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Performance Evaluation of Watermark ImageQuality by Using DCT with Arnold transform

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Abstract: Digital watermarking Technique utilized to avoid Illegal copy as well as replication with in digital media. The fast growth of World Wide Webhas created easier to deliver the data/image correct and quicker to the desired destination.The major problem in hypermedia technology is attacks on digital watermarking.In digital watermarking single attack on a given watermark image has effective outcome but multiple attacks on a given watermarked image and other watermark scrambling need to be improved. This paper evaluates a new watermarking technique using integrated approach of DCT, DWT and SVDwith Arnold Transform The proposed algorithm enhanced imperceptibility and robustness in the watermarked image which shows that the improvement in the visual quality of watermark image as well maintains theaccuracy in it.

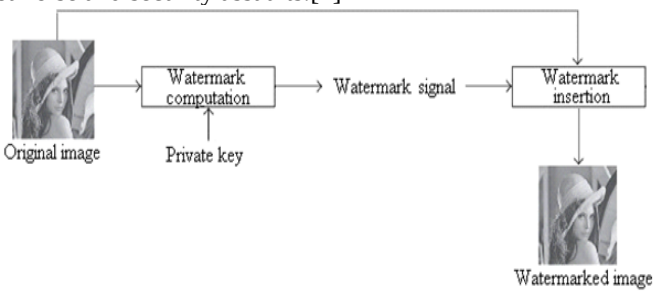
Key Words: Watermarking; Watermarking Techniques;DCT; SVD;DWT; Arnold Transform;

I. INTRODUCTION

The objective of digital watermarksto give copyright security with regarding intellectualasset that isinan electronic format. The actual information/logo is usuallyinsert into the image is named as digital image watermark. Digital image watermarking technique providesperceptibility**.**Digital Image Watermarking is prominent approach thatprovides solution to material authentication issues and digital delivery of information [1].

A.Watermarking process

The watermark is inserted into the original image .It begins with watermark computation done by using watermarking algorithms (spatial and frequency domain) and develops their corresponding private key then watermark is embed into cover image and new image formed called watermarked image an on the other side watermark is extracted by using corresponding public key. Hence the digital image watermarking techniques needs to be resistantagainst noise and security assaults.[1]



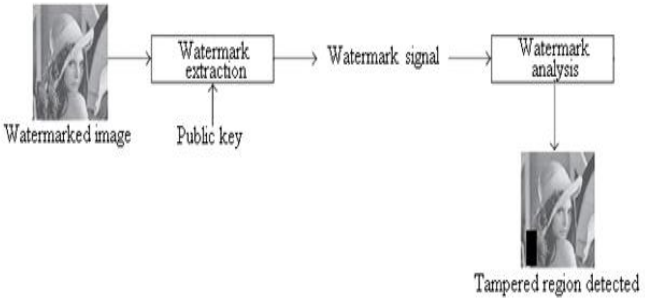


Figure 1: embedding and extraction process of watermarking

B.Watermarking Techniques

Several watermarking techniques are available:

1. Discrete Cosine Transform (DCT)
2. Arnold Transformation

1**.** Discrete CosineTransform (DCT)

DCT converts or switches a signal from spatial domain into a frequency domain. DCT is real-valued and offers a much better approximation of a signal with few coefficients. This process reduces how big the conventional equations by discarding higher volume DCT coefficients. Essential structural information is contained in the reduced volume DCT coefficients. Thus, breaking up the high-frequency DCT coefficient and using the lighting advancement in the low–volume DCT coefficient, it'll acquire and cover the edge information from satellite images. The increased picture is reconstructed by utilizing inverse DCT and it is likely to be sharper with excellent contrast. DCT is popularly used in information pressure techniques such as for example JPEG and MPEG **[4].**

2. **Arnold Transformation**

Image scrambling recognizes change of the photo, which improves the spatial position of the pixels as per a few standards, and makes picture distortion for the objective of security. On the off chance that the change standards and suggestions were not given, the first picture can't be remade. Important techniques for scrambling is Arnold change, miraculous change, Fractal Hilbert bend, Conway sport and Gray code change etc. Arnold change is utilized to struggle watermarking picture. This is a change proposed by Arnold in his suggestive hypothesis named cat-face transformation.

II. METHODOLGY

This part will explain the working of the recommended algorithm.

A. WATERMARKING EMBEDDING PROCESS

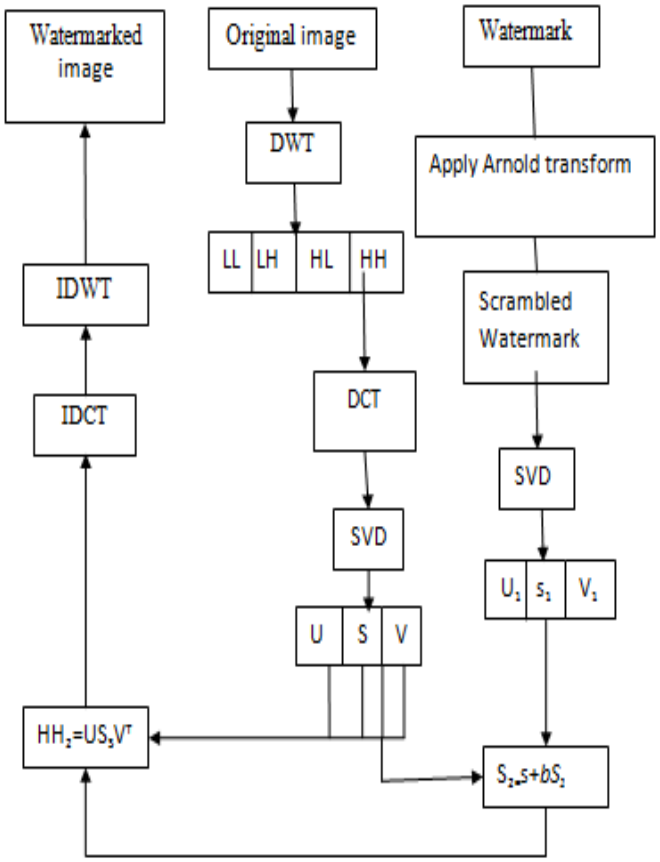


Fig2: flowchart of watermarking embedding process

B. WATERMARK EXTRACTING PROCESS

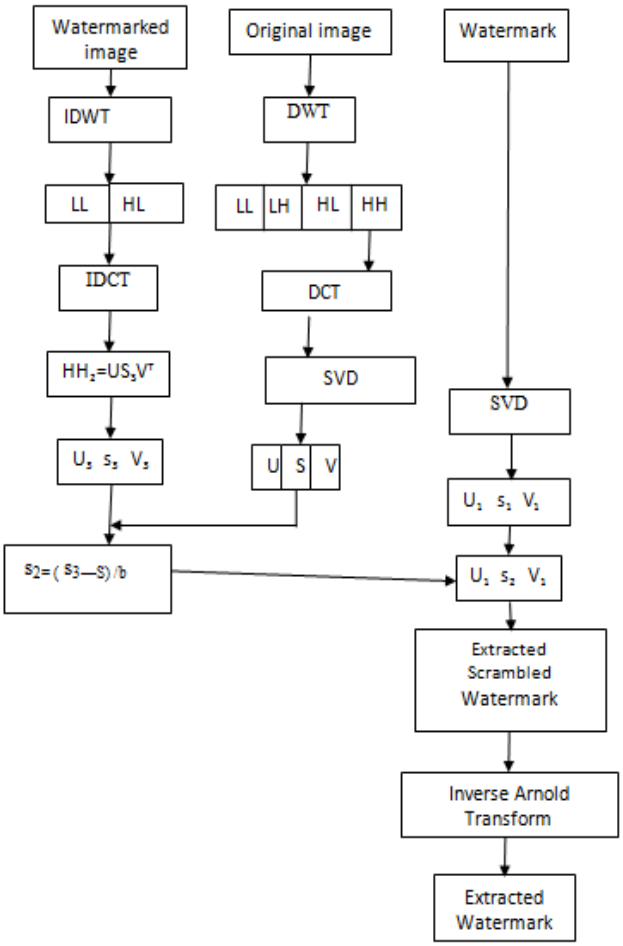


Fig3: Flowchart of the watermarking extracting technique

III. EXPERIMENTATION AND RESULTS

Applying various attacks on the watermarked image where lena picture is a cover image C1 and watermark W1 is embedded and various malicious attack applied on the watermarked image which may result into distortion in visual quality of the image but this recommended method provide immunity from various attacks with providing more imperceptibility and robustness against attacks.

Cover image C1 watermark image w1

Fig: 4(cover image and watermark image)

Now the watermark inserted to the cover image and attacks were applied.

(a) (b)

Fig: 5 **a**the AWGN, **b**the extracted watermark

(c) (d)

Fig: 6 cthe sharpening attack, **t**he extracted watermark

(e) (f)

Fig: 7 **e**the extracted watermark, **i**the histogram equalization attack

(g) (h)

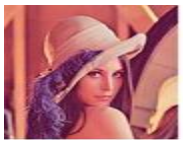


Fig:8 **g** the extracted watermark, **h** the gamma correction attack

The different attacks applied on the Lena image but it does not exploit visual quality of watermarked image and by applying extraction process obtained watermarked image without any distortion.

Multiple attacks (histogram equilization,awgn,sharpenning attack) are applied on the image.The watermark images extracted are:-

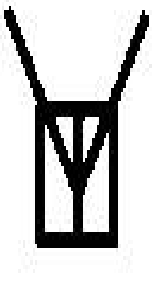


Fig:9 Existing extracted imageFig:10 Proposed extracted image

Experimental results using (225× 225) gray scale level image. Lena, peppers, baby, jeep and six more images are used as the cover images. In this paper all experiments are done over the lena image fig: 4. The experiments conducted by using (140× 138) watermark image.

The actual visible excellence of the watermarked picture is improved by applying the recommended watermarking method (DCT–DWT–SVD) in contrast to the existing watermarked image using (CZT –DWT-SVD) method.

After applying different attacks on taking ten different cover images and watermark images are computed through performance matrix.

A. PERFORMANCE ANYLYSIS

This paper has been implemented the proposed method in MATLAB tool u2013a. The recommended method is applied on different images. The algorithm is applied using various performance parameters Mean Square Error (MSE), Peak Signal to Noise Ratio (PSNR), structural similarity index matrix (SSSIM),Root mean square error(RMSE)andNormal cross correlation(NCC) for finding out the comparison between initial watermarked image and the extracted watermarked image from the attacked image. Here we also compare the proposed method against the present attacks like Sharpening Attack, AWGN Attack and Histogram Attack.

1) Mean square error

Mean square error used as measure ratio of picture excellence table. The expansive estimation of mean square guarantees that picture is a low quality. The MSE is the normal of the pixel distinction between two pictures.

$$\text{MSE} = \frac{1}{ab}\sum_{i=1}^{m}\sum_{j=1}^{n}(J_{ij} - K_{ij})^2$$

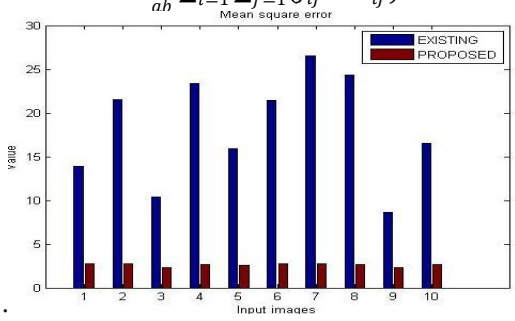


Fig 11: Mean Square error

Fig 11 shows the investigation of the mean square error of several images working with watermarking through pre –existing method (blue color) as well as watermarking with proposed method(red color).In this paper different ten cover images and watermark images are used.MSE values have been decreased which shows good quality of watermark.

2) Peak signal noise ratio

PSNR is used to estimate the imperceptibility. PSNR is utilized to gauge the corruption brought about by the watermarked impact. The PSNR, i.e. calculated within decibels characterizes the likeness between a unique picture and the reproduced picture. The greater PSNR estimations for the reproduced picture give better quality in digital watermarking.In this table different ten cover images are used whereas watermark image is same.

$$\text{R} = 10\log_{10}\frac{255^2}{MSE}.$$

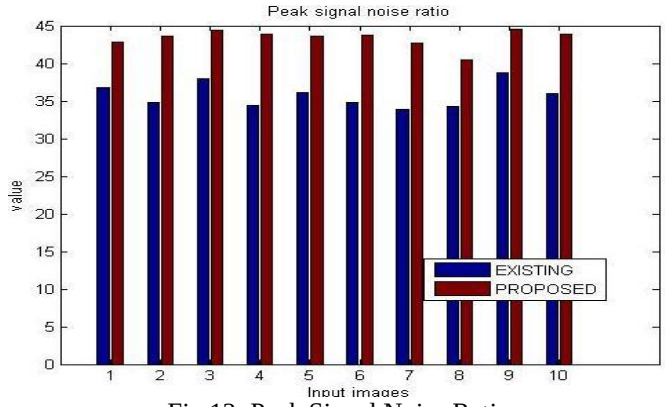


Fig 12: Peak Signal Noise Ratio

Fig 12 shows that the analysis of PSNR of several images working with watermarking through existing method (blue color) as well as watermarking with proposed method (red color). In this paper different ten cover images and watermark images are used. Have been increased which shows good quality of watermark.

3) Structural similarity index metric

The Structural Similarity Index Metric (SSIM) is a technique to compute the actuallikeness in between a pair of pictures. The actual SSIM can be regard as a high quality way of measuring among the list of pictures in contrast to, available other pictures is consider as excellent quality. TheSSIM index is actually computedon various windows associated with pictures. To evaluate in between pair of windows jand kassociated with typical dimensions N×*N* is:

SSIM (j, k) = $\frac{(2\mu_a\mu_b+c_1)(2\sigma_{ab}+c_2)}{(\mu_a{}^2+\mu_b{}^2+c_1)(\sigma_a{}^2+\sigma_b{}^2+c_2)}$.

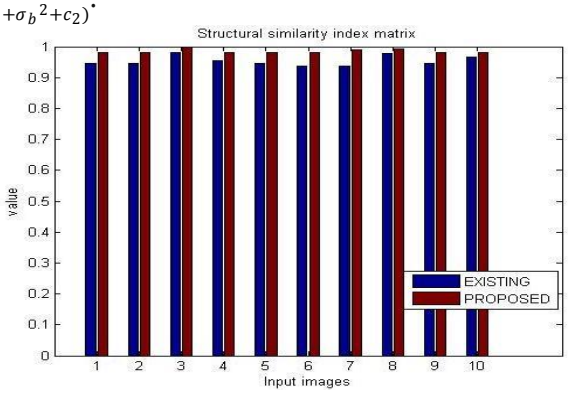


Fig: 13 structural similarity index matric

Fig 13 shows that the analysis of SSIM of several images working with watermarking through pre – existing method (blue color) as well as watermarking with proposed method (red color). In this paper different ten cover images and watermark images are used. SSIMhave been increased which shows good quality of watermark

4) Root mean square

Root Mean Square Error (RMSE) is simply employed to compute the variation in-betweenthe value (Sample and inhabitants values) estimated through a model or even an estimator and the ideals actuallycalculated. The actual RMSDassociated with an estimator $\bar{\theta}$in regarding to an approximately parameter $\mu$is described as the square root associated with the mean square error:

$$\text{RMSE } (\bar{\theta}) = \sqrt{MSE(\mu)} = \sqrt{E((\mu-\mu)^2)}$$

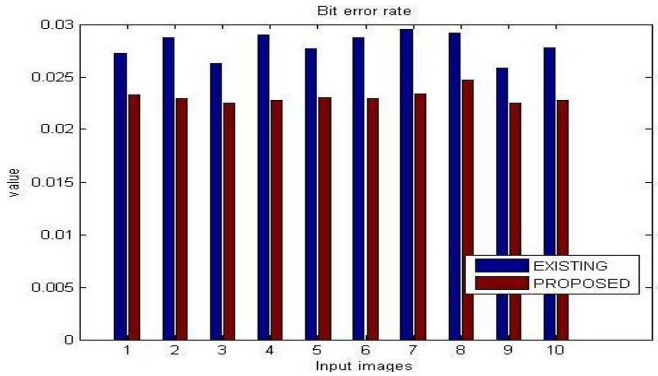


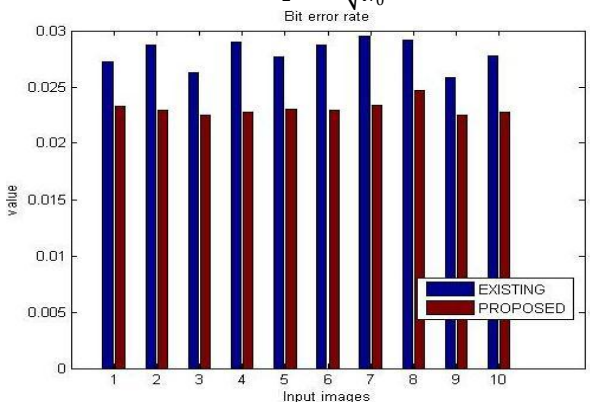
Fig: 14 root mean square error

Fig 14 shows that the analysis of RMSE of several images working with watermarking through existing method (blue color) as well as watermarking with proposed method (red color). In this paper different ten cover images and watermark images are used. Have been decreasedwhich shows good quality of watermark.

5) Bit error rate

The bit error rate (BER) is usually thequantity of bit errors for eachsystem. The bit error ratio(also BER) is actually the quantity of bit errors split through the overall amount of transmitted bits within the analyzed time period interval.

$$BER = \frac{1}{2}\text{erfc}\left(\sqrt{\frac{E_b}{N_0}}\right)$$



Fig; 15 mean square error

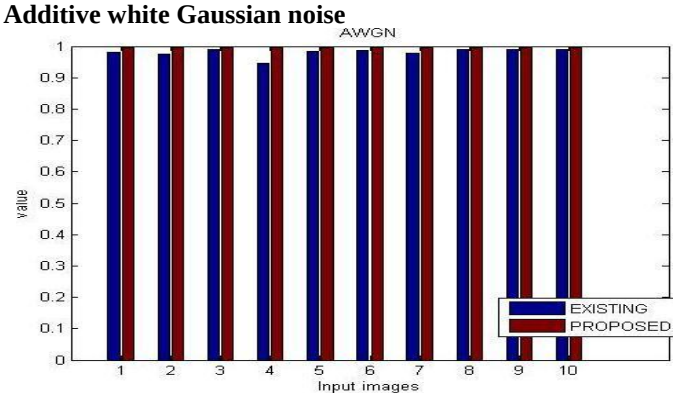
Fig 14 shows that the analysis of RMSE of several images working with watermarking through existing method (blue color) as well as watermarking with proposed method (red color). In this paper different ten cover images and watermark images are used. Have been decreased which shows good quality of watermark.

6) Normalcross correlation

Normalized cross correlation can be used to find out similarities between fused picture and registered picture is given by the following equation:

$$NCC = \sum_{i=1}^{a}\sum_{j=1}^{b}(J_{ij} * K_{ij})$$

A. NCC evaluation for Additive white Gaussian noise



Fig; 16 AWGN

It is concluded that Normalized Cross-Correlation of various images using watermarking by pre-Existing Technique (Blue Color) and watermarking by Proposed Approach (Red Color) for awgn.This growthindicates the bettervisual quality of the image

B. NCC evaluation for sharpening attack

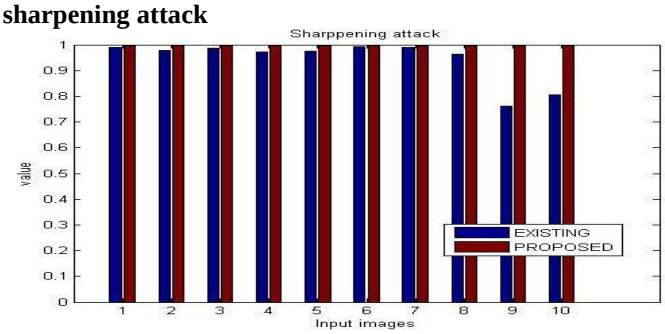


Fig: 17 sharpening attack

It is concluded that Normalized Cross-Correlation of various images using watermarking by pre-Existing Technique (Blue Color) and watermarking by Proposed Approach (Red Color) for sharpening attack.This growth indicates the bettervisual quality of the image

C. NCC evaluation for histogram equilization

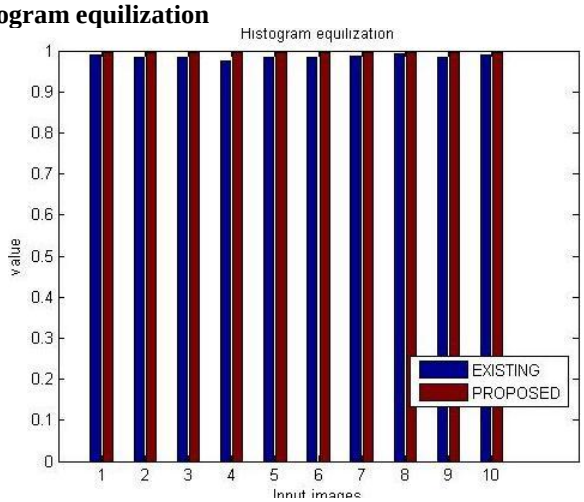


Fig:18 histogram equilization

It is concluded that Normalized Cross-Correlation of various images using watermarking by pre-Existing Technique (Blue Color) and watermarking by Proposed Approach (Red Color) for histogramequalization.This growth indicates the bettervisual quality of the image

D. Gamma correction

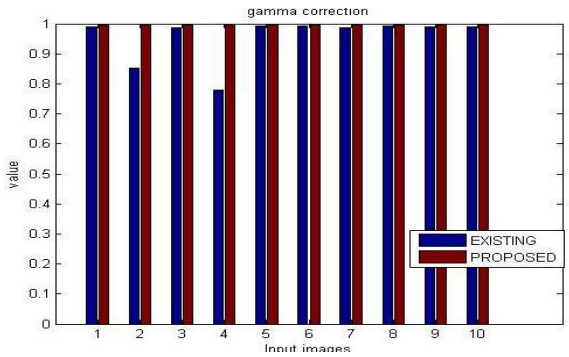


Fig: 19 gamma correction

It is concluded that Normalized Cross-Correlation of various images using watermarking by pre-Existing Technique (Blue Color) and watermarking by Proposed Approach (Red Color) for gamma correction.This growth indicates the bettervisual quality of the image

E. Multiple attacks

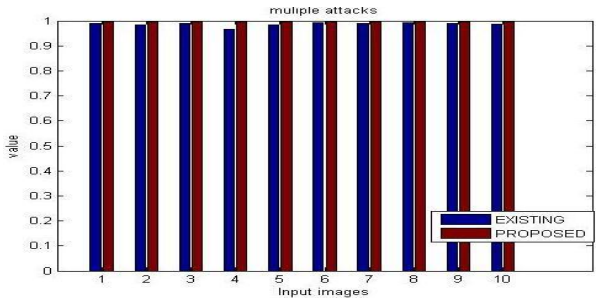


Fig 20: multipleattacks

It is concluded that Normalized Cross-Correlation of various images using watermarking by pre-Existing Technique (Blue Color) and watermarking by Proposed Approach (Red Color) for multiple attack.This growth indicates the bettervisual quality of the image

IV. CONCLUSION AND FUTURE WORK

The digital watermarking technique based on the DCT in combination with the DWT and SVD which makes the improvement in the visual quality of watermarked image.The implementation of(DCT-DWT -SVD)with the emergence of Arnold transform used for the watermarking scrambling. Soto evaluate the performance of proposed algorithm through the performance evaluation parameters(PSNR ,SSIM ,MSE ,RMSE ,BER and NCC).So implemented algorithm shows the increased value of PSNR,SSIM. Pre-existing PSNR was value (35.7372) dB and proposed value is (43.52119) db.As in near future we try to enhance the proposed watermarked algorithm further by using the contourlet transform and bcolonyinstead of DCT transform. Also SVD algorithm replaced by different image encryption techniques.

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