Secure Digital Image Steganography

Tamanna Jagga, Jyoti Mann

Abstract: Steganography is the art of hiding the fact that communication is taking place. It is the science that hides the information in an appropriate cover carrier like image, text, audio and video media. Established businesses have adopted steganography for covert communication, artists have done the same for intellectual property protection from consumers and advertising agencies. This work proposes a DWT and Arnold Transform based Steganographic technique. Arnold transform is a significant technique of image encryption. Results show that proposed algorithm has good perceptual invisibility.

Keywords: Alpha Blending, Arnold Transformation, DWT, Steganography.

I. INTRODUCTION

Steganography means covered writing. Purpose of it is to hide the fact that communication is taking place. Steganography is the technique to achieve secret communication between two parties that are interested in hiding not only the content of a secret message but also the act of communicating it. Its main goal is to communicate securely in a completely undetectable manner and to prevent arising of suspicion about the transmission of a hidden data. It is not only to stop others from knowing the hidden information, but it is also to keep them thinking that the information does not even exist. If the steganography method causes suspicion in someone about the carrier medium, this indicates that the method has failed. Cover Image: This is the original image into which required information is embedded. It is also termed as carrier image. The information should be embedded in such a manner that there are no significant changes in the statistical properties of cover image. Stego Image: It is an image obtained by the combination of payload and cover image. Its main goal is to communicate securely in a completely undetectable manner and to prevent arising of suspicion about the transmission of a hidden data. It is not only to stop others from knowing the hidden information, but it is also to keep them thinking that the information does not even exist. If the steganography method causes suspicion in someone about the carrier medium, this indicates that the method has failed.[1]-[6]

II. RELATED WORK

Po-Yueh Chen* et al. [7] have proposed secrete message is embedded into the high frequency co-efficient of the wavelet transform while leaving the low frequency co-efficient sub-band unaltered.

S.Arivazhagan1 et al. [8] describes a generic steganalytic scheme that builds a feature database from statistical and Co-occurrence features extracted from DWT decomposition. Though the classifier needs to be checked with a very large database, results are promising to provide useful information to the Steganalyst.

R. Talwar et al. [9] proposed a robust blind watermarking algorithm based on Arnold-Chaoss encryption and combined discrete wavelet transform-discrete cosine transformation. Dual encryption technique is deployed to enhance the security of the watermark. The watermark become more secure because the pseudo-random sequence generated by Arnold and chaos system possesses feature of very high randomness.

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

Pratibha Sharma et al. [13] presented a 3 level DWT based image watermarking technique. This technique can embed the invisible watermark into the image using alpha blending technique which can be recovered by extraction technique. In this technique a multi-bit watermark is embedded into the low frequency sub-band of a cover image by using alpha blending technique. During embedding, watermark image is dispersed within the original image depending upon the scaling factor of alpha blending technique. Extraction of the watermark image is done by using same scaling factor as for embedding.

III. PROPOSED METHOD

A. Dwt

Discrete Wavelet Transform provides a multiresolution analysis of real world images and signals. A 2-dimensional Haar-DWT comprises of two operations: one is horizontal operation and other is vertical operation.

Step 1: Scan the pixels from left to right in horizontal direction and then perform the addition and subtraction operations on neighbouring pixels. Store sum on left and difference on right. Repeat this until all the rows are processed. Difference represents high frequency part (H) and sum represents the low frequency part (L) of the original image.

Step 2: Scan the pixels from top to bottom in vertical direction. Perform addition and subtraction on neighbouring pixels. Store the sum on top and difference on the bottom. Repeat this until all the columns are processed. Finally 4 sub- bands are obtained known as LL, LH, HL, HH. LL sub-band is low frequency band and is much similar to original image. LL sub- band known as approximate sub-band can be decomposed further to obtain higher level DWT. LH, HL, HH are the detailed vertical , horizontal, diagonal sub-bands, respectively [10][11].

Manuscript Received on July 2014.

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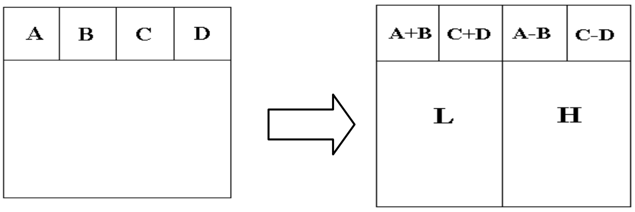

Fig. 1: The Horizontal Operation on the First Row

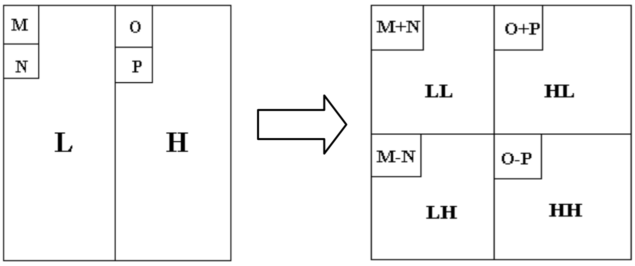

Fig. 2: The Vertical Operation

B. Arnold Transform

Arnold Transform is only suitable for N×N digital images. It is defined as $\begin{pmatrix}x'\\y'\end{pmatrix} = \begin{pmatrix}1 & 1\\1 & 2\end{pmatrix}\begin{pmatrix}x\\y\end{pmatrix}$mod N, (x , y) and (x' , y') {0, 1, 2, ………………..N-1} where (x, y) are the coordinates of original image, and (x',y') are the coordinates of image pixels of the transformed image. It is commonly known as cat face transform. Transform changes the position of pixels and if done several times, scrambled image is obtained. N is the height or width of the square image to be processed. Arnold Transform is periodic in nature. The decryption of image depends on transformation period. Period changes in accordance with size of image. Iteration number is used as the encryption key. Iteration number is used as a secret key for extracting the secret image[7]-[9].

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. It can be accomplished by blending each pixel from the secret image with the corresponding pixel in the cover image. 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 is called the "alpha." Formula for the extraction of secret image is given by Secret Image = (Stego Image – Cover Image) /q Value of alpha determines the level of mixing [12][13].

D. Implementation f Steganography Model

1) Encoding Process

During encoding process the cover image(N*N) and scrambled secret image(N*N) are DWT transformed and 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.

1. Perform 2-D discrete wavelet transform (dwt) at level 2 of cover image (N/4*N/4).
2. Apply arnold transformation on secret image and get the scrambled secret image.
3. Perform 2-D dwt at level 2 of the secret image image (N/4*N/4).
4. Next extract the approximation co-efficient of matrix LA1 and detail coefficient matrices LH1, LV1 and LD1 of level 2 of the scrambled image.
5. Apply alpha blending on cover image and secret image.
6. Perform 2-D IDWT (inverse discrete wavelet transform) to form stego image.

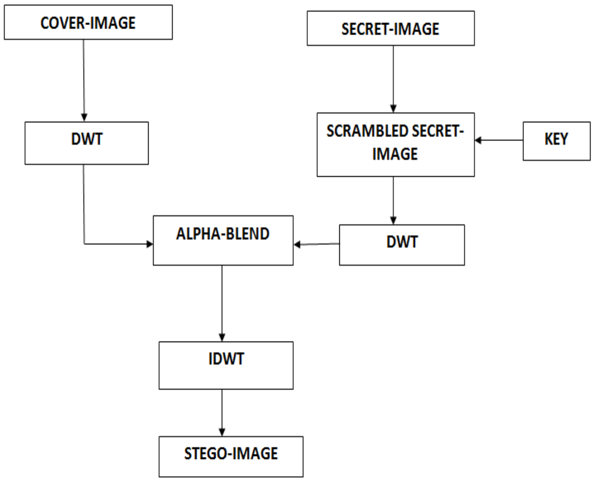

Fig 3: Encoding Process

2) Decoding Process

The received stego image and known cover image are reconstructed with DWT tarnsform followed by alpha blending process. Next, IDWT is performed to rebuild the scrembled secret image. Finally the secret key is applied to get the original image.

1. Receive the stego image.
2. Perform 2-D DWT at level 2 of the stego image amd cover image.
3. Apply alpha blending on both stego image and cover image.
4. Separate wavelet coefficients and take IDWT to reform scrambled image.

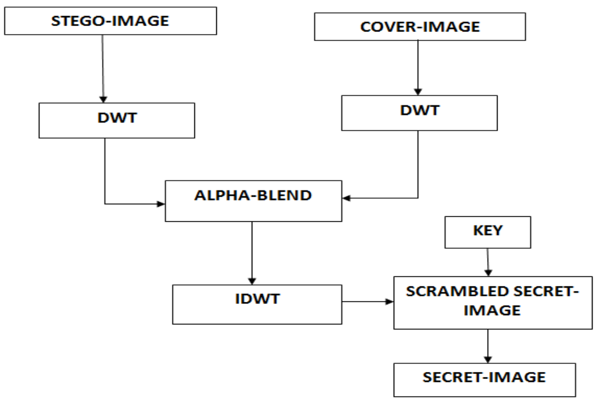

Fig 4: Decoding Process

Published By:
Blue Eyes Intelligence Engineering
& Sciences Publication Pvt. Ltd.

IV. EXPERIMENTAL RESULTS AND PERFORMANCE ANALYSIS

It is experimentally observed that as the value of alpha increases PSNR and NCC decreases, MSE increases. Peak Signal To Noise Ratio (PSNR), Normalized Cross Corelation(NCC), and Mean Square Error(MSE) are the parameters used for evaluating the performance of the proposed technique. Peak Signal to Noise Ratio measures the distortion between stego image and cover image. MSE corresponds to the difference between stego image and cover image.NCC measures the degree of similarity between cover image and stego image. Ideal value of NCC is 1.

V. CONCLUSION

It is experimentally observed that as the value of alpha increases PSNR and NCC decreases, MSE increases. Peak Signal To Noise Ratio (PSNR), Normalized Cross Corelation(NCC), and Mean Square Error(MSE) are the parameters used for evaluating the performance of the proposed technique. Peak Signal to Noise Ratio measures the distortion between stego image and cover image. MSE corresponds to the difference between stego image and cover image.NCC measures the degree of similarity between cover image and stego image. Ideal value of NCC is 1.

TABLE-I

COMPARISON OF VARIOUS QUALITY MEASUREMENTS ON COVER IMAGES AND STEGO IMAGE WITH SECRET IMAGES

COVER IMAGE	SECRET IMAGE	PSNR	MSE	NCC	ALPHA
1)Barbara.png 512×512	*Lenna.tiff 256×256*	52.3777	1.1552e+005	0.9956	0.005
2)Peppers.tiff 256×256	*Baby.jpg 600×420*	51.0117	3.5483e+004	0.9962	0.005
3)Barbara.png 512×512	*Lenna.tiff 256×256*	48.2953	2.9572e+005	0.9930	0.008
4)Peppers.tiff 256×256	*Baby.jpg 600×420*	46.9293	9.0836e+004	0.9940	0.008
5)Barbara.png 512×512	*Lenna.tiff 256×256*	46.2722	3.7427e+005	0.9922	0.009
6)Peppers.tiff 256×256	*Baby.jpg 600×420*	45.9063	1.1496e+005	0.9932	0.009
7)Barbara.png 512×512	*Lenna.tiff 256×256*	45.5292	5.5910e+005	0.9905	0.011
8)Peppers.tiff 256×256	*Baby.jpg 600×420*	44.1633	1.7174e+005	0.9917	0.011
9)Barbara.png 512×512	*Lenna.tiff 256×256*	45.3571	4.6207e+005	0.9914	0.01
10)Peppers.tiff 256×256	*Baby.jpg 600×420*	44.2482	1.4193e+005	0.9923	0.01

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