

# Hybrid DCT-DWT Digital Image Steganography

Ms. Anusha M N<sup>1</sup>, Ms. Ashwini S R<sup>2</sup>, Akshatha M K<sup>3</sup>, Lokesh H B<sup>4</sup>, Lubna Tabasum<sup>5</sup>, Monika N Y<sup>6</sup>

<sup>1,2</sup> Asst. Professor, Dept. of ECE, BGS Institute of Technology, Mandya

<sup>3,4,5,6</sup> Student, Dept. of ECE, BGS Institute of Technology, Mandya

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**I. ABSTRACT-** Steganography is a method of hiding secret information in the multimedia carrier as image file, audio file and video file. This differs from cryptography concept which is applied to make as a message unreadable by a third party; it does not hide the existence of secret communication. By researching in image steganography are to increase efficiency in terms of the payload capacity of secret information, robustness against visual attacks and statistical attacks. Image steganography in wavelet transform domain have higher robustness against statistical attacks compare to image steganography in spatial domain and discrete cosine transform domain, while DCT image steganography have higher imperceptibility compared to DWT image steganography. The hybrid technique of DWT and DCT provides more advantages of both techniques. The proposed algorithm presents hybrid DCT-DWT digital image steganography algorithm.

Proposed approach Embedding image is done by embedded is not detectable part of an image than other methods as shown in results. The Steganography process is done by embedding image in middle frequency coefficient set of the 3-level DWT transform of host image followed by block DCT transformation and embedding in selected HH DWT coefficient sets.

**Keywords:** steganography, Digital image, DCT, DWT, PSNR.

## II. INTRODUCTION

### A. Steganography

Steganography is the method of hiding secret information, so that only sender and receiver know that the message even exists so it does not attract unwanted attention. Image steganography protects the data from illegal access by hiding the data into a cover image such that an unintended observer is not aware of the existence of the hidden data. Steganography basically consists of three things: cover object (used to hide secret messages), secret messages to be, and stego object (cover object hiding the secret data).

Steganography terminologies are as follows:

- Cover image: Original object which are used as a carrier for conceal the information.

- Message: Actual information which is used to hide. Message could be a text or some other image.
- Stego-Image: After embedding message or secret information into cover object is known as stego-object.
- Stego-Key: A key is used for embedding or extracting the messages from cover-object and stego-objects.

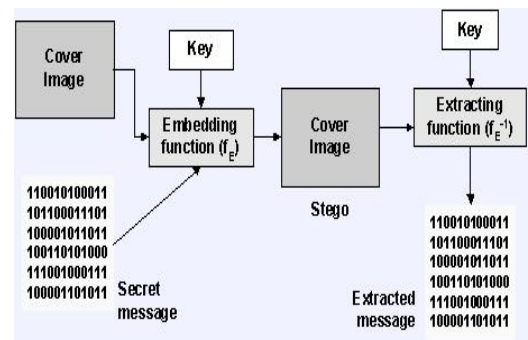


Figure 1: Block diagram of process of steganography.

As shown in Figure 1, Secret message + carrier + steganography key = Steganography in medium. Image steganography is a method of hiding the information into cover-image and generates a stego-image. Stego-image then sent to the other party by some known medium, where the other party does not know that this stego-image has hidden message. After receiving stego-image hidden message can simply be extract with stego-key by the receiving end.

### B. Steganography v/s Other Hiding Technique

#### 1. Cryptography v/s Steganography:

Steganography and cryptography both are techniques to protect information from untrusted party but neither technology alone is perfect when the presence of hidden information is revealed the steganography is partly defeated. So the strength of steganography can be amplified by combining it with cryptography. In image steganography the information is hidden in images only.

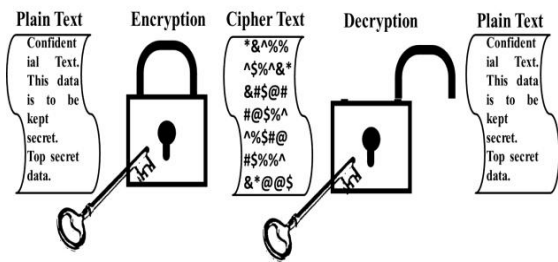


Figure 2: Process of cryptography.

2. Steganography V/S Watermarking

Watermarking is done to prevent the illegal copying of cover object and has an additional requirement of robustness against possible attacks.

Steganography system urges to secure embedding of a large amount of information, with no visible degradation to the cover object but watermarking system, however, embeds information that stick to the cover object so difficult that it could not be removed or altered without making the cover object entirely unusable. These are vulnerable to illegal copying and regeneration due the advent in the technologies for editing, converting and copying of multimedia. Counter measures are required against duplication and redistribution of digital content.

III.METHODOLOGY

A. DISCRETE COSINE TRANSFORM (DCT)

The two dimensional DCT is the most popular lossy digital image compression systems now a days. This method encodes the secret information in the frequency domain by modulating the relative size of two or more DCT coefficients in an image. It is an orthogonal transform, which has a fixed set of (image independent) basis functions, an efficient algorithm for computation, and good energy compaction and with complementary relationship reduction properties.

The 1D DCT of a 1\*N vector s(j) is shown as

$$X_k = \frac{1}{2} (x_0 + (-1)^k x_{N-1}) + \sum_{n=1}^{N-2} x_n \cos \left[ \frac{\pi}{N-1} nk \right]$$

Where  $k = 0, 1, \dots, N - 1$

The DCT can be extended to the transformation of 2D signals or images. This can be achieved by following steps:

1. By computing the 1D DCT of each of the individual rows of the two dimensional image.
2. Computing the 1D DCT of each column of the image.

In digital image processing, the two dimensional version of DCT is used which is given below:

$$X_k = \sum_{n=0}^{N-1} x_n \cos \left[ \frac{\pi}{N} \left( n + \frac{1}{2} \right) k \right] \quad k = 0, 1, \dots, N - 1$$

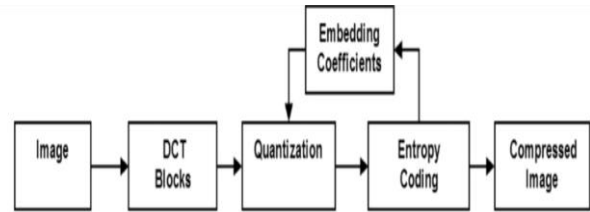


Figure 3: Block diagram for embedding data using DCT.



Figure 4: Block diagram for extraction data using DCT.

DCT has the possessions that, for an ordinary image the nearly all part of the visually critical information of an image are concentrated in only couple of coefficients. After processing of coefficients, these are normalized by quantization process using quantization table with diverse scales provided by the JPEG standard. Choice of quantization table influences the entropy and compression ratio. The estimation of quantization is inversely proportional to the quality of reproduced image, better mean square error and good compression ratio. In a lossy compression approach, during Quantization, the less significant frequencies components are discarded, and essential frequencies components that remain are make use of to recover image in decomposition process, after quantization, quantized coefficients are adjusted in a zigzag way for further compressed by an proficient coding algorithm.

Discrete Cosine Transform (DCT) has many advantages:

- (1) DCT can pack almost all data in least number of coefficients.
- (2) DCT decreases the piece like form called blocking object that outcomes while limits among sub-images get to be noticeable.

B. DISCRETE WAVELET TRANSFORM (DWT)

A wavelet has its energy directed towards time to give a tool for the analysis of transient, non-stationary or time varying phenomena. A signal can be better analyzed

if expressed as a linear decomposition of sums of products of coefficients and functions. These set of coefficients are called the Discrete Wavelet Transform (DWT) of a signal. DWT has spatial frequency locality, which means that if signal is embedded, it will affect the image locally.

The forward 2-D DWT can be implemented by using a set of up-samplers, down-samplers, and recursive two-channel digital filter banks. There are many available filters, but the most commonly used are Haar Wavelet filters, and Daubechies filters. The important properties of wavelet filters in digital image compression are symmetry, orthogonality, regularity, and degree of smoothness.

When applying DWT on an image, four different sub-bands are obtained, which are LL, LH, HL, and HH as shown in figure 4.1.

- LL: A coarser approximation to the original image containing the almost all information about the whole image. Since human eyes are more sensitive towards the low frequency part, this is the most necessary component in the reconstruction process.
- HL and LH: These are gain by applying the high pass filter on one coordinate and the low pass filter on the other coordinate.
- HH: This shows the high frequency component of the image in the diagonal direction.

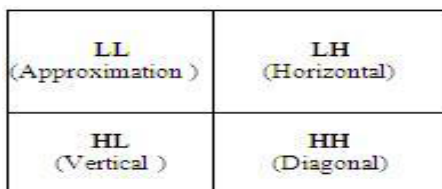


Figure 5: DWT Sub-bands.

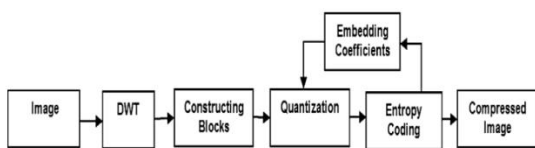


Figure 6: Block diagram of embedding data using DWT.

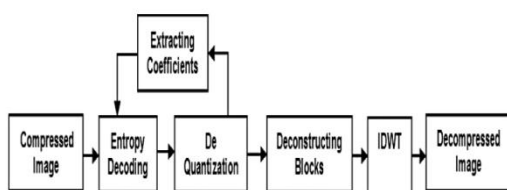


Figure 7: Block diagram of extraction data using DWT.

Wavelets techniques are very helpful in the compression, processing and enhance of signals, in various areas like medical imaging, where degradation in image is not accepted. Wavelets techniques can be employed in order to reduce noise from the image. Wavelets are statistical functions, which are employed to transform one illustration into another one. Wavelet transform carry out multi-resolution image analysis purposes. In 2D transform, the images are consideration to be a grid having N rows and M columns and decomposition of an image into wavelets includes a couple of waveforms at every level:

1. To characterize high frequency components related to the detailed part of image.
2. For low frequency or smooth parts of an image.

**RESULTS:**

The Experiments of Proposed methodology is performed on host images, and Elaine of size of 512x512 pixels each. A secret image of size of 32x32 binary image as shown in the figure is embedded as secret image in host images.

**Encoding process for image in image:**



Figure 8: Original cover image.



Figure 9: Message bit.

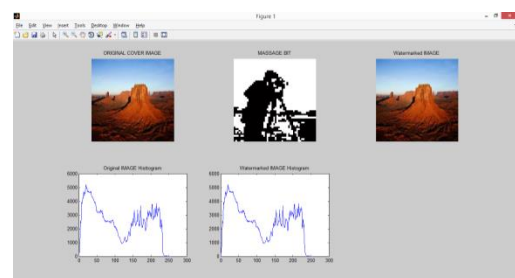


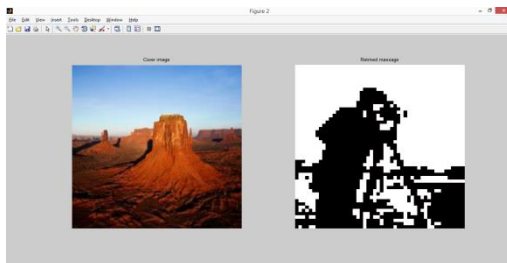
Figure 10: Output with histogram.

The watermarked image is obtained by hiding message bit in original cover image with histogram.

#### Decoding process for image in image:



**Figure 11:** Watermarked image.



**Figure 12:** Retrieved message from cover image.

By taking input as watermarked image we retrieve message from a cover image.

#### CONCLUSION:

The Proposed algorithm gives Hybrid DCT-DWT Digital image steganography algorithm. Proposed method exploits strength of two combined transform domain techniques DCT & DWT to obtain further imperceptibility and robustness. The idea of inserting embedding image in combined transform is based on fact that joint transform eliminates drawback of each other and thus an effective embedding image method can be obtained. Proposed Approach embedding image is embedded is imperceptible part of an image than other methods as shown in results. The Steganography process is done by embedding image in middle frequency coefficient set of the 3-level DWT transform of host image followed by block level Discrete Cosine Transform and selected HH Discrete Wavelet Transform coefficient sets. So proposed technique has higher imperceptibility or higher robustness against visual attacks.

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