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HYBRID APPROACH FOR IMPROVING DATA SECURITY AND SIZE REDUCTION IN IMAGE STEGANOGRAPHY

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Abstract – *Image steganography is used to hide the secret message under a cover image in order to enhance the security. There are several proposed techniques which are focused on the security issue in their work. In this paper, a new technique is presented, implemented and analyzed. The proposed method uses three different techniques such as Huffman encoding, Deoxyribonucleic acid and State Transition. Initially, Huffman is applied over the text for the compression, and then Deoxyribonucleic acid is applied over the compressed data for the encryption and lastly State Transition algorithm has used for updating the location in the image. The application of these algorithms provides high security in comparison with the traditional algorithms. The implementation of these algorithms is done with respect to message bits. Total three images are used for the evaluation of traditional and proposed techniques in which the message bit varies from fifty to hundred. The simulation analysis concludes that the proposed method is efficient, more secure and proficient in comparison with other techniques such as LSBs, LF-DCT and MF-DCT. The parameters PSNR and MSE are used for the evaluation of their performance.*

Keywords: Steganography, Cryptography, Huffman Encoding, Deoxyribonucleic acid, State Transition.

1. INTRODUCTION

Steganography is the word taken from the two Greek words as "steganos" and "graphic" which mean "concealed" and "writing" respectively. Jointly it referred as concealed (hidden or covered) the message. Accordingly, steganography is the process of hiding the message before transmitting it to the receiver. Data can be hidden within another digital medium such as text, image, audio or video. With the application of this technique intruder will not be able to suspect the existence of the message.

Basic idea or motivation behind implementation of image steganography is to communicate between the members without having fear of being attacked of messages. Due to its advantages, it has been used in several areas including military, intelligence operatives or bureaus. These fields of espionage required a method which can hide their critical data and no intermediate person can evaluate the meaning of the data.

The main goal of using steganography is to avoid the attention of the attacker from the hidden information in the transmitted as if attacker would come to know that there is a hidden data into the sent message then observer will try each possible idea so that he can read the hidden message.

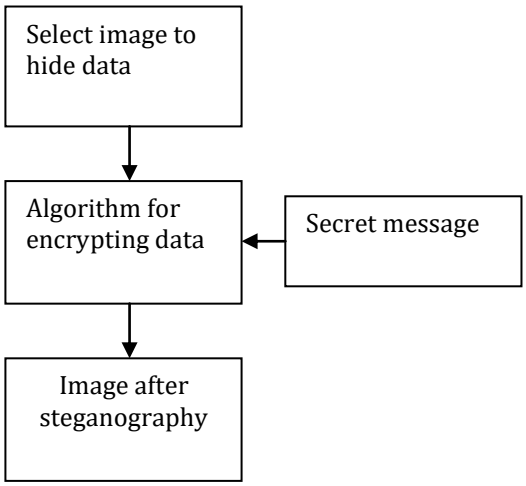


Fig-1: Process of steganography

Steganography can be applied with cryptography. Fig-1 shows the model of steganography process with cryptography.

1.1 Techniques for Steganography

Steganography provides various methods which can be used to embed the data with the cover object. Techniques for the steganography are classified such as:

- **Spatial Domain Methods:**

In this type of Steganography method, data that needs to be hidden is directly embed with the current intensity of the pixels. Which resultant into the change of pixel values of the image directly at the time of hiding data. Some of the spatial domain techniques are:

(1) Least Significant Bit (LSB)
(2) Pixel value Differencing (PVD)
(3) Edges based Data Embedding Method (EBE)
(4) Random pixel embedding method (RPE)
(5) Mapping pixel to hidden data method
(6) Labeling or connectivity method

(7) Pixel intensity based
(8) Texture based method

➢ **Transform Domain Technique:**

In this type of technique message is embedded in the frequency domain of the cover object. Several algorithms and transformations can be used to conceal the message into image. Classifications on the transfer domain are mentioned below:

(1) Discrete Fourier transformation technique (DFT)
(2) Discrete cosine transformation technique (DCT)
(3) Discrete Wavelet transformation technique (DWT)
(4) Lossless or reversible method (DCT)
(5) Embedding in coefficient bits

1.2 Data Compression

There are number of techniques available used for data compression such as "Lossy" compression. In such technique it provides help in reducing the actual amount of the data. Basically, it reduces the size of the information by losing redundant part of it. Image format JPEG uses Lossy compression technique. Lost information can be restored after performing decompression on the targeted image.

Alternatively, "Lossless" compression technique does not discard any of the information from the original image. There are different techniques available for lossy and lossless compression which can be chosen according to the requirements.

Compression means reduction of redundant data but retains the quality of the image. There are two types of techniques that are used to compress the image.

A. Lossless compression technique
B. Lossy compression technique

2. LITERATURE SURVEY

R.S.A-EI *et.al* [13] describes discrete Cosine Transform based steganography uses DC parts to hide secret bits in a sequence manner in Least significant Bits. Their values indicate that the proposed tool provides a relatively a high embedding storage with no visual damage in the resulting image, whereas it enhances the security level and manages the correctness of the hidden data. S. Esra *et.al* [14] discussed about the storage and security problems of text steganography that have been considered to do better by propose scheme of a novel approach. The proposed scheme has been reached to 7.042% for hidden messages that contains 300 characters. Experimental results obtains that the proposed scheme provides a significant addition in terms of capacity. Q.T.Thach *et.al* [12] describes the work in need to find the modified pixels, or residuals, as an artifact of the embedding process. This paper establishes an excellence result that addresses shortcoming: shows that the expected mean residuals contain enough data to order logically the located payload provided that the size of the payload in each stego image varies. S.H.J *et.al* [15] discussed about three data hiding methods that are proposed, that are based upon the features of DNA sequences. For each method, a corresponding DNA sequence S is selected and the hidden message M is incorporated into it so that S' is produced. S' is then transfer to the receiver and the receiver is able to recognize and extract the message M hidden in S'. Finally, experimental results indicate a better performance of the proposed methods in comparison to the performance of the traditional methods.W.Kan *et.al* [19] describes technique is based on manipulating the quantization table and quantized discrete cosine transformation coefficients. Experimental reports show that the proposed method attains both high storage and high image quality without any damage. G.X.Z.D.Yang *et.al* [4] discussed about discrete STA, there are four basic operators like swap, shift, symmetry and substitute as well as the "risk and restore in probability" strategy. Firstly, main concern is on a parametric study of the restore probability p1 and risk probability p2. To effectively deal with the head pressure constraints, it investigates the effect of penalty coefficient and finds enforcement on the performance of the algorithm. Based on the experience gained from the training of the Two-Loop network problem, the discrete STA has successfully achieved the best known results for the Hanoi and New York problems. S.K. K *et.al* [16] describes paper proposes a scheme by compressing encoded data with the help of a subservient data and Huffman coding. The encoded data is then compressed using a quantization mechanism and Huffman coding. To quantize the image subservient data obtained by the data owner is used. The quantized values are then coded by the use of Huffman coding. Experimental results show that the compression ratio distortion performance of this method is superior to the traditional Techniques. T. Turker *et.al* [18] discussed about a new data hiding technique is proposed based on hidden sharing scheme with the DNA exclusive operator for color images. Each input value of truth table is analyzed and according to that analysis, highest PSNR value is selected for secret sharing. The comparison of these techniques indicates that proposed techniques give the most successful result. M.Samiha *et.al* [11] describes paper presents a comprehensive analysis between the DNA-based play RSA, AES ciphers, fair, and vigenere each combined with a DNA hiding method. The conducted analysis results the performance diversity of each combined method in terms of security, speed, hidden storage in addition to both key size and data size. J.Reza *et.al* [6] discussed about, improvement of image compression through steganography. The first scheme in addition to a steganographic algorithm with the baseline DCT-based JPEG, while the next one uses this steganographic algorithm with the DWT-based JPEG. In this paper data compression is performed two times. Experimental results shows for this promising method to have wide potential /in image code.

3. PROBLEM FORMULATION

On the basis of literature survey it is found that the technique that was widely used for the purpose of image steganography was LSB (Least Significant Bit). The main unsolved issue is pixel variation in the image while using LSB

(Least Significant Bit) technique. Many techniques have been combined with LSB such as Laplacian Pyramid, Chaos, genetic algorithm etc to provide a solution of variation of pixel but have no positive impact on the issue. Another problem is regarding the security of the data that is hidden behind the image. Hence there is a requirement to develop such a technique that can be able to secure the data as well as maintain the effects of pixel variation in the image that occur after hiding the data.

4. PROPOSED WORK

As steganography is the process of hiding the data in the image. Various techniques have been proposed but still the security of the data that is one of the major concerns while the data transferred is not achieved. So by studying various techniques a new method is to be proposed in which the security of the data is increased. Before hiding the data first of all compression by Huffman Encoding technique will be applied to the data and then DNA is applied for encrypting the data. State Transition optimization is used for hiding the data behind the image. By compression and encryption of the data its security level is increased and is not easily detectable. The proposed work aims to increase the security of the hidden data by applying the HE, DNA and ST.

5. METHODOLOGY

The proposed work is divided into two parts first one is to hide the data and second is to extract the hidden data from stego image. The methodology for the proposed work is given as:

➢ Data Embedding

1. Initially, select the cover image under which data will be hidden. Correspondingly, enter the text which is required to be hidden under the selected cover image.
2. Apply State Transition technique over the entered text for the hiding process. On the other side, Huffman encoding has applied over the entered text.
3. Then Encryption has applied over the compressed data and sends it forward for the hiding of data.
4. Once the compression, Encryption and hiding processes are done, final stego image has acquired in this stage.

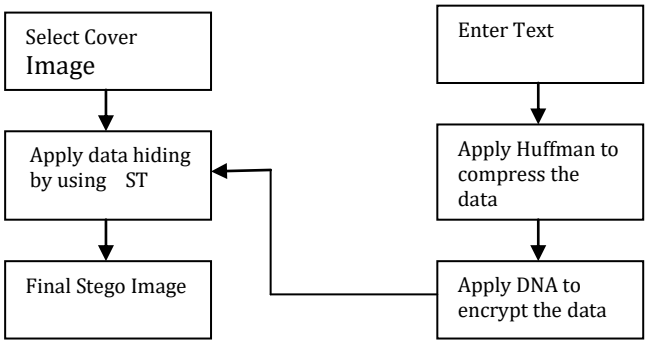
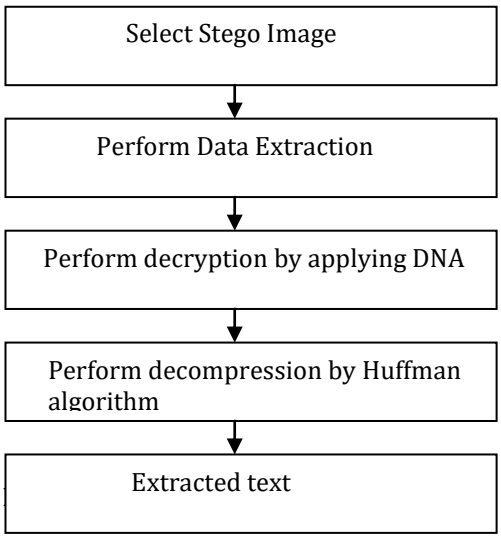


Fig- 2: Block Diagram for data embedding

➢ Data Extraction

At sender's side, text is hidden under cover image and at receiver's side it is uncover. The steps which are followed by the process are given as:

1. In the beginning selects a stego image on which operation has been performed.
2. Perform data extraction operation over the stego image.
3. Then perform decryption of data or text using DNA approach.
4. After decrypting the text, perform decompression over the text using Huffman algorithm.
5. Obtain extracted text from the stego image.



6. RESULTS AND DISCUSSIONS

This section of the paper concludes the objectives of the study in terms of results. Experiments have performed using several techniques and their performances are measured in terms of two parameters such as Peak Signal to Noise Ratio and Mean Square Error.

For the simulation, three different images such as Mandrill image, Lena image and Flower image has been taken. Each image has measured over performance parameters and different techniques i.e. 1-LSB, 2-LSB, LF-DCT, MF-DCT and proposed are applied. The performance of each technique with different images has shown below. The comparison between different technique using different images concludes the proficiency of the proposed technique in terms of different existing techniques.

The graph below shows the PSNR of the Mandrill image, where five different techniques are applied over a single image. Among these techniques, MF-DCT produces least PSNR value which shows the high amount of noise in the image. Alternatively, proposed technique out performs all in terms of PSNR value as in this technique high amount of data lays with respect to noise.

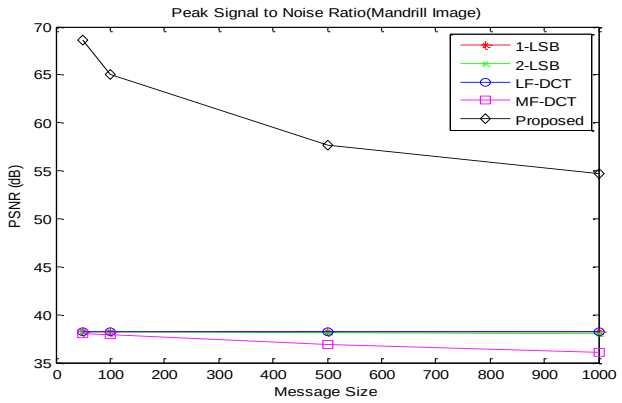


Chart-1: Comparison of different techniques in terms of PSNR(MandrillImage)

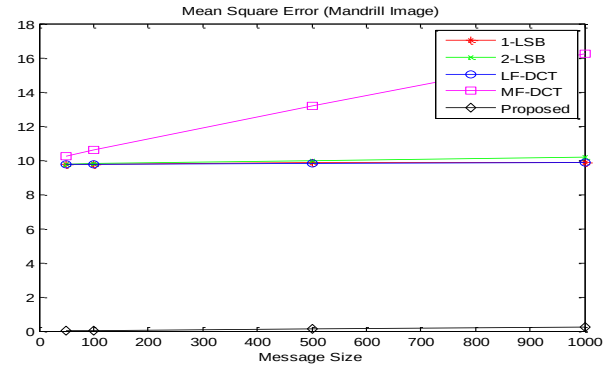


Chart-2: Comparison of different techniques in terms of MSE (Mandrill Image)

The chart 3 and 4 shows the performance parameter PSNR and MSE applied on the Lena image. The techniques are measured on the size of the message. In chart 3 , with variations in the message size, each technique's efficiency is also varies. The proposed technique is superior to other techniques as the PSNR of the proposed technique is quite high.

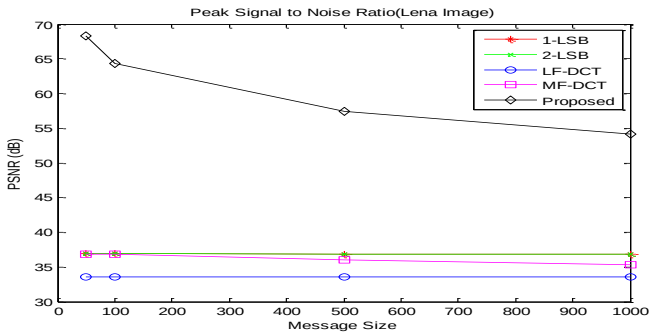


Chart-3: Comparison of different techniques in terms of PSNR (Lena Image)

The chart 4 reveals the MSE of each technique with respect to message size. The LF-DCT exposes the high MSE that means its efficiency is lower in comparison with other techniques. The least MSE value is of proposed technique which ensures that the proposed technique is better.

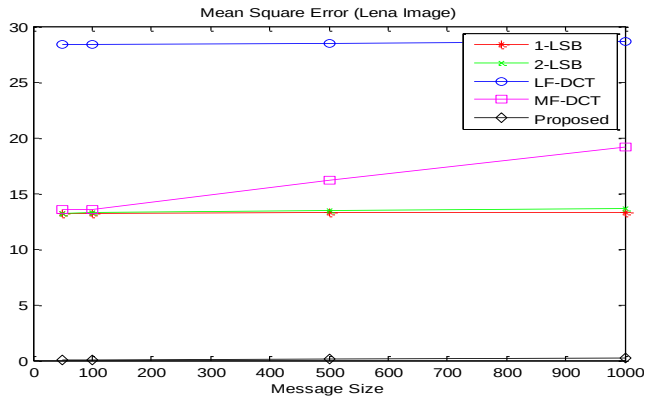


Chart-4: Comparison of different techniques in terms of MSE (Lena Image)

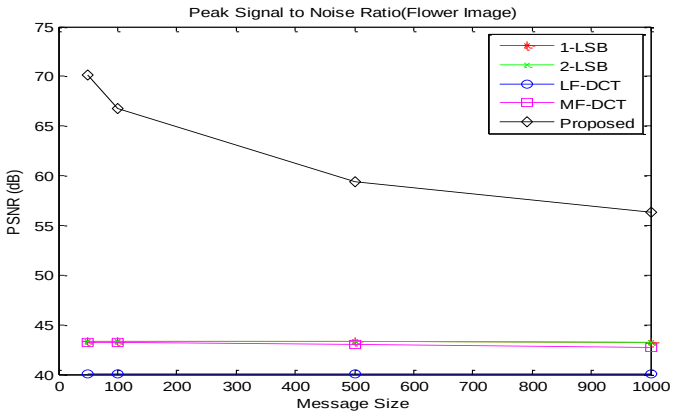


Chart-5: Comparison of different techniques in terms of PSNR (Flower Image)

The chart 5 and 6 depicts the PSNR and MSE parameter in Flower image. And in both the parameters, the result of the proposed technique is enhanced in comparison with other techniques. In both charts, PSNR is higher and MSE is low that confirms its stability,accuracy and proficiency.

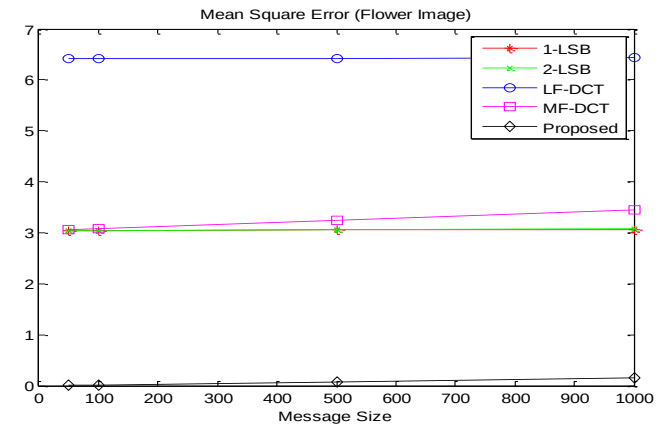


Chart- 6: Comparison of different techniques in terms of MSE (Flower Image)

Table-1: Testing measurements of the proposed technique

Image Used	Message Size (Characters)	1-LSB MSE	1-LSB PSNR	2-LSB MSE	2-LSB PSNR	Proposed MSE	Proposed PSNR
Mandrill	50	9 .7654	38 .234	9 .7804	38 .227	0.0089	68.6327
	100	9 .7766	38 .229	9 .8017	38 .218	0.0204	65.0332
	500	9 .8519	38 .196	9 .9584	38 .149	0.1106	57.6927
	1000	9 .8543	38 .195	10 .158	38 .063	0.2193	54.7204
Lena	50	13 .227	36 .916	13 .237	36 .913	0.0097	68.2650
	100	13 .234	36 .914	13 .258	36 .906	0.0241	64.3116
	500	13 .33	36 .882	13 .422	36 .852	0.1179	57.4148
	1000	13 .333	36 .882	13 .63	36 .786	0.2468	54.2071
Flower	50	3 .0462	43 .293	3 .0468	43 .292	0.0062	70.1890
	100	3 .0468	43 .292	3 .0482	43 .29	0.0136	66.7940
	500	3 .0525	43 .284	3 .0589	43 .275	0.0744	59.4153
	1000	3 .0594	43 .274	3 .0732	43 .255	0.1499	56.3714

The performance of the proposed technique and existing techniques has measured which are indicated in the above table. The acquired values from the results identified the performance of individual technique and conclude that proposed technique is more efficient in comparison with other traditional techniques. The PSNR parameter of each image is high in the proposed technique with respect to traditional technique's PSNR. Correspondingly, MSE is low

in the proposed technique for each image as compared to the existing techniques. Consequently, the proposed technique surpasses the each existing technique.

7. CONCLUSION AND FUTURE SCOPE

The image steganography techniques have been used to embed the secret message under the cover image. The proposed technique has also performed the similar task of stegangraphy with two different algorithms such as DNA and Huffman. Whereas DNA algorithm is used for hiding and decryption of the text and Huffman is used for compression and decompression of the entered data. The experimental analysis concludes that the proposed technique surpasses the other techniques and extracts the message accurately. The comparison of the proposed technique with other techniques has been performed which confirms that the DNA based encryption technique provides high reliability and security. DCT based steganography provides neutral results and has distortion, 1-LSB and 2-LSB based algorithms have least PSNR and high MSE and have maximal distortion. Consequently, proposed technique resultant into low MSE and High PSNR which concludes less distortion and high security.

For the future research, the present work can be applied over the different media such as video. Moreover, the State transition algorithm which is used for the optimization in the proposed work can also be replaced with the more superior optimization algorithm.

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