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Dual Transform Color Image Steganography Method

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Abstract— Steganography is that the Art and Science of concealment the knowledge and noteworthy cover media. So, as to not arouse on Eaviesdropper's suspicion. In this paper, secret image is hide into two totally different domains like as SVD (Singular value Decomposition) and DWT (Discrete wavelet Transform). the cover image and secret image DWT co-efficient values are embedded by 512*512 victimization fusion method techniques. The each domain offers safer with secret key and sure robustness of our algorithmic rule. This model provides high capacity and security. This proposed algorithm is tested with image quality parameters and compared to different algorithms. Experimental results analysed and showed that our proposed algorithm, by this method achieved high imperceptibility, were PSNR worth ranged between 45-55dB and sure robustness even many image process manipulations were performed.

Keywords— Steganography; Fusion method; DWT; SVD; Arnold Transform; Color models.

I. INTRODUCTION

Steganography, the science of secret communication, has received a lot of attention from the scientific community recently. The most goal of Steganography is especially involved with the protection of contents of the hidden data.

II. RELATED WORK

Umashankar Dewangan et al.,[1] proposed a Development and Analysis of Stego Image Using Discrete Wavelet Transform. The Experimental results showed the high invisibility of the proposed model even with large message size. Juned Ahmed Mazumder et al.,[2] proposed a A High Capacity and Secured Color Image Steganographic Technique Using Discrete Wavelet Transformation. MSE and PSNR was calculated for each of the cover and stego image and also the RGB histogram of each of the file format was analysed. The MSE and Capacity are improved with acceptable PSNR compared to the existing algorithm [3].

Yambem Jina Chanu et al.,[4] proposed a Steganography Technique based on SVD. Results of different images with values are normalized correlation (NC) and peak-signal-to-noise-ratio (PSNR. Ali Al-Ataby et al.,[5] proposed a modified high capacity image steganography technique that depends on wavelet transform with acceptable levels of imperceptibility and distortion in the cover image with high levels of overall security.

Rowayda A. Sadek et al.,[6] proposed a SVD Based Image Processing Applications: State of The Art, Contributions and Research Challenges. Experimentally examined and gave promising results compared to developed ones. Image denoising and compression were thoroughly examined and provided good results although they are image dependent. Nilanjan Dey et al., [7] proposed a Novel Approach of Color Image Hiding using RGB Color planes and DWT. In this approach the stego image generated is of acceptable level of imperceptibility and distortion compared to the cover image and the overall security is high.

This paper is organized in the following sections. Methodology is described in section III. Section IV introduced the proposed model. Testing and Performance analysis is discussed in section V. Experimental results are illustrated in section VI. Conclusion is discussed in section VII. Finally References are given in the last section.

III. METHODOLOGY

A. Preprocessing

Pre-processing strategies use a tiny low neighbourhood of an element in associate degree input image to induce a brand new brightness price within the output image. All the pixels of an image are spatial domain square measure multiplexed by embedding.

B. Arnold Transform

Image Scrambling will be dispensed through several steps to boost security levels. Arnold transform has special

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property of Arnold transform is that image involves its original state once sure range of iterations. These numbers of iterations is named 'Arnold Period' or 'Periodicity of Arnold Transform'.

C. Color models:

A Color space could be a mathematical illustration of a collection of colours True color shown in Table 1. The three most popular color models are RGB (used in computer graphics), YIQ, YUV or YCbCr (used in video system) and CMYK (used in color printing). However, none of those color areas are directly associated with the intuitive notions of hue, saturation and brightness. This result within temporary pursuit of different models, likes HIS and HSV, to modify programming, process and user manipulation.

Table1.Comparition on Color Combinations

Color	R	G	B
Block	0	0	0
White	255	255	255
Red	255	0	0
Green	0	255	0
Blue	0	0	255
Cyan	0	255	255
Magenta	255	0	255
Yellow	255	255	0

D. Singular value decomposition:

Singular value Decomposition (SVD) is one amongst variety of effective numerical analysis tools accustomed analyse matrices. In SVD transformation, a matrix may be rotten into 3 matrices that square measure constant size because the original matrix. though SVD works for any n*n matrix A, and while not loss of generality, our discussion are restricted for the n*n matrix.

E. Discrete Wavelet Transform

Wavelet transforms square measure linear and that they will be outlined by matrices of dimension n X n if they\'re applied to inputs of size n. Wavelets convert the image into a series of wavelets which will be hold on a lot of expeditiously than component blocks. DWT square measure applied to separate information sets and turn out separate outputs. DWT eliminates the `blocking' artifacts that deprive the reconstructed image of the required smoothness and continuity. Wavelets convert the image into a series of wavelets which will be hold on a lot of expeditiously than component blocks. In numerical analysis and useful analysis, a DWT any moving ridge rework that the wavelets square measure discretely sampled. like alternative moving ridge transforms, a key advantage it\'s over Fourier transforms is temporal resolution: it captures each frequency and placement info. separate moving ridge transforms map information from the time domain to the moving ridge domain. The result\'s a vector of constant size.

F. Fusion Method

Fusion will be performed on pixel, feature or call level. The complexions of pixel primarily based algorithms are lesser than alternative strategies. Image fusion provides an efficient manner of reducing this increasing volume of information whereas at identical time extracting all the helpful information from the supply pictures. In application where ever each pixel spacing and spectral properties of supply images are same or similar.

IV. PROPOSED WORK

In this section, we have a tendency to given our increased physical property and lustiness for image steganography theme with nice stego image quality and increase payload by victimization dual embedding theme. During this theme, that explores the characteristics of each the rework. The represented illustration of planned steganography encryption and decryption model was shown in fig1 and fig2.

A. Encoding process

During the statistical encoding process as shown in fig1, both cover image and secret image converting given color image to SVD. Perform DWT on cover image and DWT on secret image by using alpha blend technique. Then take inverse IDWT to get stego image.

1). Algorithm for steganography encoding process

Step 1: Select the Image from Image Database.
Step 2: The Selected Image is a Cover Image, and checks with size, contrast, brightness and etc.,

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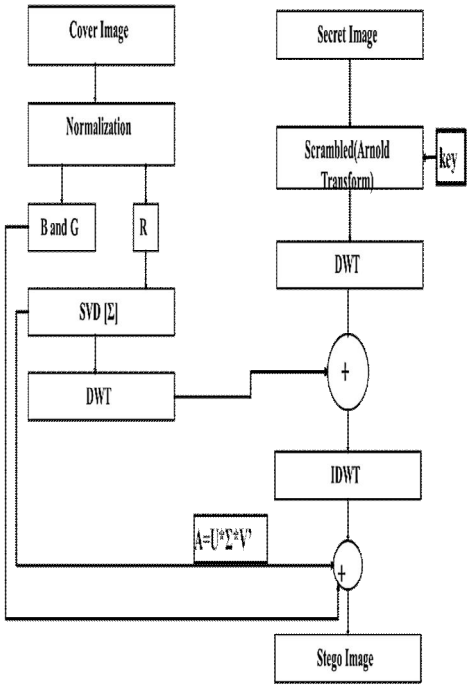

Fig 1: Shows the Proposed Dual Transform Steganography Method- Encoding(DTSM)

Step 3: Apply preprocessing on cover image can be Separated into R, G, B Planes.
Step 4: Calculate SVD for R-component Image.
Step 5: Decomposition on Σ-Singular Value block image using for DWT.
Step 6: Simultaneously Select the Secret Image.
Step 7: Secret Image is scramble by Arnold Transform with key(key2).
Step 8: Decomposition on image using for DWT.
Step 9: Both are added with Fusion Process. Stego=α*C coff+(1- α)S coff.
Step 10: Obtained Scrambled Image is fusion with SVD and G,B components.
Step 11: To get the Stego Image.

B. Decoding process

During the statistical decoding process as shown in fig2, the recover stego image and known cover image was reconstructed with DWT transform domain and followed by alpha blending process. Next, IDWT was performed to rebuild the secret image. Finally the secret image is obtained, which is similar to original secret image.

2). Algorithm for steganography decoding process

Step 1: The Select Image is a Cover Image, and checks with size, contrast, brightness and etc., .
Step 2: Apply preprocessing on cover image using Normalization.
Step 12: Normalized Image is can be Separated into R, G, B Planes.
Step 3: Calculate SVD for R component Image.
Step 4: Decomposition on each Σ-Singular Value blocks image using for DWT.
Step 5: Get the Stego Image and take R-component.
Step 6: Stego image R-component is Decomposition on image using for DWT.
Step 7: Apply Reverse Fusion Process on Coefficient Values
Step 8: Obtained Scrambled Image is reconstructed by Arnold Transform with Key(key2). Modify Anti-Arnold Transform x'=x+y, and N+y'=x+2y.
Step 9: To recover the Secret Image.

V. Testing And Performance Analysis

We designated commonplace check image of enormous size grey scale (512*512)cover image and enormous size of grey scale secret image (image to be embedded into cover image) for analysis of performance. Here we have a tendency to are about to engraft a 512*512 secret image into a 512*512 cover image.

A. Testing

MATLAB could be a high performance language for technical computer, integrates computation, mental image and programming in a simple to use atmosphere. one in all the explanations of choosing is to judge the performance of the method, we tend to implement the planned technique by exploitation Matlab R2010a and 7.10 version.

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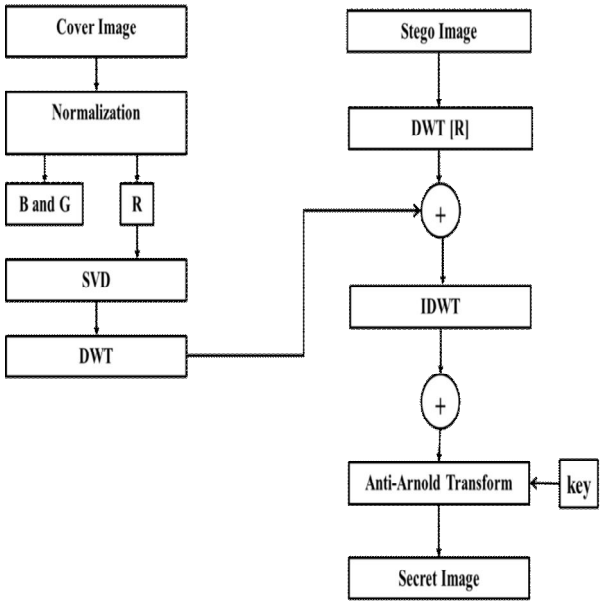

Fig 2: Shows the Proposed Dual Transform Steganography Method-Decoding (DTSM)

Table.2 Quality Metrics Formulas

1.MEAN SQUARE ERROR (MSE)

$$MSE = \frac{1}{MN}\sum_{j=1}^{M}\sum_{k=1}^{N}\left(x_{j,k} - x'_{jk}\right)^2$$

2.PEAK SIGNAL TO NOISE RATIO (PNSR)

$$PSNR = 10^{\frac{\log_{10}(255)^2}{MSE}}\,dB$$

3.NORMALIZED CROSS CORRELATION (NCC)

$$NCC = \sum_{j=1}^{M}\sum_{k=1}^{N}\left(x_{jk} - x'_{jk}\right)\frac{1}{\sum_{j=1}^{M}\sum_{k=1}^{N}(x_{j,k})^2}$$

4.STRUCTRAL CONTENT (SC)

$$SC = \sum_{j=1}^{M}\sum_{k=1}^{N}(x_{j,k})^2 \,/\, \sum_{j=1}^{M}\sum_{k=1}^{N}(x'_{jk})^2$$

5.UNIVERSAL IMAGE QUALITY INDEX (UIQI)

$$UIQI = \frac{4\sigma_{xy}\bar{x}\bar{y}}{\left[\left(\sigma_x^2 + \sigma_y^2\right)\right]\left[(\bar{x})^2 + (\bar{y})^2\right]}$$

B. Image Quality Metrics Measurements

The equations of the image quality metrics with corresponding formulas used in our study has been illustrated in Table(2).

C. Performance analysis

Performance analysis of these wavelet transforms is done based on parameters. PSNR is used to measure the quality of the reconstructed image. We used PSNR to measure the distortion between an original cover image and stego image. MSE is the mean square error representing the difference between the cover image X sized M x N and the stego image X' sized M x N, and the $X_{j,k}$ and $X'_{j,k}$ pixels are located at the j^{th} row the k^{th} column of images X and X', respectively. Normalized Correlation coefficient (NCC) between recovered and original secret image, is used as a metric for performance evaluation.

To evaluate the Dual Transform Steganography Method using in Color Image Steganography. The performance results of our transform steganography technique based on SVD and DWT techniques. We compare their image quality measurement values with the other existing method, our algorithm calculated the quality metrics which gets better acceptable ratio that was shown in above equation on Table.2.

VI. EXPERIMENTAL RESULTS AND DISCUSSIONS

Table.3: Shows the Image sets.

S.No	Cover Image 512*512	Secret Image 512*512	Image Set
1	Lena.jpg	Map.jpg	Image set 1
2	Baboon.jpg	Map.jpg	Image set 2
3	Chilly.jpg	Map.jpg	Image set 3
4	Mixedfruit.jpg	Map.jpg	Image set 4

Table.4: Image vs. MSE

S.No	Image Set	MSE		
		Red component	Green component	Blue component
1	Image set 1	1.5913	0.5504	0.3795
2	Image set 2	0.8988	0.7018	0.7457
3	Image set 3	0.9520	0.9833	0.4590
4	Image set 4	1.2440	0.7372	0.6368

The performance of a steganography system can be measured using several properties shown in Table 3,

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Table 4, Table 5 and Table 6. The most important property is the statistical undetectablility (imperceptibility) of the data, which shows how difficult it is to determine the existence of a hidden message. Other associated measure is robustness, which refers to how well the steganography system resists the extraction of hidden data.

Table.5: Image vs.PSNR

S.No	Image Set	PSNR		
		Red component	Green component	Blue component
1	Image set 1	46.1133	50.7243	52.3391
2	Image set 2	48.5941	49.6687	49.4650
3	Image set 3	48.3443	48.2038	51.5125
4	Image set 4	47.1825	49.4549	50.0910

Table.6: Image vs. UIQI

S.No	Image Set	UIQI		
		Red component	Green component	Blue component
1	Image set 1	0.9864	0.9942	0.9576
2	Image set 2	0.9979	0.9989	0.9983
3	Image set 3	0.9959	0.9664	0.9713
4	Image set 4	0.9846	0.9556	0.9575

(PSNR= Peak Signal to Noise Ratio),
(MSE= Mean Square Error),
(UIQI= universal image quality index)

The comparison was done in favour of DWT as expected due to the ability of wavelet transform technique not only provides a better way for embedding large amounts of data into cover images with imperceptions, but also offers more robustness, which can avoid various image attacks like as noise addition, compression and so on.

There are mainly three aspects that should be taken into account when discussing the results of Double-Key Dual Transform method using in image steganography. They are security, imperceptibility and robustness.

The perceptual difference between the stego image and original cover image should be unnoticeable to the human observer. As we seen the stego image given nice invisibility and quality. PSNR is often expressed on a logarithmic scale in decibels (dB). PSNR values below 30dB indicate low quality (distortion caused by embedding is clear). A high quality stego image should strive for a PSNR of 40 dB, or higher shown in fig.3, fig.4 and Quality for UIQI as shown in fig5.

This proposed technique is employed to increase the robustness and the imperceptibility of the image after embedding as shown in fig6 and fig7.

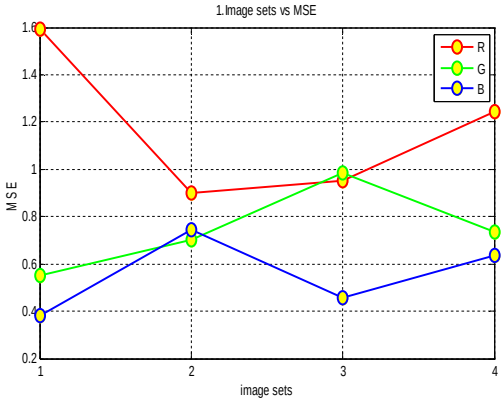

Fig.3: Image set vs. MSE

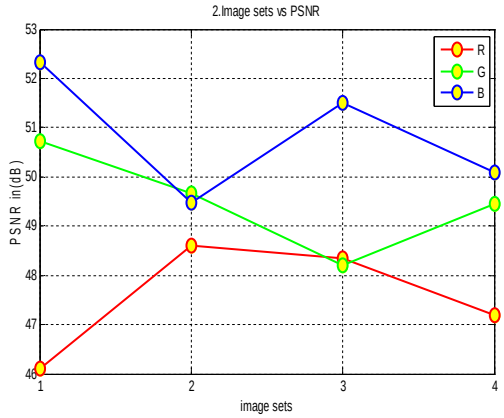

Fig.4: Image set vs.PSNR

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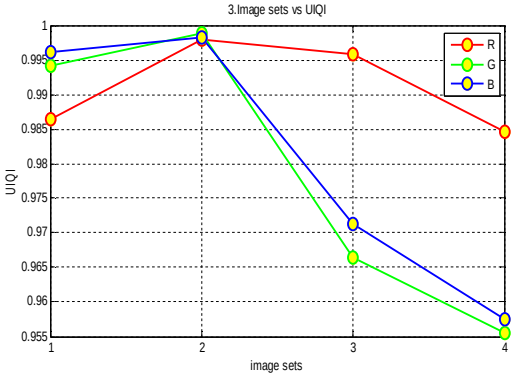

Fig.5: Image set vs. UIQI

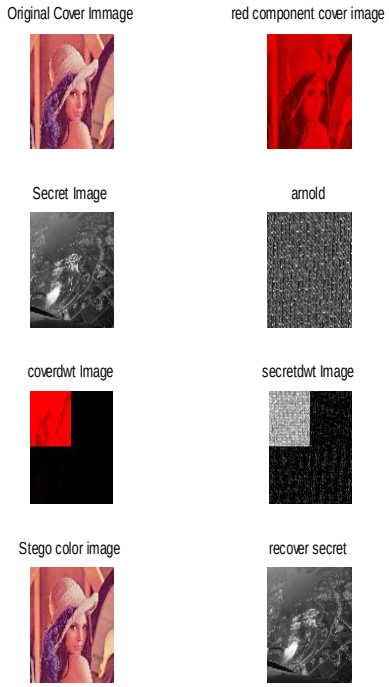

Fig.6: Dual Transform Steganography Method-Image

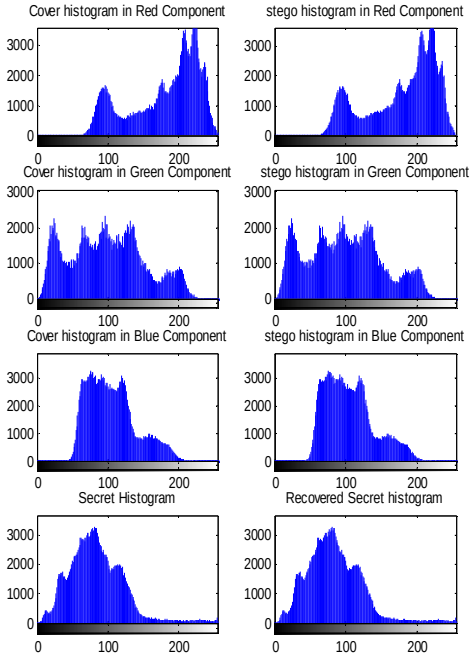

Fig.7: Dual Transform Steganography Method-Histogram

VII. CONCLUSION

Eventhough all types of steganography techniques provide high imperceptibility, security and robustness, it is not easy to develop a method that satisfies all these three needs, because of being application dependent may vary from one application to another application. In this paper we have presented a new image steganography scheme under Dual Transform Steganography Method in Color Image. Simulations are carried out on images of different formats viz. JPEG, TIFF and BMP using MATLAB. This technique achieved Embedded Image is 512*512, more robustness against image manipulation. Performance analysis of these two transforms is done based on parameters PSNR, MSE and UIQI than the earlier techniques. In this technique more Secure, Robust and High Capacity steganography based on Dual Transform technique, we achieved high PSNR ratio values approximately near 53 and less MSE values.

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