

# Comparative Study on Different Image Steganography Based Edge Detection Approach

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**ABSTRACT:** Steganography is become a well-known feature of hiding secret messages within every day, seemingly innocuous objects to produce a stego text. The recipient of a stego image/message can use his knowledge of the particular method of steganography employed to recover the hidden information from the stego image. This paper shows a technique for image steganography using edge detection for colour images. We have basically used 2nd level transform of haar wavelet after embedding secret message. Edge detection is the most important feature of image processing for object detection, it is crucial to have a good understanding of edge detection algorithms/operators. Here, We have used the approach of Wavelet based Technique for Steganography and sobel method for edge detection. Here a comparative study is done between different steganography algorithms using edge detection.

**KEYWORDS:** Steganography, Information hiding,, Haar Wavelet Transform, Stego image, Pixel Value Differencing, Secret Message, Security, PSNR, MSE, Threshold, Edge Detection.

## I. INTRODUCTION

Edge detection of an image reduces the amount of data and filters out useless information, without changing important structural properties in an image. Edge detection is kind of a fundamental concepts which is used for image segmentation. Steganography can be defined as the art and science of invisible communication. This is accomplished through hiding information in other information, thus hiding the existence of the communicated information. Though the concept of steganography and cryptography are the same, but still steganography differs from cryptography. Cryptography focuses on keeping the contents of a message secret, steganography focuses on keeping the existence of a message secret. Steganography is the method for secret communication. The word “Steganography” derives from Greek and it means “cover writing”.Steganography is the art of hiding information within other information in such a way that it is hard or even impossible to tell that it is there. The proposed method has the ability of hiding secret message in a digital color image. In image steganography, many different image file formats exist. For different image file formats, different steganographic algorithms are there. Here we compare between three approach to say that our method shows better results in hiding capacity and detecting the edges partially.

In our experiment different kind of color images are basically used, in which plaintext used as a secret message which are hidden. Our used technique of steganography is implemented using wavelet transform approach to hide secret message in gray and color images and results are compared.

## II. WAVELET TRANSFORM

In the decomposition level 1, the image will be divided into 4 sub bands, called LH, LH, HL, and HH . The LL sub band is a low-resolution residue that has always low frequency components, which are often referred to as the average

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the image. LH provides vertical detailed images. HL provides detailed images in the horizontal direction of image, The HH sub band of the image gives details on the diagonal, the while LL sub band is divided again at the time of decomposition at a higher level i.e. LL sub band can be further decomposed into four sub bands labelled as LL2, LH2, HL2, and HH2 as shown in Figure.

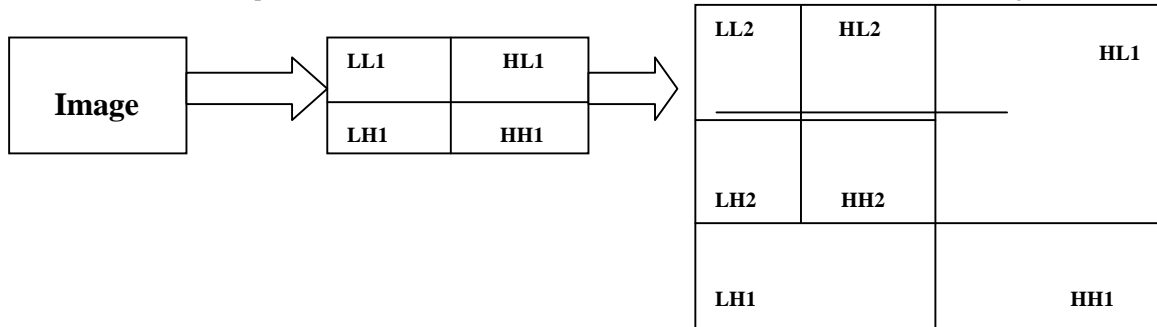


Figure1:- Different Level Transfer of Wavelet upto 2 nd level

### III. LSB METHOD

One of the popular and oldest technique for hiding the message in a digital image is the LSB based data hiding. In LSB method hiding is done in the least significant bits (LSB's) of pixel values of an image. In this approach binary equivalent of the secret message is distributed or altered among the LSBs of each pixel.

- |   |
|---|
| <p>Step 1: Take Input Cover Image X of <math>m * n</math>.<br/> Step 2: Convert the image into grey scale.<br/> Step 3: Take the message.<br/> Step 4: Convert this message stream into bit stream.<br/> Step 5: Hiding is done Using LSB based hiding technique.<br/> Step 6: Generate the image after hiding data.<br/> Step 7: Execute the further steps of Sobel edge-detection.<br/> Step 8: A threshold value is taken and it is compared with the pixel gradients. If the gradient value is lesser than threshold value, it is not considered as the edge pixel. Other pixels are edge pixels.<br/> Step 9: Final image is received and compare it with Threshold values.<br/> Step 10: Compute Mean Square Error(MSE) and Peak Signal to Noise Ratio(PSNR) and Time to execute.<br/> Step 11: Obtained Stego Image and Edge Detected Image.<br/> Step 12: End</p> |
|---|

Figure2:- Steps of LSB Approach For Edge Detection

### IV. SOBEL EDGE DETECTION METHOD

In Sobel edge detector, the task of edge detection is fulfilled by performing a 2D spatial gradient convolution operation on an image. The sobel edge detector computes the gradient by using the discrete differences between rows and columns of a 3X3 neighborhood. The sobel operator is based on convolving the image with a small, separable, and integer valued filter. In below a sobel edge detection mask is given which is used to compute the gradient in the x (vertical) and y (horizontal) directions[27],[11]. This is given in below:-

-1	0	+1
-2	0	+2
-1	0	+1

+1	+2	+1
0	0	0
-1	-2	-1

Figure3:- Sobel Method

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## V. PROPOSED APPROACH

Here We have used haar wavelet transform for wavelet decomposition. Here firstly we embed some message to the image , then wavelet transform is done and after that the edge detection is done using sobel method.

Step 1: Take Input Cover Image X of  $m * n$ .  
 Step 2: Convert the image into grey scale.  
 Step 3: Enter the name different name of wavelet.  
 Step 4: Find the DWT coefficients [LL, LH, HL, HH] of image X.  
 Step 5: Decompose the vertical component up to 2-nd level.  
 Step 6: Encrypt the secret data into binary form in cover image.  
 Step 7: Generate the image after hiding data.  
 Step 8: Execute the further steps of Sobel edge-detection.  
 Step 9: A threshold value is taken and it is compared with the pixel gradients. If the gradient value is lesser than threshold value, it is not considered as the edge pixel. Other pixels are edge pixels. Final image is received and compare it with Threshold values.  
 Step 10: Compute Mean Square Error(MSE) and Peak Signal to Noise Ratio(PSNR), and Time to execute.  
 Step 11: Obtained Stego Image and Edge Detected Image.  
 Step 12: End

**Figure4:- Steps of Proposed Wavelet Based Edge Detection Approach**

We have Used Some Cover Image for experimental purposes are shown below:-



a



b



c



d

**Figure5:- Original Cover image of (a) image1, (b) image2, (c) image3, (d) image4**

## VI. EXPERIMENTAL RESULTS

The algorithm performance is tested using a lot of images. The simulations results are taken in MATLAB environment. Here, MSE/PSNR is the kind of standard and widely used metric for quality assessment of image. Physically, it represents the error due to difference between the original and distorted images. Mathematically it is given, for a gray scale image wherein the intensity range of pixels is 0-255, by Eqn. 1.

$$MSE = \frac{1}{mn} \sum_{i=0}^{m-1} \sum_{j=0}^{n-1} \| I(i, j) - K(i, j) \|^2 \quad (1)$$

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where  $I(i, j)$  and  $K(i, j)$  are intensity values at pixel locations  $(i, j)$  in the original and distorted images of size  $m \times n$  respectively. How Much Lower the numerical value of MSE, better is the image quality. As the image is considered as a signal represented in spatial domain, any amount of noise or distortion may be found to affect its quality significantly. After adding noise to the image, the assessment of the ratio of signal component to noise component is done using PSNR. This parameter makes use of MSE and gives an assessment up to what extent the peak noise is present within the signal (image). Mathematically, it is clearly shown by Eqn. 2. where  $MAX_I$  is the maximum intensity of the pixels of the image and MSE is the mean square error for the pixels. PSNR is Peak Signal To Noise Ratio for Image.

$$PSNR = 10 \cdot \log_{10} \left( \frac{MAX_I^2}{MSE} \right) = 20 \cdot \log_{10} \left( \frac{MAX_I}{\sqrt{MSE}} \right) \quad (2)$$

Here the Stego image is generated after hiding message in it that is shown in given below. So the figure below shows the cover and stego images of used image. If , We compare two results of Pixel value Difference method of Steganography method, LSB Approach and Our proposed Wavelet based approach then we can see for proposed wavelet steganography method gives higher PSNR value and lower MSE value than other method.

Image	Pixel value Difference PSNR	Pixel value Difference MSE	LSB Approach PSNR	LSB Approach MSE	Wavelet Based Approach PSNR	Wavelet Based Approach MSE
Image1	42.084	4.0237	43.3503	3.0064	50.3776	.5961
Image2	41.957	4.1432	43.3052	3.0376	50.2033	.6205
Image3	42.872	3.3567	43.3541	3.0034	50.5965	.5668
Image4	42.598	3.5745	43.3492	3.0049	50.5629	.5712

**Table1:- Comparative Results of Different Method**

We can see that the wavelet based proposed method gives better PSNR and MSE values than other. If PSNR values are higher and error is lesser then the hiding is better and image quality is higher. The Table1 shows the higher PSNR values in the range of 50. Also for pixel value difference method the MSE values are higher.

Image	Pixel value Difference Execution Time Sec	LSB Approach Execution Time Sec	Wavelet Based Approach Execution Time Sec
Image1	.2107	.0277	.3789
Image2	.2789	.0289	.4669
Image3	.2321	.0169	.4113
Image4	.2943	.0187	.4359

**Table2:- Comparative Results of Execution Time Of Different Method**

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## VII. ANALYSIS

The variations of Peak Signal To Noise Ratio is shown in Different Methods are shown in figure below. The figure shows that the PSNR values of proposed method give better performance than other methods.

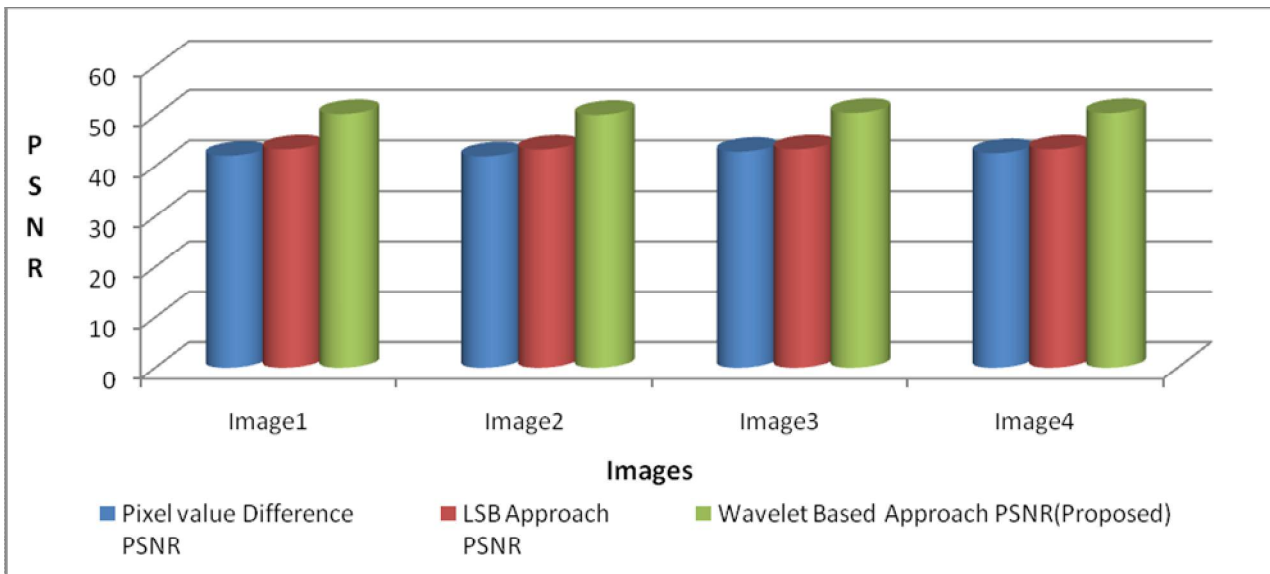


Figure6:- Graphical representation of PSNR values

The variations of Mean Square Error(MSE) is shown in Different Methods are shown in figure below. The figure shows that the MSE values of proposed method give better performance than other methods. In this figure the PVD method contains higher mse values than other but the wavelet based method consists less mse values.

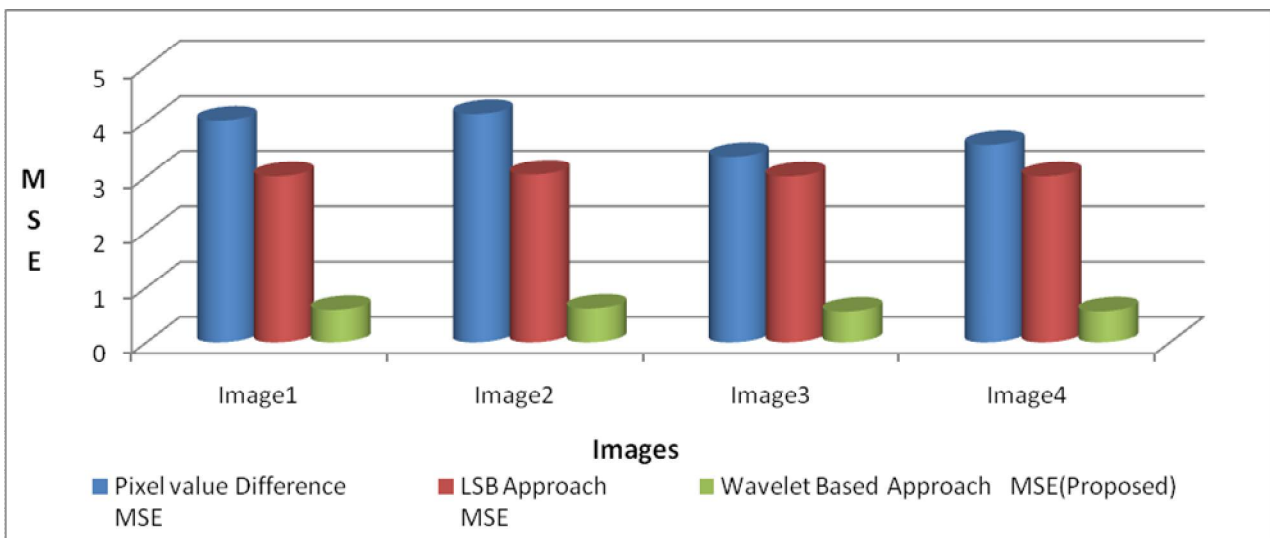


Figure7:- Graphical representation of MSE values

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In the graphical representation of time graph the execution time of proposed wavelet method require higher time period because upto 3-rd level decomposition time requirement become higher. LSB Based Approach gives lower execution period than other methods.

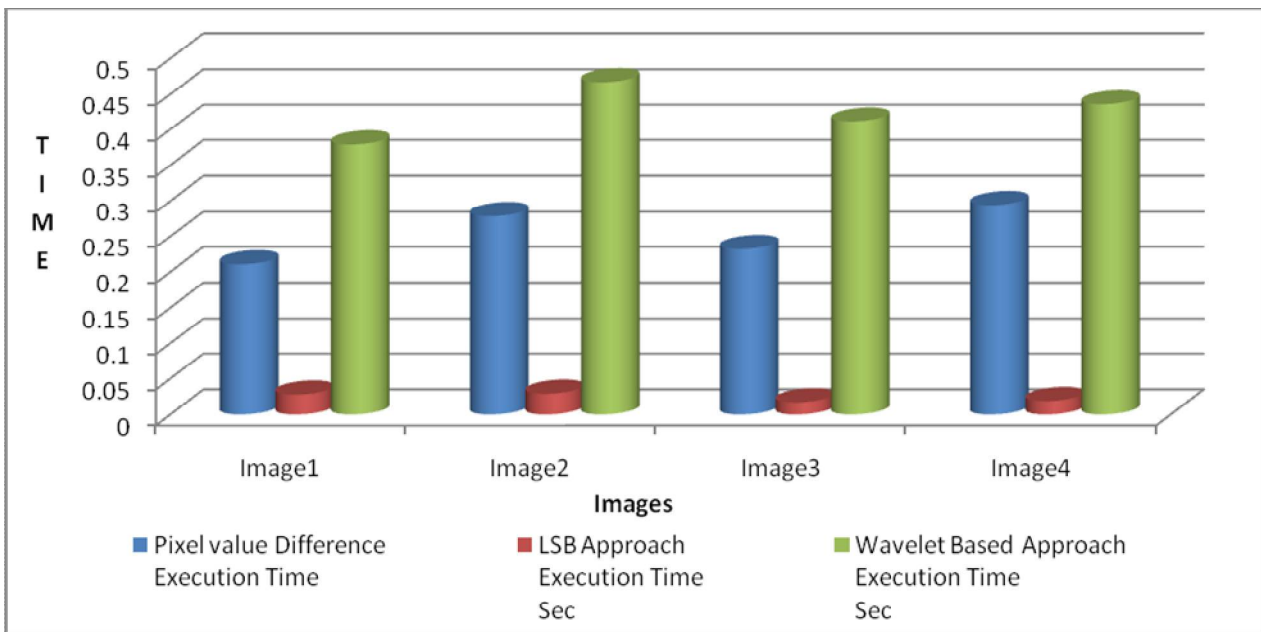


Figure8:- Graphical representation of Execution Time values

## VIII. CONCLUSION

This work proposed an algorithm that is combination of edge detection method and data hiding method for encoding. From the above sections we can conclude that proposed algorithm has shown better results. The performance of proposed algorithm has been implemented by embedding messages within the Original images to produce stego images. When these stego-images are decoded, the messages which are hidden basically fully recoverable. Here the changes of edge detected image according to threshold level also shown in given technique. In our technique the quality of stego image is very impressive. The Embedding capacity of the image is increased by using the concept of Edge Detection. The proposed algorithm produces better capacity of stego images due to use of several edge detection method. So, the technique shows slightly better performance rather than the other method which we have used for our experiments.

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## REFERENCES

- [1] Y.Ramadevi, T.Sridevi, B.Poornima, B.Kalyani, " Segmentation And Object Recognition Using Edge Detection Techniques", International Journal of Computer Science & Information Technology (IJCSIT), Vol 2, No 6, December 2010.



## International Journal of Innovative Research in Science, Engineering and Technology

(An ISO 3297: 2007 Certified Organization)

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- [2] Beant Kaur, Mr. Anil Garg, "Comparative Study Of Different edge Detection Techniques", International Journal Of Engineering Science And Technology (IJEST).
- [3] Meghana D. More, G.K. Andurkar, "Edge detection techniques :a comparative approach", World Journal of Science and Technology 2012, 2(4):142-145.
- [4] Madhuri A. Joshi, "digital image processing(algorithmic approach)", PHI.
- [5] R. C. Gonzalvez and woods "digital image processing" third edition.
- [6] D. Ziou and S. Tabbone, "Edge detection techniques: An overview", International Journal of Pattern Recognition and Image Analysis, 8(4):537-559, 1998.
- [7] W. Zhang and F. Bergholm, "Multi-scale blur estimation and edge type classification for scene analysis", International Journal of Computer Vision, vol 24, issue 3, Pages: 219 - 250, 1997.
- [8] <http://pirsquared.org/research/mcgilldb/Flowers.html>.
- [9] <http://www.mathworks.com>
- [10] Pramit Brata Chanda, Santanu Datta, J Paul Choudhury, Sakil Ahamed Khan, "Performance Analysis Of Different Edge Detection Approaches", Proceedings Of National Conference On Recent Developments in Electrical, Electronics and Engineering Physics, RDE3P-13, ISBN: 978-81-8424-877-7.
- [11] Sunanda Gupta, Charu Gupta, S.K. Chakarvarti, "Image Edge Detection: A Review", International Journal of Advanced Research in Computer Engineering & Technology (IJARCET) Volume 2, Issue 7, July 2013.
- [12] Sneha Arora, Sanyam Anand, "A New Approach for Image Steganography using Edge Detection Method", International Journal of Innovative Research in Computer and Communication Engineering, Vol. 1, Issue 3, May 2013.
- [13] <http://en.wikipedia.org/wiki/sobel/>
- [14] Amanpreet Kaur, Sumeet Kaur, "Image Steganography Based on Hybrid Edge Detection and 2k Correction Method", International Journal of Engineering and Innovative Technology (IJEIT) Volume 1, Issue 2, February 2012.
- [15] H. B. Kekre, Sudeep D. Thepade, Ratnesh N. Chaturvedi, "Block Based Information Hiding using Cosine, Hartley, Walsh and Haar Wavelets", International Journal of Advanced Computer Research ISSN (online): 2277-7970, Volume-3 Number-1 Issue-9, March 2013.
- [16] Suvarna Patil, Gajendra Singh Chandel, "Performance Analysis of Steganography Based on 5-Wavelet Families by 4 Levels -DWT", International Journal of Advance Research in Computer Science and Management Studies, ISSN: 2321-7782, Volume 1, Issue 7, December 2013.
- [17] Nikita Kashyap, G. R. SINHA, "Image Watermarking Using 3-Level Discrete Wavelet Transform (DWT)", I.J. Modern Education and Computer Science, 2012, Volume-3, 50-56.
- [18] Pallavi Patil, D.S. Bormane, "DWT Based Invisible Watermarking Technique for Digital Images, International Journal of Engineering and Advanced Technology (IJEAT) ISSN: 2249 - 8958, Volume-2, Issue-4, April 2013.
- [19] C.K Chan and L.M Cheng, "Hiding data in images by simple LSB substitution," Pattern Recognition, pp. 469-474, Mar. 2004.
- [20] Bender, W., Gruhl, D., Morimoto, N., Lu A., "Techniques for data hiding", IBM System Journal, vol. 35, no. 4, pp. 313-336, 1996.
- [21] Colm Mulcahy, "Image compression using the Haar wavelet transform", Spelman Science and Math Journal, vol. 1, no. 4, pp. 22-31, 1995.
- [22] Sherin Youssef, Ahmed Abu Elfarg, Reta Raouf, "A Robust Steganography Model Using Wavelet Based Block Partition Modification", International Journal of Computer Science & Information Technology (IJCSIT) pp. 15-28 Vol 3, No 4, August 2011.
- [23] Vijay V, BhavyaR, "Variable Load Image Steganography using Multiple Edge Detection and Minimum Error Replacement Method", International Journal Of Innovative Research & Development, Vol 2 Issue 1, January, 2013.
- [24] Sujay Narayana and Gaurav Prasad, "Two Approaches for Secured Image Steganography using Cryptographic Techniques and type Conversions", Signal & Image Processing: An International Journal (SIPIJ) Vol.1, No.2, December 2010.
- [25] Wen-Jan Chen a,\*, Chin-Chen Chang b,c, T. Hoang Ngan Le, "High payload steganography mechanism using hybrid edge detector" Expert Systems with Applications 37 (2010) 3292-3301, 2009 Elsevier Ltd.
- [26] Saiful Islam, Majidul Ahmed, "A Study on Edge Detection Techniques for Natural Image Segmentation", (IJITEE), Volume-2, Issue-3, February 2013.
- [27] Mamta Juneja, Parvinder Singh Sandhu, "Performance Evaluation of Edge Detection Techniques for Images in Spatial Domain", International Journal of Computer Theory and Engineering, Vol. 1, No. 5, December, 2009.