Design of Image Steganography using M-BAT Optimization

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Abstract:*This paper devotes itself to the study of secret message delivery using the cover image and introduces a novel steganography technique based on bat algorithm. To maintain the same quality even after extraction of the image at the receiving end of the system, we used a data encryption standard approach integrated with wavelet transform for preserving high security. Also to increase the embed capacity modified BAT technique is used that results in high PSNR and low MSE values. With the help of modifications to exploitation, swarm initialization and Torus gives rise to (M-BAT) for fast convergence rate. All the simulations are carried with Matlab 2017a and its evaluation parameters are related with other traditional techniques.*

Keywords:**Steganography;** ***Des; M-Bat Optimization***

I. INTRODUCTION

Today, there is a lot of communication via the Internet. Sensitive information vulnerable to intruder eavesdropping. Both cryptography and steganography are used to protect secret information to assure confidentiality of data.But, through authentication, a third party can see that all sides interact anonymously and the encoded text can be quickly noticed [1]. As previously mentioned, steganography gives an extra protective layer that essentially integrates the media. By fact, the directory used where the information are covered is named "Cover File" and the folder is alluded to as "Stego Subject" with a secret message. The basic structure of steganography is shown in Fig.1.Due to high density [2] of pixels in the image, data can be hiding in it with highly secure and quality with the help of a cover image, so it is best suited for secure communication applications. The technique of image steganography is widely used as protected information for hidden communication. Military organizations copy the right security, such as marking, [3]. Steganography strategies are categorized into two groups: space domain and domain frequency techniques. In the space domain, the encoding of data is concealed explicitly on the object pixel values, and objects are transformed in the frequency domain and transformed coefficients are hidden [4]. As mentioned previously several spatial techniques are available in the literature that is supposed to be applied for secure communication of data.Although the global search is widely used in optimization techniques, they are inflexible with the exploration of data, the local search is replaced for balancing it.

Thus we have created an expanded version of BA named the modified bat algorithm (MBAT) to increase the exploration efficiency.For the authenticity of the new M-BAT methodology, nine well-known reference evaluation features equate with the initial BAT. The PSNR in decibels (dB) is calculated between the original cover image and the corresponding stego image in order to evaluate the functioning of the suggested M-BAT algorithm.

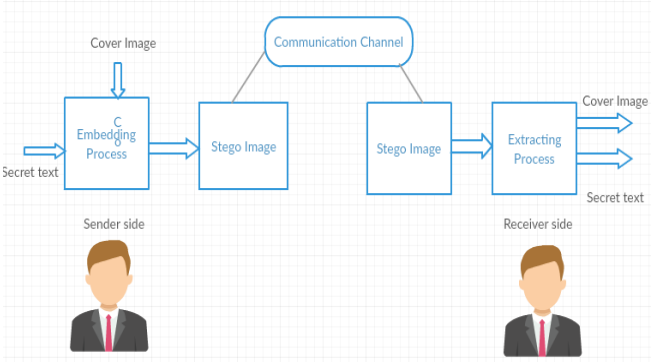

Figure 1. General Steganography mechanism

The mean square error (MSE) is first calculated to calculate the PSNR. The lower PSNR value means that MSE between the original image cover and the labeled picture is negligible and stego image quality is maintained, the original image cover can be restored without distortion after the hidden encoded message has been removed.

The main contributions and organization of this paper are summarized as follows: In section 2 we describe background details of optimizing algorithmstreatment. Section 3 discusses the proposed work. Section 4 deliberates results and discussions. Finally, in section 5, we concluded the paper.

II. BACKGROUND WORKS

In [6], the researchers initiated a research into the technique of cat swarm optimisation (CSO) in order to obtain the optimal or close optimal solution of the problem of stego-image quality. The secret data is covered in a cover image utilizing basic LSB replacement which drastically degrades the image quality. The findings show that the system suggested could achieve the desired resolution with less measurement time.

In [7] the researchers implemented a JPEG-steganography method that uses GA to solve the steganography image problem. This approach could incorporate secret data in the cover image to be RS-resistant.

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At the beginning, it uses the basic LSB replacement technique and covers key parts in the cover image. In order to maximize the safety against RS analysis, pixel values are detected by the GA when the secret data in the cover image are hidden by the LSB. Therefore, it is difficult to detect secret data by way of RS analysis. The results revealed that the resistance of the proposed steganalysis system offers greater performance and a good balance between protection and the subsequent stego-image quality.In [8], the authors adapts and uses basic Particle Swarm Optimization (PSO) as an optimisation technique to solve the problem of stego-image optimisation. The scientific results revealed that the PSO achieved better performance than other methods, including genetic algorithm.

BAT Algorithm:

Bat algorithm operates on microbats echoing and uses bats echo to search for food. It focuses primarily on three rules for the formulation of the bat: Firstly, all bats use echolocation to calculate the distance from the specific point. Secondly, due to the random nature of bats, they used to fly to the particular region maintaining a constant velocity, where its wavelength value varies concerning the time. So bats automatically when they see the target region regulate their wavelengths accordingly. Thirdly, rather than any other method, the researcher found that the intensity ranged from average to low as shown in Fig.2.

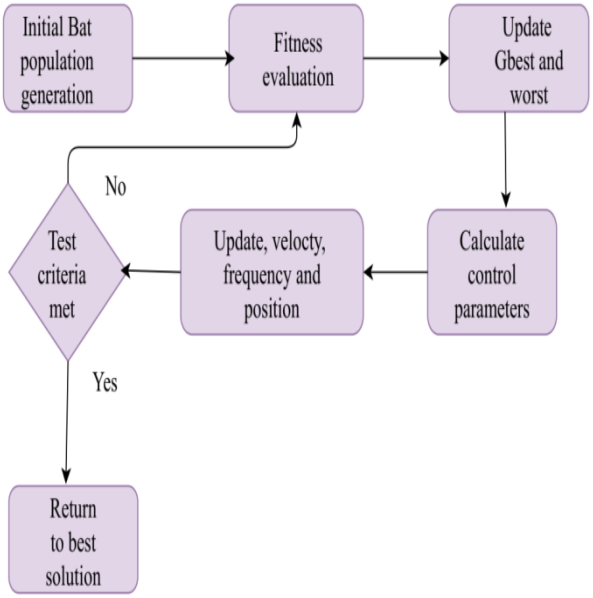

Fig. 2. Flow chart for standard bat algorithm

III. PROPOSED WORK

In the proposed system, mask the text information in the protection image using the modified 2-level DWT bat algorithm. In steganography, the hidden data is normally used to secure and authenticate the element, and each element needs to be encrypted and decrypted by the length of the characters. The cover image is broken into R, G, B planes after a gray image has been transformed. In these planes hidden objects are mounted. Suggested data or image hide concept for encryption and decryption using the DES algorithm. The cover image and hidden images are decomposed at *N*-level and certain DES-factor intensity components are mixed. Secret messages from the stego image are extracted. Again the data obtain forms the bit to last meaningful values and for user key authentication. An estimation of recovery values for MSE variables using PSNR. Development and execution of a plan explicitly to conceal messages in images is shown in Fig.3.

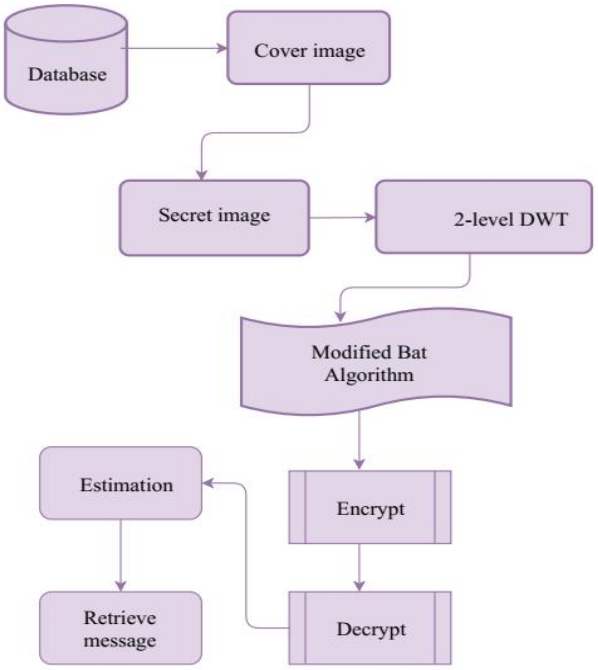

Fig. 3. Flow diagram of proposed model

Wavelet transform:

The wavelet transforms typical image data into a few large coefficients and many small magnitude coefficients are shown in Fig.4. Initially the process of wavelet transformation begins with the decomposing in to components either in to respective time domains or else frequency domains. In four different levels, image or signal are decomposed: approximation, vertical detail, horizontal detail and diagonal detail.

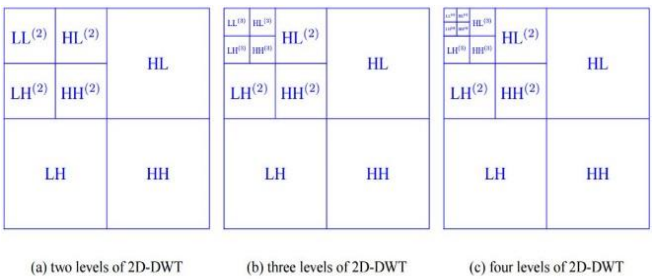

Fig.4. Overview of 2-level DWT scheme

The decomposition on the approximation coefficients is replicated to a point. Since details are not broken up at high levels and the small wavelet coefficients can be defined, the wavelet transformation is not suitable for rapidly validating images.

Modified BAT algorithm:

We made two major contributions to this report as stated above. Next, they created a new form of population initialization using a low differential series, which utilizes the Torus number pattern makes to initialize the random distribution correspond swarm.

Secondly, there is a flexible process for obtain the bat algorithms, thereby enhancing the parameters that are more essential for optimal convergence rate.

A. *Random Number Generator*

The primary requirement of available functions is to generate instant random number in which it is proportional to the respective constant distribution of probability function.

$$f(p) = \begin{cases} \dfrac{1}{q-r} \; for\, q < p < r \\ 0 \; for\, t \langle q \, or \, p \rangle r \end{cases} \qquad (1)$$

Where *q*and *r*supposed to be denoted as likelihood features.

B. *Unique Initialization Method Torus*

In this carried work, there is an efficient implementation for initialization of the population with TO-BA) low differences sequence, which employs quasi-random structure to initialize required Swarm.

C. *Modified Localsearch method*

Through relying on the local search process, they adopted the next change. In standard BA, swarm bats are permitted by using regional random walking through the current region to the new random region. It is clear that searching locally rather than globally patterns play an important role in assessing optimum local conditions.

IV. RESULTS AND DISCUSSION

For the correlation of stego images with cover output, the quality of a particular image test includes widely employed metric so-called PSNR measurement. As it is observed that the value of metric PSNR values to be high, then the difference between the original (no noise) and the blurred image is imperative. The major benefit of this metric is an easy calculation, but it represents notional value. A key feature of PSNR is, a slight spatial change in the image quality can lead to a large numerical distortion, however, if the deviation is localized in a particularly appropriate area, there will be no perceptual distortion, and the opposite is true.

$$MSE = \frac{\sum M,N[I_1(m,n) - I_2(m,n)]^2}{M \times N} \qquad (2)$$

Where,

$$PSNR = 10 \times log10\left[\frac{255^2}{MSE}\right] \qquad (3)$$

Where M and N are the numbers of pixels elements in respective matrix respectively. I_1 treated to be embedded image to be embedded and I_2 treated to be cover image.

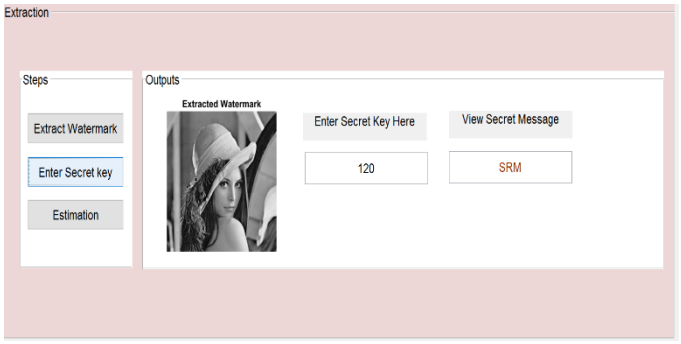

Fig. 5. Extraction Process

Fig. 6. MSE and PSNR Estimation Window

Table 1. Evaluation parameters of images

Image	MSE		PSNR in dB	
	Standard Algorithm	Proposed M-BAT	Standard Algorithm	Proposed M-BAT
Lena	0.0321	0.0114	43.6552	48.1392
Baboon	0.0058	0.0021	45.5203	50.0043
Boat	0.0331	0.0118	43.5624	48.0463
Honeybee	0.0195	0.0069	44.3317	48.8157

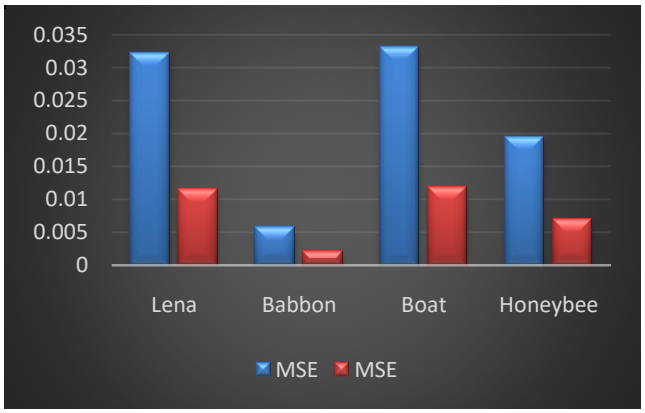

Fig. 7. Comparision of mean square error (MSE)

It is clear from the Fig.7 the MSE value is low for all the four images for propsed M-BAT as related to standard algorithm.

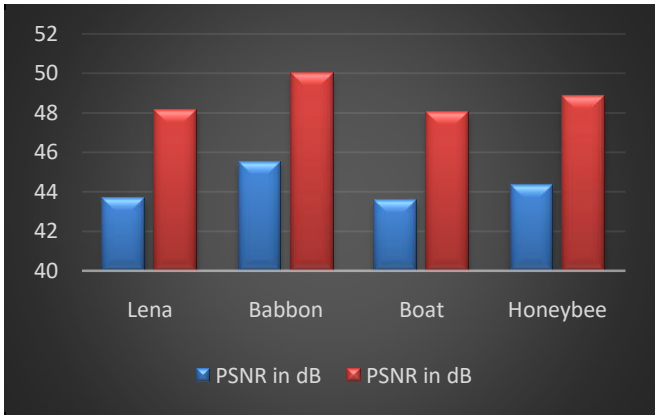

Fig. 8. Comparision of peak signa to noise ratio (PSNR)

It is clear from the Fig.8 the PSNR value is high for all the four images for propsed M-BAT as related to standard algorithm.

V. CONCLUSION

Steganography is the field of science in which the data can be hiding more securely in cover images in a robust manner. In this paper, there is an investigation of how data can be hidden securely and the proposed technique is related to the traditional steganography based on DWT in terms of image evaluation metrics such as PSNR and MSE. It can be observed that there is a dropping of MSE metric to nearly 45.6% and improvement of 11.12% in the PSNR values shows outperformance of the proposed technique. As DES supposed to use for authentication purposes and the M-BAT algorithm greatly improves hiding efficiency. The benefit of using DWT is that it provides a partial remedy over other transformations. PSNR is good, and MSE is much smaller than many current algorithms. This algorithm is also simpler, more stable and secure than other algorithms. Further work needs to be done to increase the computation time required without losing the quality of this system.

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