and imperceptibility [5] and it is applied to the various domains and techniques [6].

II. LITERATURE SURVEY

The properties of robustness and security of [7], Digital Watermarking systems are discussed in the article [8]. DCT-based systems are popularly used [9]. Various non-geometric strategies like JPEG compression and filtering and also some geometric distortions are reviewed as robust watermarking [10]. Wavelet-based Contour let Transform (WBCT) is implemented using new adaptive robust watermarking algorithm and conventional transform domain methods for non-redundant contour let transform [11]. The DWT divides an image into a lower resolution approximation image (LL), horizontal (HL), vertical (LH) and diagonal (HH) detail components [12]. SVD based and DCT-DWT oriented digital watermarking method is deliberated to accomplish high robustness against JPEG compression [13]. A DWT-DCT-SVD watermarking algorithm is analysed [15]. Image watermarking scheme based on SVD-IWT which results in high robustness and varying scaling factors [19]. 4D Wavelet Transform discussed with robust light field watermarking techniques which achieves good robustness [20]. CKGSA discussed using SVD-DCT algorithm for watermarking [21].

III. EVALUATION OF WATERMARKING METHODS

(a)Robustness: The alikeness among the extracted watermark and original watermark from the assaulted watermarked Image was calculated by using the correlation factor [14], which is calculated using the following Equation (1)and number of pixels in watermark is N and $\hat{W}$ and correlation factor ρ assigned with -1to 1[15].

$$\rho(w,\widetilde{w}) = \frac{\sum_{i=1}^{N} w_i \widetilde{w_i}}{\sqrt{\sum_{i=1}^{N} w_i^2}\sqrt{\sum_{i=1}^{N} \widetilde{w}_i^2}} \quad (1)$$

(b)Imperceptibility**:** It is tested through judging the original and watermarked image.

(c)Mean Squared Error (MSE):

$$MSE = \frac{\sum_{i=0}^{M-1}\sum_{j=0}^{N-1}[I_1(i,j)-I_2^{'}(i,j)]^2}{MXN} \quad (2)$$

(d)Peak Signal to Noise Ratio (PSNR): PSNR is used to verify the dissimilarity among two images. Equation (3) displays the method to obtain it.

$$PSNR = 10log_{10}\left(\frac{255^2}{MSE}\right) \quad (3)$$

IV. IMPLEMENTATION OF ALGORITHM

Significant advantages of combination of DWT-DCT- SVD are used in Mat Lab [16]. Using DCT, SVD and the decomposition standard implemented in the manuscript, they embed sub-image having low-frequency and the three high frequency sub images obtained watermarking image into those of the original image adaptively [17]. The step by step method is conversed in 2 sections as Watermark Embedding Procedure and Watermark extraction.

Discrete Wavelet Transform:

The Wavelet transform implementation is DWT utilizing a translations and discrete set of the wavelet scales.

$$\phi(x) = \sum_{k=-\infty}^{\infty} a_k \phi(Sx-k) \quad (4)$$

S is Scaling factor. The scaling function represented as,

$$\int_{-\infty}^{\infty} \phi(x)\,\phi(x+l)\,\mathrm{d}x = \delta_{0,l} \quad (5)$$

Discrete Cosine Transform:

A 2D DCT can be computed as two separate one-dimensional transforms. The normal equation for 2DDCT is defined,

$$C(u,v) = \alpha(u)\alpha(v)\sum_{x=0}^{N-1}\sum_{y=0}^{N-1} f(x,y)cos\left[\frac{(2x+1)u\pi}{2N}\right]cos\left[\frac{(2y+1)v\pi}{2N}\right] (6)$$

Foru,v = 0,1,2,3…N,

$$\alpha(u) = \begin{cases} \frac{1}{\sqrt{2}} & u = 0 \\ 1 & u = 1,2,..N-1 \end{cases} \quad (7)$$

$$\alpha(v) = \begin{cases} \frac{1}{\sqrt{2}} & v = 0 \\ 1 & v = 1,2,..N-1 \end{cases} \quad (8)$$

Singular Value Decomposition:

$$A=USV^T \quad (9)$$

Here m x n matrix is represented as A. An invertible matrix is

$$(A)^{-} = VD^{-}U\ T \quad (10)$$

Watermark Embedding and Extraction

Watermark embedding flow chart is shown in figure 1and figure 2 displays the flow chart for watermark extraction process as shown below. The objective of the watermark extraction is to obtain the estimate of the watermark. For watermark extraction, [18] original reference and watermarked images, left and right singular vectors must be available at the receiver end. Figure 1shows the watermark embedding flow chart. The objective of the watermark extraction is to obtain the estimate of the watermark. For watermark extraction, original reference and watermarked images, left and right singular vectors must be valuable at the receiver end.

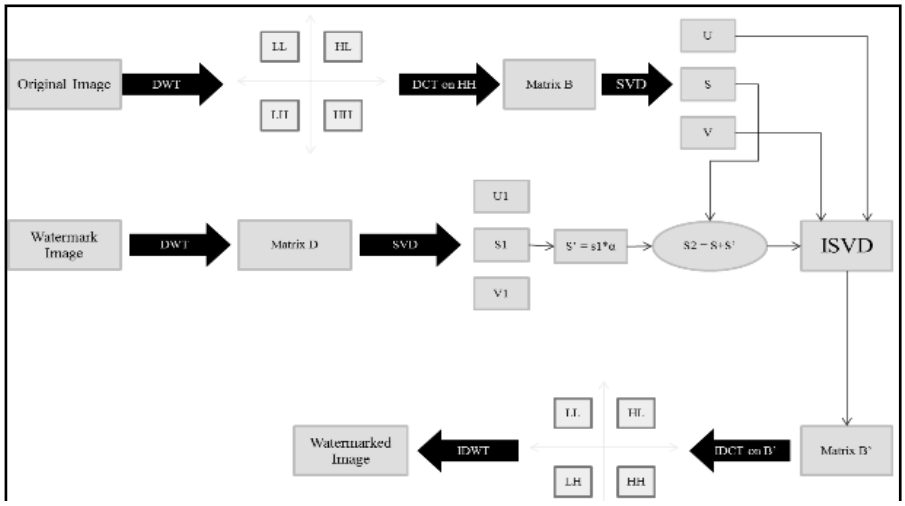


Figure 1. Watermark Embedding-Flow Chart

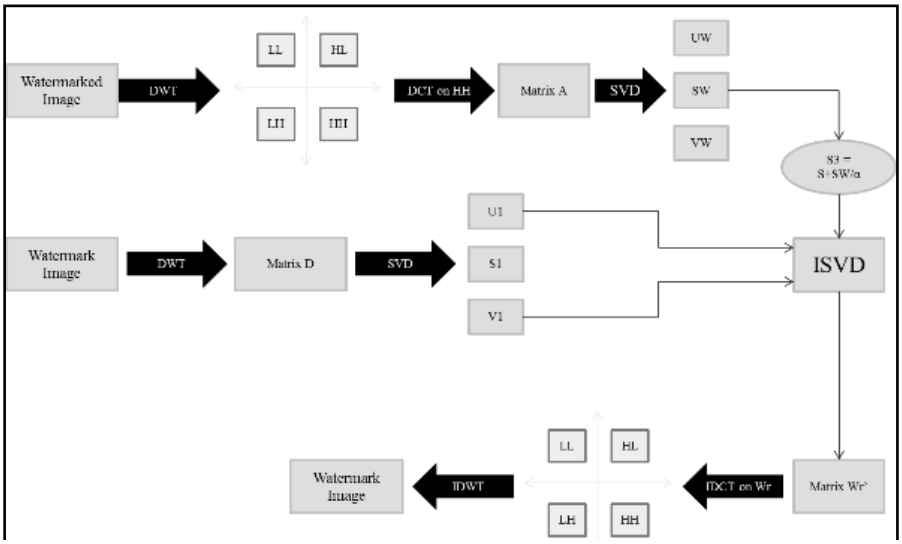
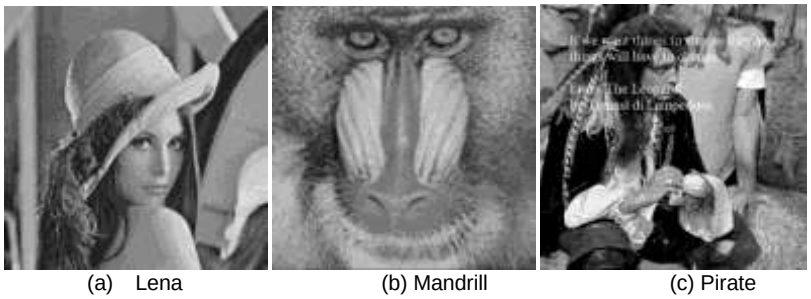


Figure 2. Watermark Extraction-Flow Chart

V. RESULTS & DISCUSSIONS

The existing algorithms efficiency is checked by different images size using MATLAB 14.0.Results are displayed with 512 x 512 Gray images "LENA", "MANDRILL" & "PIRATE" as cover image and 256 x 256 gray scale cameraman images as watermark image.



(a) Lena (b) Mandrill (c) Pirate

Figure 3. Cover images

Figure 4. Watermark image-Camera

Figure 5(a). 2 Level DWT applied on Cover (Lena+ Cameraman)

Figure 5(b). 2 Level DWT applied on Water Marked) (Lena + Cameraman)

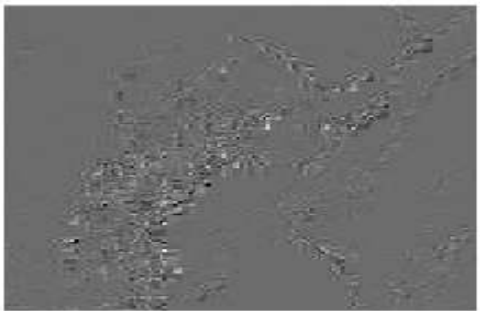


Figure 5(c). DCT coefficients image representations (Lena + Cameraman)

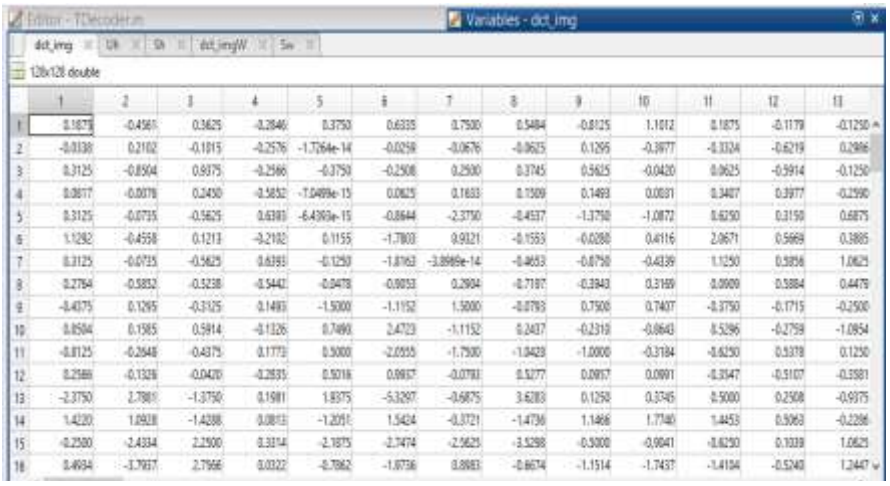


Figure 6. (a) The matrix representations of DCT Coefficients (Lena + Cameraman)

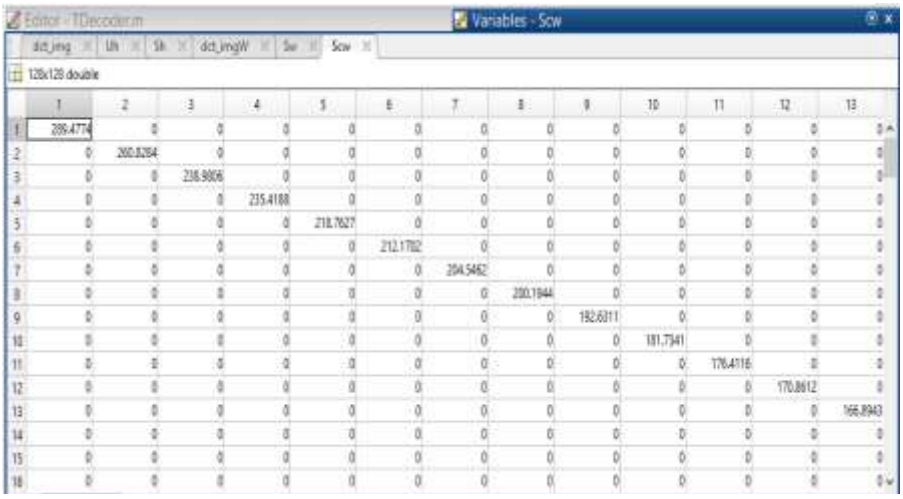


Figure 6. (b) SVD output diagonal matrix representations (Cameraman Image)

Figure 7. Water Mark Extracted Image (Cameraman Image)

Table 1. Result of existing algorithm for Normalized Cross Correlation (NCC) value for different attacks and PSNR value for watermark embedding

Attacks	Lena
PSNR	56.7783
	NC
Mean	0.9760
Median	0.9940
Noise (Salt & Pepper)	0.9982
Rotation	0.9959
Shear	0.9986
Cropping	0.9489
Contrast Adjust	0.9850
Histogram	0.9744
Gamma Correction 0.8	0.9972
Gamma Correction 1.2	0.9983

Figure 3 displays the cover images of Lena, Mandrill & Pirate. Figure 4 displays the Watermark image as Cameraman. Figure 5(a) displays the 2 Level DWT on Cover image (Lena), Figure 5(b) displays the 2 Level DWT on Water Marked Image (Lena + Cameraman) and Figure 5(c) displays the DCT coefficients image representations (Lena + Cameraman).From the encoder output is taken as an input for the decoder part.

The Level – 1 DWT is applied to the encoder image from those results, consider LL band for further process and apply for that LL band to Level-2 DWT. The level -1 and level-2 DWT results are shown in Figure 5(a) & Figure 5(b) respectively. Figure 6(a) displays the matrix representations of DCT Coefficients (Lena + Cameraman) and Figure 6(b) displays the SVD output diagonal matrix representations (Cameraman Image).

From the DCT coefficient matrix consider for SVD operation. The SVD matrix values are shown in Figure 6(b). Figure 7 displays the Water Mark Extracted Image (Cameraman Image). As per the algorithm, HH band frequencies are extracted from watermark embedded step and the watermark embedded image is obtained after doing inverse DWT and inverse DCT. From the existing algorithm steps, the Water Marked Image (~Cameraman) as shown in Figure 7. Table 1 displays the list of attacks listed as Mean, Median, Noise (Salt & Pepper), Rotation, Shear, Cropping, Contrast adjust, Histogram, Gamma correction 0.8 & Gamma correction 1.2.

VI. CONCLUSION

In this manuscript, two watermarking algorithms were processed using DWT, DCT, SVD, IWT cross combination in many digital image watermarking. Using DCT block, Watermarking is embedded into the mid band of frequency Wavelet transformation domain and prior to embedding the watermark image, DCT is applied for progressing the quality and robustness of the watermarked image is good in terms of perceptibility. In further development, the deliberated technique can be applied on both colour and gray images which provides greater improvement in PSNR and NCC in contrast with existing methods. Also, testing has been done for every single one listed attacks and for NCC value

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