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Enhancing the Image Compression Rate Using Steganography

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ABSTRACT
Image compression is a technique to minimize the size in bytes of a graphics file without degrading the quality of image to an unacceptable level. On the other hand, steganography deals with embedding secret data in redundancies of image in invisibility manner. The goal of this study is to improve image compression through steaganography. Therefore, this paper proposes two schemes one of which combines a steganographic algorithm with the baseline DCT-based JPEG, and the second one uses this steganographic algorithm with the DWT-based JPEG. Hence, data compression is performed twice.

KEYWORDS : *DCT,DWT,JPEG,LSB coding.*

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I. INTRODUCTION

Image compression addresses the problem of reducing the amount of data required to represent a digital image. It is a process intended to yield a compact representation of an image, thereby reducing the image storage/transmission requirements. The main use of our paper is to increase the image compression rate using steganography and the most effective compression algorithmic program is DWT. For removing the redundant binary data from the image we use (DWT) separate wavelet transform and (DCT) discrete cosine transform algorithmic program. We are using this technique for removing the redundant data from the image. The DCT algorithm removes the data and compresses the image size. The DCT compression technique mostly gives minimal compression rate as compared to DWT.Compression is incredibly necessary to reduce storage size on storage device. Digital images compressed by eliminating redundant information present within the image, like spatial redundancy, spectral the image binary code. We use two techniques co-jointly to compress an image that is DCT & DWT. The first algorithmic program combines a steganographic algorithm with the baseline DCT-based JPEG, whereas the second one uses this steganographic algorithm with the DWT-based JPEG. We are employing mostly DWT only because the image compression rate is maximum as compare to DCT. The algorithm of DWT removes the amount of bits data from the image.

II. RELATED WORK

Many research works related to data embedding based on compression have been proposed till now. [1] implemented a technique to improve color image coding. Transforms a given color image into the YIQ color space where the chrominance information is sub sampled and embedded in the wavelet domain of the luminance component. [2] proposed image embedding using quantization index modulation. Several authors used the discrete wavelet transform to split the original image into two parts, the low-pass image (called host image), and the high-pass image (called the residual image). The residual image is, first, coded using a modified version of the embedded zero-tree wavelet coder (EZW) and, then embedded into the host image. The embedding process is based on a linear projection, quantization and perturbation in the DCT domain (bits in each 8 * 8 blocks). [7] includes an approach for lossless image compression in spatial domain for continues tone images using a novel concept of image folding.[8] proposes a novel high capacity data hiding method based on JPEG. It employs a capacity table to estimate the number of bits that can be hidden in each DCT component so that significant distortions in the stego-image can be avoided. [9] presents an unique theme for image quality assessment, here introduced an alternative framework for quality assessment based on the degradation of structural information. However, the above mentioned schemes uses were not clear and the embedding techniques details are not shown. Therefore, in this paper, we introduce a novel algorithm Stego-JPEG (DWT) as an extension to previous work Stego-JPEG (DCT) (Jafari, Ziou, &Mammeri, 2011) to apply steganography in DWT domain. Moreover, we intend to extend our previous framework for color images which provides high compression gain with high quality.

III. METHODOLOGY

The main focus of this approach is to compress image and extend the compression rate. We are using two methods DCT and DWT. When we divide the input image into set of 8 * 8 pixels, it embeds into 196 this reduces file size using steganography. Target blocks us going to hide for understanding. It receives bits from target block (Jafari et al., 2011). To compress target block B_k of image the method is using lossy JPEG. Now we hide input data in to subsequent block B_{k+1},……B_l in to compressed image[6].

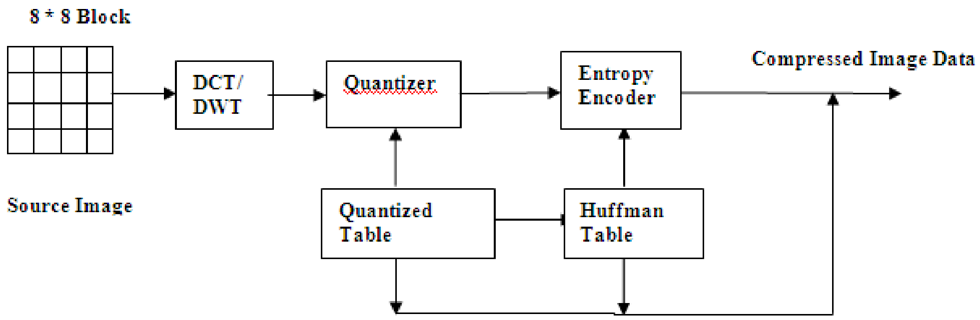

Fig.1. DCT/DWT-based block diagram for encoding

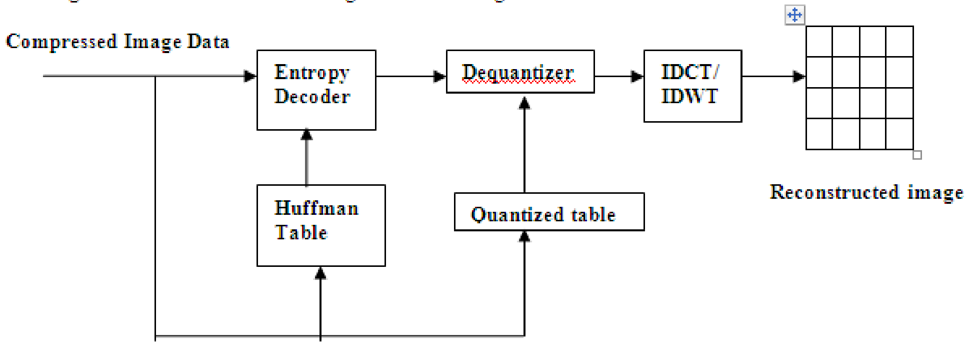

Fig.2. DCT/DWT-based block diagram for decoding

DCT based scheme

For color images, each component (Y, C_b, and C_r) will be processed separately. The embedded bits total number is $n = n_{k+1} + n_{k+2} +\ldots\ldots + n_l$, where $n_{k+1} + n_{k+2} +\ldots\ldots + n_l$ are the embedded. bits on blocks B_{k+1}, . . . ,B_l, respectively, and it depends on the number of bits that are coded. If we consider μ the mean number of bits hidden per block, then the payload size is equal to $\mu \times [N \times M/8 \times 8]$. Note that we hide the data in DC component[6].

DCT based encoding

DCT stands for discrete cosine transform (DCT) and it removes the redundant bits from image bits. DCT it is finite sequence of data points. The terms of a sum of cosine functions oscillating at different frequencies. For DCT Compression method uses the algorithm given below to compress the data.

Algorithm 1. Stego- JPEG (DCT) Encoding [6]

Input: The quantized coefficients block B_i from image which we provided as input of N*M pixels, where I € [1,(N*M)/(8*8)].

Output: A compressed JPEG (DCT) image.
The following steps are executed for embedding process:
I. Applying rounding step to block B_k.
II. Compressing B_k block using lossy JPEG method.
III. Hide the block B_k current bits of compressed in the n coefficients of the subsequent blocks B_{k+1},…..B Where $N=n_{k+1}+n_{k+2}+\ldots\ldots+ n_l$, n_i the number of coefficients that are used in the i^{th} block such that:

$$C_i(i,j) = \begin{cases} Q_b(\bar{C}_i(i,j)) | \bar{C}_i(i,j)| \geq T \\ \lfloor \bar{C}_i(i,j) \rfloor T - 1 \leq |\bar{C}_i(i,j)| < T \\ \lfloor \bar{C}_i(i,j) + 0.5 \rfloor Otherwise \end{cases}$$

IV. Repeat I-III until k >$\lfloor N \times M/m \times m \rfloor, k = l + 1.$

DCT based decoding

Encoding and decoding are parallel operation for coding and decoding algorithm. Way extract blocks from compressed image used embedding process. Decoder having some methods a Huffman decoder and a coefficient de-quantizer where all coded data flows.

Firstly decompression is performed, embedded blocks are extracted by checking odd and even C_i(i,j) coefficients from n coefficients of sequential blocks. That quantize to a value with magnitude T or smaller decoder disregards all coefficients. Then inverse DCT is used. Stego-JPEG (DCT) decoder is repeated for each of the components Y, C_b, and C_r separately for color images. Decoding speed is increased by using a plurality of decoding devices in parallel with each decoder having a Huffman decoder and a coefficient de-quantizer through which all coded data flows.

Algorithm 2. Stego-JPEG (DCT) decoding [6]
Input: A compressed JPEG (DCT) image.
Output: A decompressed image.
The following steps are executed for embedding process:
I. Lossy JPEG decoding by decompressed blocks.
II. Extract the embedded block of B_{k+1},…..B_l coefficients $|C_i(i,j)| \geq$ T from the subsequent blocks such that:

$$\text{Embedded – bit} = \begin{cases} 1 & C_i(i,j) = odd \\ 0 & C_i(i,j) = even \end{cases}$$

Apply lossy JPEG decoding for embedded block.
Repeat I-III until$l > \lfloor N \times M/m \times m \rfloor, l = l + 1$.

IV. DWT BASED SCHEME

DWT based encoding

Same method is used in DCT which is before embedding process we follow it. Before embedding the target blocks are compressed using DWT-JPEG, including DWT transformation, quantization, and entropy coding. Blocks are transformed using DWT and quantized. Depending on the embedded bit (0 or 1), the receiving blocks is rounded to the nearest odd or even value. If the embedded bit is equal to 0.
C_i(i, j) is rounded to its odd value, otherwise, it will be rounded to the even value.

Note: same conditions applied for steganographic scheme used in DCT-JPEG are applicable integrated within DWT-JPEG. The embedding process for gray images and for each of the components Y, C_b, and C_r separately for color images is summarized as follows:

Algorithm3. Stego-JPEG (DWT) encoding
Input: DWT coefficients.
Output: A compressed JPEG(DWT) image.
Steps for embedding process:
I. Group wavelet coefficients into m * m blocks B_k from an image I of $N \times M$pixels.
II. Apply rounding and quantization for block B_k.
III. Compress B_k by using lossy JPEG coding based on DWT.
IV. Current bits embed of compressed block B_k in the n coefficients of the subsequent blocks B_{k+1}, . . . ,B_l Where $N=n_{k+1}+n_{k+2}+\ldots+n_l$,$n_i$ the number of coefficients that are used in the i^{th} block such that:

$$C_i(i,j) = \begin{cases} Q_b(\bar{C}_i(i,j)) | \bar{C}_i(i,j)| \geq T \\ \lfloor \bar{C}_i(i,j) \rfloor T - 1 \leq |\bar{C}_i(i,j)| < T \\ \lfloor \bar{C}_i(i,j) + 0.5 \rfloor Otherwise \end{cases}$$

IV. Repeat I-III until k >$\lfloor N \times M/m \times m \rfloor, k = l + 1.$

DWT based decoding

The same process used for extraction with DCT is used by DWT. The process for images as follows:

Algorithm 4. Stego-JPEG (DWT) decoding [6]
Input: A compressed JPEG (DWT) image.
Output: A decompressed image.
The steps are as follows:
I. JPEG decoding based on DWT by extraction.
II. Extract the embedded block of $B_{k+1}, \ldots, B_l$ coefficients $|C_i(i,j)| \geq T$ from the subsequent blocks such that:

$$\text{Embedded} - \text{bit} = \begin{cases} 1 & C_i(i,j) = odd \\ 0 & C_i(i,j) = even \end{cases}$$

III. On embedded block apply JPEG decoding based DWT.
IV. Repeat I-III until $l > \lfloor N \times M / m \times m \rfloor, l = l + 1$.
V. Create DWT image form from extracted and original blocks.
VI. Apply IDWT.

V. RESULTS AND DISCUSSION

We have evaluated two image compression schemes and presented the evaluation methodology used in this work as well as the simulation parameters. The compression performance of the schemes under consideration is assessed using both the compression ratio and the quality of compression. Note that the criterion of image quality comparison is the resemblance between original and reconstructed images. For the comparison between images, we employed the peak signal-to-noise ratio (PSNR) as the measure of image quality. Our results show that when T = 1 increasing compression ratio is maximum with acceptable quality for both Stego-JPEG (DCT) and stego-JPEG (DWT).

Table 1.JPEG comparison PSNR and Compression Ratio

Image Name	**DCT**		**DWT**	
	PSNR	**Compression ratio**	**PSNR**	**Compression ratio**
Lenna	33	3.642	10	51.13
Baboon	18	1.461	20	51.12

Table 2.BMP comparison PSNR and Compression Ratio

Image Name	**DCT**		**DWT**	
	PSNR	**Compression ratio**	**PSNR**	**Compression ratio**
Lenna	33	4.179	10	51.13
Baboon	18	1.468	20	51.12

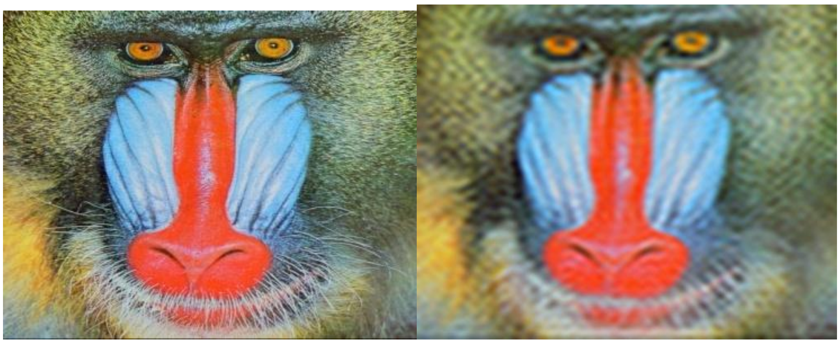

Fig.3. Baboon Original-Stego-JPEG(DCT)

Fig.4. Baboon Original – Stego-JPEG(DWT)

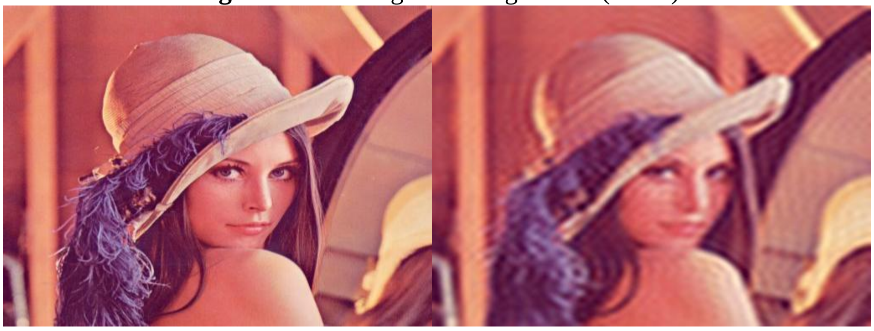

Fig.5. Lena Original-Stego-JPEG(DCT)

Fig.6. Lena Original-Stego-JPEG (DWT

From the above tables it shows that, As JPEG images are smaller in size than BMP images still JPEG images achieve a good compression ratio through our proposed approach as compare to the BMP images.

V. CONCLUSION

This paper proposes a novel technique to increase image compression rate using steganography which is the most effective compression algorithmic program such as DWT. We have also shown here the stenography data hiding into the image in cryptography the data into binary format. The data is used to secrete message hidden information to send the secure message to receiver it is used. We described here image compression method that redundant data is to remove from the image binary code. After we remove the redundant binary data the image compression rate increased inflated. Digital images compressed by eliminating redundant information present within the image, like spatial redundancy. There are several techniques for increasing image compression rate using steganography. However, we tend to compare only DCT & DWT algorithm. We have made use of maximum DWT only as a result of this algorithm minimizes image size more than DCT. Image conversion by using DWT it not effects on image however it minimizes very much bits of image size.

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