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Steganography on Color Image Using Different levels Of DWT Algorithm

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Abstract: ***In this paper, Steganography is used for covered writing .It is a art and science of writing hidden messages. Steganography techniques can be utilized for images, a video file or an audio file hiding. In this paper, performance analysis of image steganography based on 2 level, 3 level and 4 level DWT associated to colored images is done. It is a efficient and secure method of hiding secret message-extracting embedded message into/from a color image will be proposed. The proposed method will be tested, implemented and analyzed. Efficiency, quality, and security issues will be done by calculating PSNR to prove the advantages of the proposed method.***

Keywords: Steganography, DWT, Wavelet, Haar, PSNR, MSE.

I. INTRODUCTION

Steganography is the art and science of writing hidden messages so, no one except the sender and intended recipient, suspects the message existence, a form of security through obscurity. The data to be hided is called the secret message and the medium in which the data is hided is called the covering media. The covering media (color image) containing hidden message is called stego-image (holding image). The stego system uses algorithms used for hiding the message in the cover medium at the sender side and extracting the hidden message from the stego-image at the receiver side to provide security.

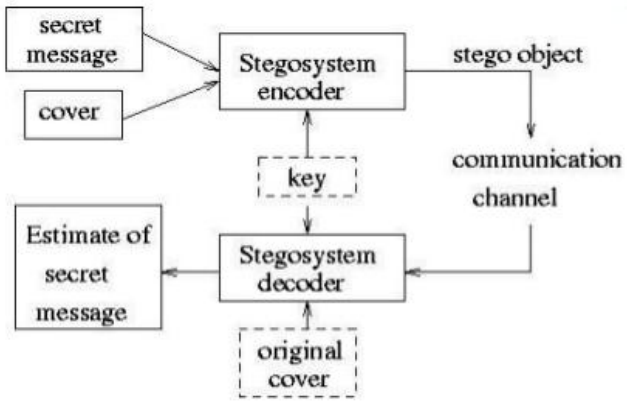

Fig .1: Steganography Model

Fig.1 shows the flow of processes that takes place in image steganography. This paper presents DWT (2-level, 3level &4-level wavelet decomposition) based image steganography. Haar wavelets are used in embedding process of the steganography techniques It has been observed that wavelets based techniques are most robust as compared to Least Significant Bit (LSB)

based techniques. Wavelet based techniques provide good quality stego-image. For image quality measurement, Peak Signal to Noise Ratio (PSNR) &Mean Square Error (MSE) is used. It analyzes the Peak Signal Noise Ratio (PSNR) of Haar wavelet. The PSNR means the peak signal-to-noise ratio, in decibels, between two images. This calculated ratio is used as a measurement between the quality of original and a compressed image. The higher the PSNR& lower the MSE, the better the quality of the reconstructed image.

II. DISCRETE WAVELET TRANSFORM

In numerical analysis, a discrete wavelet transform (DWT) is any transform in which the wavelets are discretely sampled. It collects both frequency and location information in time. The wavelet transform has gained widespread acceptance in signal processing and image compression. Wavelet transform perform the function of decomposing a signal into a set of basic functions. These basic functions are called wavelets. Wavelets are obtained from mother wavelet by dilations and shifting. The DWT has been introduced efficient and flexible method for sub band decomposition of signals. DWT transform discrete time signal to discrete wavelet representation. A discrete wavelet transform (DWT) generate sub bands of given input image. The Discrete Wavelet Transform is based on sub-band coding technique to perform a fast computation of Wavelet Transform. DWT is very easy to implement and used to reduce the computation time and resources required. DWT uses only a subset of positions and scales rather than calculating wavelet coefficient. This method results in a perfect and more efficient manner of a wavelet transform. The DWT is similar but more adaptable than the Fourier series. The discrete wavelet transform has various applications in Science, Computer Science, Engineering and Mathematics etc. DWT is used for signal coding for representation of a discrete signal in a more redundant form.

Discrete Wavelet Transform (DWT) performs same procedure at every step given as follows:

1. Filter the image by 2D-lowpass and high pass filter
2. Sub sample the result by factor 2
3. Decompose the image into 4 sub-band (LL,LH,HL,HH)

- LL-Low to Low frequency coefficient
- LH-Low to High frequency coefficient
- HL-High to Low frequency coefficient
- HH-High to High frequency coefficient

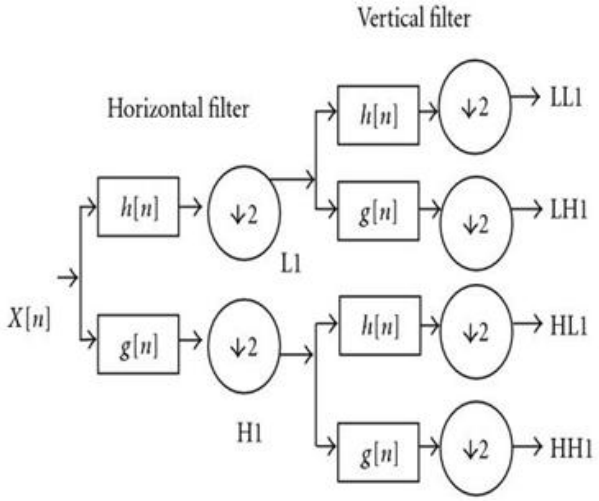

Fig.2: Subband decomposition for one-level 2D DWT

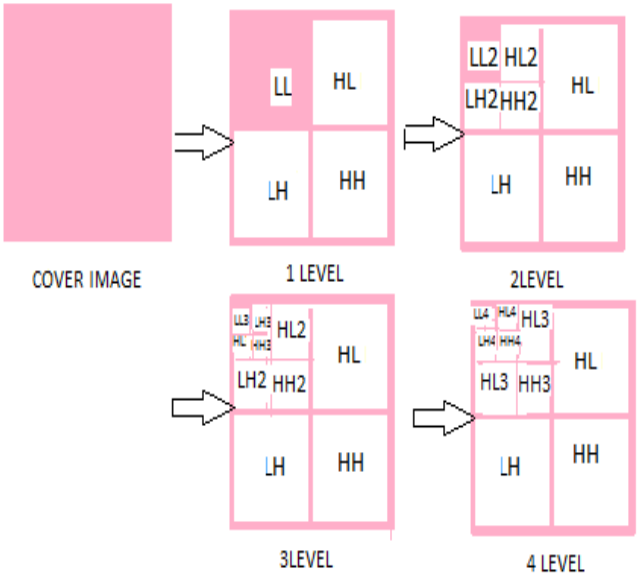

Fig.3: Decomposition for Image

A 2-Dimensional DWT can be seen as a 1- Dimensional wavelet scheme which transform along the rows and then a 1-Dimensional wavelet transform along the columns,. The 2-Dimensional DWT operates in a straight forward manner by inserting array transposition between the two 1-D DWT. One level of decomposition used to process the rows of the array . Initially divides the array into two vertical halves, with the first half storing the average coefficients and the second vertical half stores the detail coefficients. This procedure is performing again with the columns, resulting in four sub-bands (see Fig. 3) within the array defined by filter output. Fig. 4 shows a four- level 2- D DWT decomposition of the Apple image.

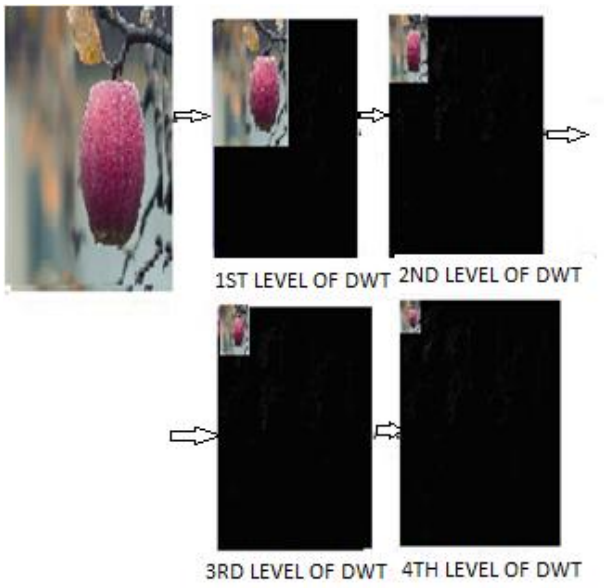

Fig.4: DWT Decomposition for Apple Image

III. HAAR WAVELET

Haar wavelet is a "square-shaped" function in mathematics which together forms a wavelet family. Wavelet analysis is allows a target function over an interval to be represented in terms of an orthonormal basis. The technical disadvantage of the Haar wavelet is that it is not continuous function, and therefore not Derivative. This property can, useful for the signals analysis with instant transitions, such as monitoring of tool failure in machines. A Haar wavelet is very simplest type of wavelet. Haar wavelets in discrete form are related to a mathematical operation called the Haar transform. The Haar transform used as a prototype for all other types of wavelet transforms. Studying the Haar transform in detail will provide a good foundation for understanding the more sophisticated wavelet transforms. Haar transform can be used for compressing audio signals and for

removing noise. Discussion on these applications will set the stage for the more powerful wavelet transforms to come and their applications to these same problems.

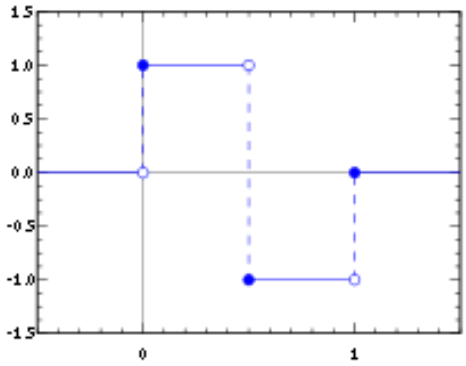

Fig.5: Haar Wavelet

IV. PROPOSED METHOD FOR EMBEDDING

Procedure for Embedding up to 2nd level,3rd level& 4th level Wavelet Decomposition :

A. Perform DWT Decomposition up to 4th level as Follows-

1. Take the cover image (JPEG) (512 x512) and its green plane alone and perform first level 2D-DWT on the image to obtain approximation 1 coefficient (LL 1),horizontal 1 coefficient (HL 1), vertical 1coefficient (LH 1), diagonal 1 coefficient (HH1) respectively.
2. Take the approximation 1 coefficient (LLl) and perform second level 2D-DWT on the image to obtain approximation 2 coefficient (LL2), horizontal 2 coefficients (HL2), vertical 2 coefficients (LH2), diagonal 2 coefficients (HH2) respectively.
3. Take the approximation 2 coefficient (LL2) and perform third level 2D-DWT on the image to obtain approximation 3 coefficient (LL3), horizontal 3 coefficients (HL3), vertical 3 coefficients (LH3), diagonal 3 coefficients (HH3) respectively.
4. Take the approximation 3 coefficient (LL3) and perform forth level 2D-DWT on the image to obtain approximation 4 coefficient (LL4), horizontal 4 coefficients (HL4), vertical 4 coefficients (LH4), diagonal 4 coefficients (HH4) respectively

B. Take the Secret Image and turn it into Black and White.

C. Perform Embedding as follows:

1. Assume an embedding coefficient of value of 0.05
2. Process LL4 block by block (4x4)
3. Process the secret image block by block (4X4).
4. The following formula is used to obtain the secret image block (4x4) which is basically swapping, secret image block =LL4 + (Embedding coefficient x secret image intensity value)

D. Perform 4 Level 2D- Inverses DWT for Reconstruction which is the Inverse Process of 4 level 2D-DWT

Decomposition in Order to obtain the Stego Image

E. Calculate the PSNR& MSE in order to check for the visual quality of the Stego Image.

V. PROPOSED METHOD FOR EXTRACTION

A. *Perform four level 2D- Haar DWT decomposition on the Stego image as well the Cover image as conducted in the Embedding Procedure.*

B. *Compute the PSNR for the decomposed Stego Image as well as the Cover Image for finding out in which sub-band the Secret Image has been Embedded. On Examining this will find it out to be LL4*

C. *Perform the processing of the LL4 of the Stego Image block by block (4x4).*

D. *Perform the processing of the LL4 of the Cover Image block by block (4x4).*

E. *Assume an embedding coefficient of 0.05.Use the formula which follows to get the image blocks of the secret image.*

Secret Image block = (Intensity value of LL4 of Stego Image – Intensity value of LL4 of of the Cover Image) / Embedding coefficient

VI. PSNR & MSE

To find the resulted PSNR, the block first computes the mean-squared error using the following equation:

$$MSE= \frac{\sum_{M,N}[I_1(M,N)-I_2(M,N)]^2}{M*N} \quad \text{---- eq.1}$$

In the eq.1, *M* and *N* are the number of rows and columns in the input images, respectively. Then the block calculates the PSNR using the following eq.2:

$$PSNR=10\log_{10}(R^2/MSE) \quad \text{---- eq.2}$$

R is representing the highest fluctuation in the input image data type. Value of R is 1 if the input image has a double-precision floating-point data type & Value of R is 255 if it has an 8-bit unsigned integer data type. Peak Signal to Noise Ratio (PSNR) and Mean Square Error (MSE) are the two error metrics used to compare image compression quality. The Mean Square Error (MSE) shows the cumulative squared error between the compressed and the original image, whereas PSNR represents a measure of the peak error. The lower value of MSE represent the lower the error.

VII. EXCREMENTAL RESULT

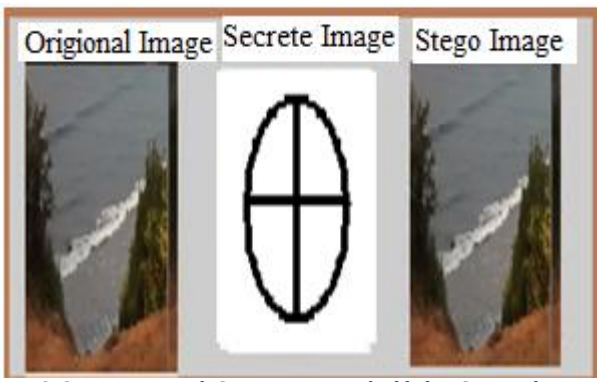

Fig .6: Stego Image with Secrete Image embedded in Origional image

Fig.6 shows embedding and extraction results using 4level 2D-Haar DWT. Fig.7 shows the PSNR value after embedding for the 4 level -2D Haar DWT is 98.33 db.

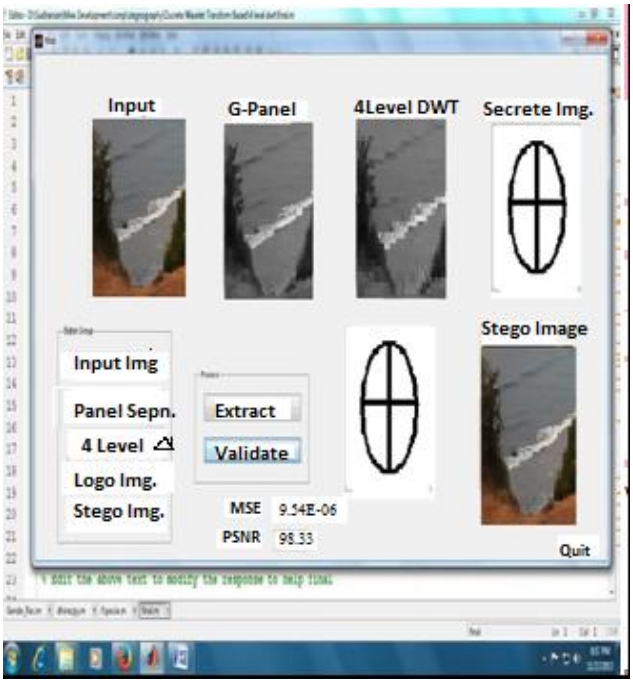

Fig .7: Screenshot Of Result Of 4level DWT

Fig.7 shows the PSNR value after embedding for the 4 level -2D Haar DWT is 98.33db. Similarly,got a PSNR value after embedding for the 3 level -2D Haar DWT is 91.59db.PSNR value after embedding for the 2 level -2D Haar DWT is 86.48db.The table 1 below lists the image quality(PSNR) in dB for the cover images after embedding for different levels such as 2level,3level &4 level. These results were obtained using MATLAB using Simulink.

TABLE 1 Image Quality Show By (PSNR) in dB of the Cover Image by 2,3&4Level of Haar Wavelet after Embedding

S.No	Level	MSE	PSNR	Extracted Logo Quality
1	2 level	1.46E-04	86.48	Poor
2	3 level	4.5E-05	91.59	Good
3	4 level	9.54E-06	98.33	Very Good

VIII. Conclusion

The main objective of this work is to obtain quality images by computing peak signal-to-noise ratio for Haar wavelet in DWT (discrete Wavelet transform). In this paper proposed system using three technique of 2-level,3-level and 4-level discrete wavelet transform for hiding images has been proposed and implemented. This is done in MATLAB 10 using simulink. This result conclude that 4-level Haar DWT has better PSNR as compared to 2-level & 3-level Haar DWT and also it provide best quality of image compared to both level.. Its future enhancements is to use other types of wavelet other than haar& also modified embedding & extraction formula for hiding audio data in cover image to enhance robustness & to get better quality image using 2,3 &4 level using DWT algorithm.

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