Text-Image Steganography

Tamanna Jagga, Jyoti Mann

Abstract: Steganography hides the existence of secret information rather than hiding its meaning only. The main aim of steganography is to increase the steganographic capacity and enhance the imperceptibility or undetectability. However, steganographic capacity and imperceptibility are at odds with each other. It is not possible to simultaneously maximize the security and capacity of a steganographic system. Increasing steganographic capacity and enhancing stego image quality are still challenges. Since peak signal-to-noise ratio (PSNR) is extensively used as a quality measure of stego images, the reliability of PSNR for stego images is evaluated in the work described. The proposed work is compared with the existing method using PSNR, NCC, SC as comparison parameters. Proposed technique reduces the requirement to keep record of cover images for secret information extraction. Otherwise for each information received, the receiver should also have the cover image saved with him, which he should recall everytime for each information extraction. Proposed technique is used for the extraction of secret information for which cover image has to be recovered by noise removal methods. In the proposed technique I have tried to obtain the secret image from stego image without having cover image. Soft thresholding and bilateral filtering are the methods used to obtain cover image. Experimental results shows that there's a trade – off between stego image and secret image extracted. It is seen that as we increase the value of alpha, stego image degrades, but secret image improves. The secret image obtained is in visually acceptable form. Results shown are objective and subjective in nature.

Keywords: Alpha blending, Arnold transformation, Bilateral Filtering, DWT, Steganography, Soft Thresholding.

I. INTRODUCTION

Steganography means covered writing. Purpose of it is to hide the fact that communication is taking place. Security is becoming more important as the amount of data being exchanged on the internet increases. Therefore to protect the data from unauthorized access confidentiality and integrity are required. This has resulted in the fast growth of information hiding techniques [1]. Sometimes it is not enough to keep the contents of message secret, it is also important to keep the existence of message secret. The technique used to implement this is known as steganography. The word steganography is derived from Greek words “stegos” meaning “cover” and “grafia” meaning “writing” defining it as “covered writing”. In image steganography the information is hidden exclusively in images [2]. Due to inability to guarantee security, various vulnerabilities exist in the network and gives rise to several security

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attacks. To mitigate such security vulnerabilities and facilitate safe transfer of data over communication channel, techniques like cryptography, steganography are developed. Steganography is the process of hiding data in some cover media like still images, audio, video. Therefore the attacker does not know that information is being transmitted, since it is hidden to the naked eye and impossible to distinguish from cover media.

A. Steganalysis

This is the practice of attacking stego image by detection, destruction, extraction, or modification of embedded data. In steganography the meaning of successful attack means that the attacker is able to identify and has proof that some kind of data is hidden within the stego- image. Successful attack for a pirate attempting to defeat a copyright mark is that he detects and also destroys or modifies the watermark without significant degradation to the perceptual quality of stego-image [4].

II. RELATED WORK

S .K. Moon et al. [1] implemented 4LSB for color bitmap images (24 bit and 8 bit i.e. 256 color palette images) and wave files as the carrier media. By using this proposed algorithm, file of any format can be hidden in an image and audio file.

T. Morkel et al. [2] attempts to identify the requirements of a good steganographic algorithm and reflects on which steganographic techniques are more suitable for which applications.

K Suresh Babu* et al. [3] proposed Steganographic model Authentication of Secret Information in Image Steganography that can verify the reliability of the information being transmitted to the receiver. The method can verify whether the attacker has tried to edit, delete or forge the secret information in the stego-image. The method can verify whether each row has been modified or forged by the attacker.

Eugene T. Lin et al. [4] reviewed various techniques for data hiding in digital images. Features of steganographic systems were also discussed. Finally, an overview of steganalysis was presented.

S.Arivazhagan1 et al. [5] The work deals with Image steganalysis which focuses first in identifying the employed steganographic algorithm and this information is used in deciphering any hidden data in cover images. In this work the stego images are decomposed into its approximation and detail sub bands and from the decomposed sub bands, co-occurrence and statistical features are derived. This leads to detection of steganographic algorithm.

Zhenjun Tang et al. [10] designed an image encryption technique by combining Arnold transform and three random strategies . The security of the scheme depends on the random strategies.. The proposed encryption scheme is robust and secure. It has no size limitation, indicating the application to any size images.

III. PROPOSED METHOD

A. Discrete Wavelet Transform

Discrete Wavelet Transform provides a fast, local, sparse, multi-resolution analysis of real world signals and images. It decomposes signal into a set of basis functions, called wavelets. Wavelet transform provides both frequency and spatial description of an image. The main idea behind DWT results from multi-resolution analysis, which involves decomposition of an image in frequency channels of constant bandwidth on logarithmic scale. DWT can be implemented as a multistage transformation. An image is decomposed into four sub- bands denoted as LL (Low-Low), LH (Low- High), HL (High- Low), HH (High-High) at level 1 in DWT domain. LL sub- band consists of low frequency wavelet coefficients. The LL sub- band can further be decomposed to obtain another level of decomposition. The decomposition process of the LL sub-band continues until the desired number of levels determined by the application is reached. When image is passed through a series of low pass and high pass filters, image is decomposed into sub- bands of different resolutions. From these DWT coefficients, original image can be reconstructed. This reconstruction process is called inverse DWT (IDWT).

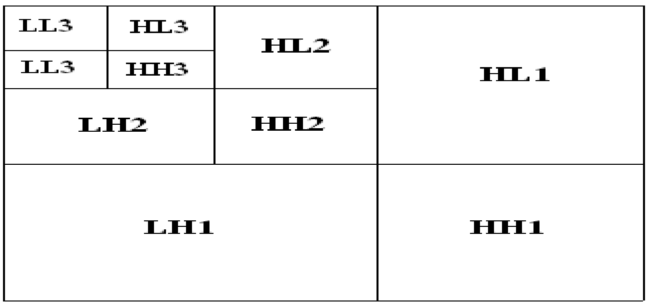

Fig. 1: Three Level Image Decomposition

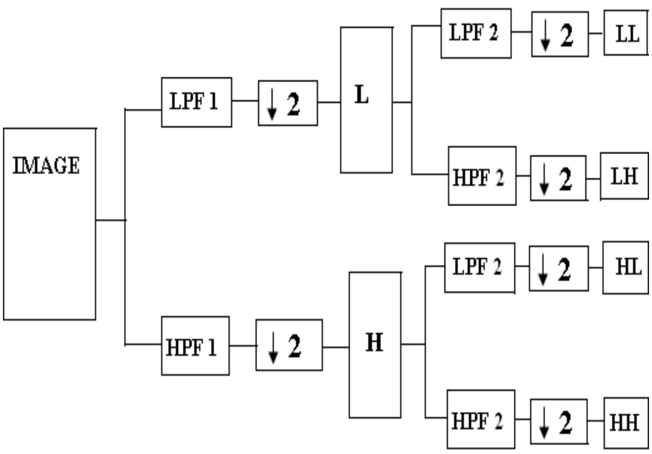

Fig. 2: One Level Decomposition using Two Dimensional DWT

LPF1 represents low pass filtering of image rows, HPF1 represents high pass filtering of image rows, LPF2 represents low pass filtering of image columns, HPF2 represents high pass filtering of image columns.

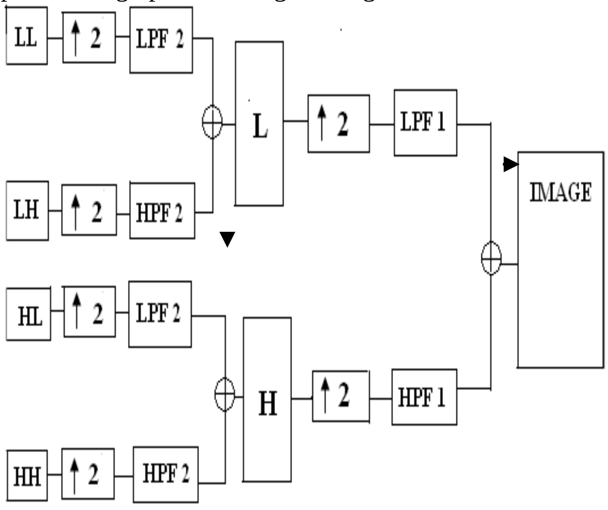

Fig. 3: Image Recomposition

Union of four sub- bands permits to reconstruct the original image. The LL subband comes from low pass filtering in both directions and is mostly like original image and so it is called as approximate component. The remaining sub-bands comes from the combination of low and high pass filter. Components obtained using only high pass filters are called as detailed components. LH preserves vertical edge details, HL preserves horizontal edge details and HH preserves the diagonal details [5][6][7].

B. Arnold Transform

The image encryption algorithms can be classified into two kinds: One is; frequency-based method the other is spatial-based method. The spatial-based algorithms are generally achieved by altering pixel values or swapping the pixel positions. Arnold transform is an efficient technique for position swapping, and widely applied to image encryption. Encryption produces an unintelligible or disordered image from the original image, therefore used to confirm the security and improve the robustness of the steganographic scheme. The transform rearranges the position of image pixels, and if it is done several times, a disordered image can be generated. The special property of Arnold Transform is that image comes to it's original state after certain number of iterations and thereby produces the original image. These number of iterations are called 'Arnold Period' or 'Periodicity of Arnold Transform. It is a one-to-one transformation applied on an image of dimensions N×N, represented by the equation

$$\begin{pmatrix} x' \\ y' \end{pmatrix} = \begin{pmatrix} 1 & 1 \\ 1 & 2 \end{pmatrix} \begin{pmatrix} x \\ y \end{pmatrix} \bmod N$$

(x , y) and (x' , y') ∈ {0, 1, 2, ………………..N-1}

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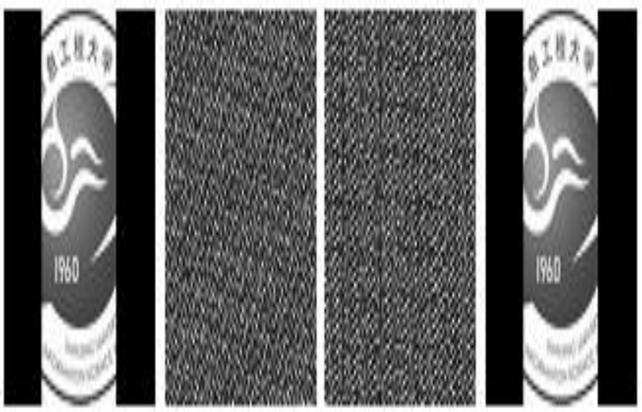
where, A= $\begin{pmatrix} 1 & 1 \\ 1 & 2 \end{pmatrix}$

The above equation rearranges each and every pixel coordinates of the images i.e. realigns the pixel matrix of digital image, where (x, y) is the location coordinates of the original image pixels and (x', y') is the location coordinates of image pixels that after transform. When all the coordinates are transformed, the image we obtain is scrambled image. *N* is the height or width of the square image processed.



(a) (b) (c) (d)

Fig. 4: Image before 20(60, 96) Time Arnold Transform With Cut Original Image

Figure 6a is the 128×128 original image. Fig. 6(b)-(d) shows the image thorough 20/60/96 times Arnold transform. Arnold transform based schemes have a common weakness that image height must equal image width. If one image iterates *m* steps to get scrambled state with Arnold transformation, it can restore its image with the same steps form the scrambled state by anti-Arnold transformation [8-13].

C. Alpha Blending

It is the way of mixing two images together to form a stego image. In this technique the decomposed components of the host image and the secret image are multiplied by a scaling factor and are added. The equation for executing alpha blending is as follows,

Stego Image = k*(LL3) +q*(Secret Image) where, k and q are scaling factors

The blending factor used in the blended image is called the "alpha".

Formula of the alpha blending extraction to recover secret image is given by

Secret Image = (Stego Image – Cover Image) /q [14-15].

D. Implementation

The following session describes the implementation of the encoding and decoding process clearly. The encoding process includes DWT, Arnold transformation, Alpha blending, IDWT and Stego image formation. The decoding process includes DWT, Arnold transformation, Alpha blending, IDWT and Secret image formation.

1. Encoding Process

During encoding process the cover image and scrambled secret image(i.e. with key) are DWT transformed and then alpha blended**.** Next, IDWT was performed to reform the stego image.This secure stego image was transferrred to any communication media. The secret key and alpha blending operation gives more security.

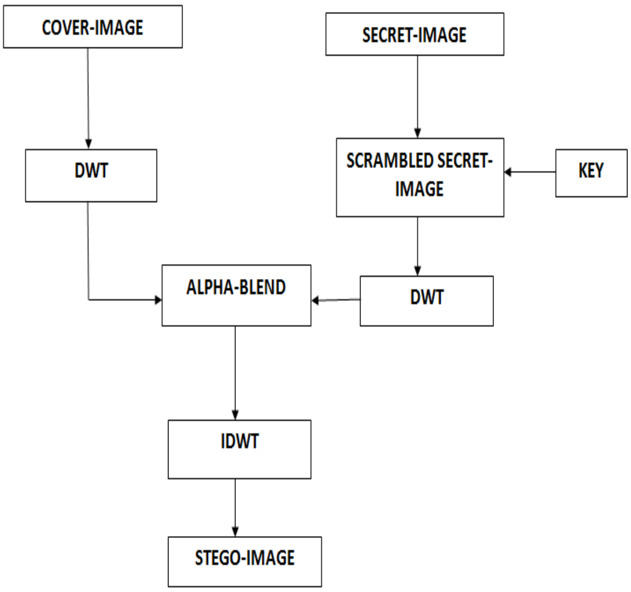


Fig. 5: Encoding Process (Existing Work)

1. Preprocessing both the cover image(N*N) and secret image(N*N).
2. Perform 2-D discrete wavelet transform(DWT) of cover image(N*N).
3. Apply private key with Arnold transformation on secret image and get the scrambled secret image(scrambling provides security and applying key further increases the security level).
4. Perform 2-D DWT of the secret image image(N*N).
5. Extract the approximation co-efficient of matrix(LL) and detail coefficient matrices LH, HL& HH of cover image.
6. Next extract the approximation co-efficient of matrix LL and detail coefficient matrices LH, HLand HH of the scrambled image.
7. Apply alpha blending on cover image and secret image.
8. Perform 2-D IDWT (Inverse discrete wavelet transform) to form stego image.

2. Decoding Process

1. Receive the stego image.
2. Perform 2-D DWT on the stego image and obtain frequency components LL, LH, HL, HH.
3. Pass approximate coefficient LL through bilateral filter and perform soft thresholding on other detailed coefficients.
4. Synthesize the outputs after performing bilateral filtering and soft thresholding and obtain required cover image.

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5. Perform DWT on recovered cover image and stego image.
6. Apply alpha blending on wavelet transformed stego image and cover image.
7. Take IDWT to obtain scrambled image.
8. Perform Arnold Transformation with key and get the original secret image.

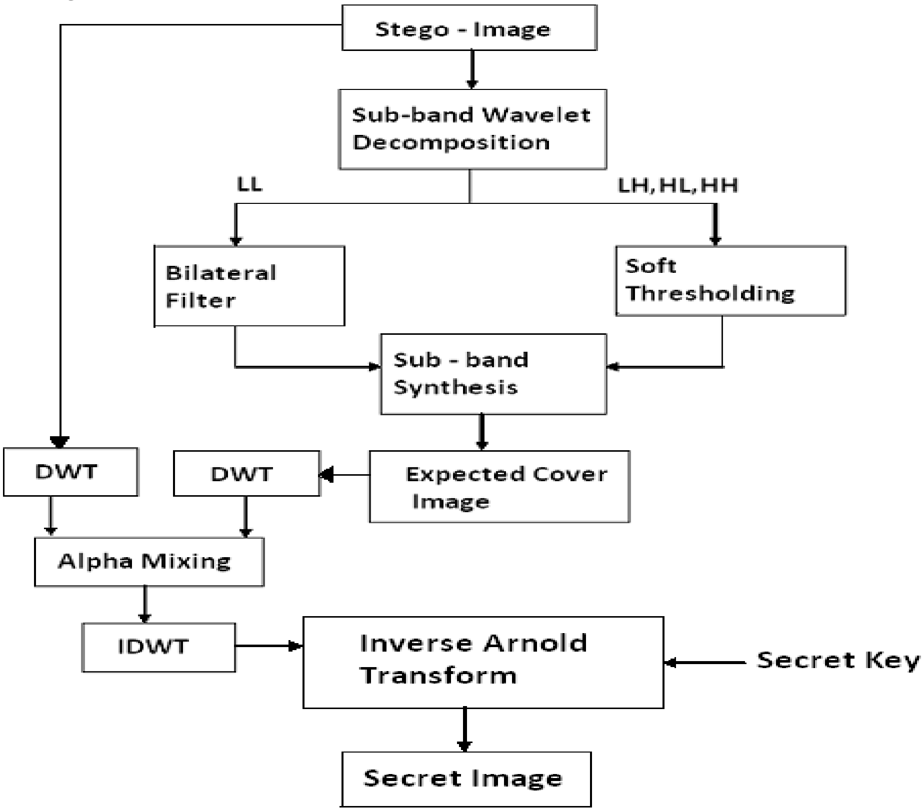
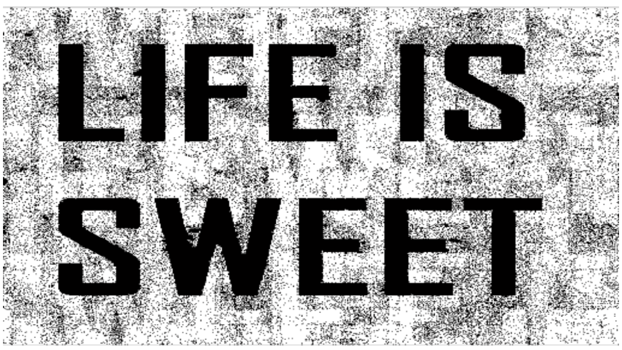


Fig. 6: Decoding Process (Proposed Work)

IV. EXPERIMENTAL RESULTS AND PERFORMANCE ANALYSIS

Implementation of the proposed method has been done using Matlab R2007a. Experimental Design: Mainly, five grayscale images: Lena, Barbara, Goldhill, Peppers, each of 256x256 pixels were arbitrarily selected, Barbara is originally taken of size 512x512 pixels and used as cover images. All the images are resized to 512x512. However, the only reason for choosing these images is being well-known and commonly used in the areas of digital image processing, compression and steganography. Variables used to evaluate the performance of proposed method are PSNR, NCC, SC. The experimental results are for only binary text images (secret images). Bayes Shrink is used for soft thresholding.

V. SUBJECTIVE RESULTS:



Extracted Secret Image(Proposed Technique)

Extracted Secret Image (Existing Technique)

VI. CONCLUSION AND FUTURE WORK

In the proposed technique I have obtained the secret image from stego image without having cover image. This work deals with secret images as binary text images, with text particulary to be black. Experimental results shows that there's a trade – off between stego image and secret image extracted. It is seen that with the increase in the value of alpha, stego image degrades but the secret image becomes more visually acceptable. The information retrieved is of visually acceptable form. Although the results obtained with previous technique were better, but the proposed technique also fulfills the requirement of a steganographic system, with a large advantage over it. Future Work: Experiments can be done for secret images not particulary be text. The work can be extended for color images. One can further try to improve the extracted secret image quality.

TABLE-I COMPARISON OF VARIOUS QUALITY MEASUREMENTS

COVER IMAGE	SECRET IMAGE	PSNR	NCC	S C	ALPHA
1) Lenna.tiff 256×256	Image1.bmp 403×327	24.5116	0.9093	0.8285	0.06
2) Barbara.png 512×512	Name.bmp 403×327	24.8025	0.9129	0.8357	0.06
3) Goldhill.tiff 256×256	Image2.bmp 403×327	24.7838	0.9069	0.8248	0.06
4) Peppers.tiff 256×256	Image3.jpeg 400×325	24.5510	0.9158	0.8409	0.06
5) Lenna.tiff 256×256	Image1.bmp 403×327	30.5322	0.9530	0.9087	0.03
6) Barbara.png 512×512	Name.bmp 403×327	30.8231	0.9551	0.9130	0.03
7) Goldhill.tiff 256×256	Image2.bmp 403×327	30.8044	0.9518	0.9067	0.03
8) Peppers.tiff 256×256	Image3.jpeg 400×325	30.5716	0.9567	0.9159	0.03

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