IJCRT.ORG ISSN : 2320-2882

INTERNATIONAL JOURNAL OF CREATIVE RESEARCH THOUGHTS (IJCRT)

An International Open Access, Peer-reviewed, Refereed Journal

Analysis of Two Dimensional Data Hiding Technique in Noisy Environment

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Abstract – In this paper, analysis of two dimensional data hiding technique in noisy environment has been presented. Data hiding methods are generally used for protection of multimedia data. The work deals with implementation of third level data hiding technique using wavelet. The proposed work embed the secret data into mid frequency band. After embedding, proposed technique is tested under various attacks such as: noise addition, resizing filtering etc. and simulation results demonstrated that this technique is robust against attacks. All simulation results have been performed on MATLAB platform and displayed.

Index Terms: **Data Hiding, DWT, Attacks, PSNR, NCC.**

1. Introduction

With the advancements in the field of digital image processing during the last decade, digital image data hiding techniques such as watermarking, Steganography have gained wide popularity. Data hiding is a very active research areas. Digital watermarking is a most popular branch of data hiding [1-2]. Watermarking is the method of embedding the watermark into cover image with the help of embedding algorithm for security and other purposes. Generally, the watermarking can be done in spatial domain or transform domain [3]. For embedding more information and better robustness against the common attacks can be achieved through transform-domain approach. Earlier embedding watermark in spatial domain has the advantages of low computational complexity and easy implementation. In literature, various methods like; Discrete Wavelet Transform (DWT), the Discrete Cosine Transform (DCT) and Discrete Fourier Transform (DFT) etc. are used. However, DWT is popular and more frequently used due to its excellent spatial localization and multi-resolution characteristics. Discrete Wavelet transform (DWT) is a mathematical tool for hierarchically decomposing an image. It is a multi-resolution technique that can analyze different frequencies by different resolutions.

2. Implementation

The implementation of proposed work has been divided into two parts which are explain below:

A. Embedding Process

Here in embedding process, firstly we take the host image and 3-level DWT (Discrete Wavelet Transform) is applied to the image which decomposes image into frequency components. In the same manner, 3-level DWT is also applied to the watermark image which is to be embedded in the host image. The wavelet used here is the wavelets of Harr. In this technique, the decomposed components of the host image and watermark are multiplied by a mixing factor and are added. Here, watermark embedded in the mid frequency component of the host image. The watermarked image is obtained by using the formula

$$WMHL3=HL3+k*HL3a; \quad (1)$$

Where WMHL3 = mid frequency component of watermarked image, HL3 = mid frequency component of the cover image obtained by 3-level DWT, HL3a =mid frequency component of Watermark image and k = mixing factor.

After embedding the watermark image with cover image, 3-level Inverse discrete wavelet transform is applied to the

watermarked image coefficient to generate the watermarked image.

B. Watermark Extraction

In the extraction process, firstly 3-level DWT is applied to watermarked image and then cover image which decomposed the image in sub-bands. To recover the watermark image, we use the formula.

$$RW= (WMHL3-HL3)/k; \quad (2)$$

Where RW= mid frequency approximation of Recovered watermark, WM LL3= mid frequency of the watermark image, and HL3= mid frequency of watermarked image.

After extraction process, 3-level Inverse discrete wavelet transform is applied to the watermark image coefficient to generate the final extracted watermark image.

3. Results and Discussion

In simulation, proposed method is applied on test image. To evaluate the performance of the proposed method, different parameters such as PSNR (Peak Signal to Noise Ratio) and NCC (Normalized Correlation Coefficient) values have been calculated.

Sample images

(a)

(b)

(c)

(d)

Fig. 1. (a) Lena (b) Cameraman (c) Barbara (d) RJIT Logo

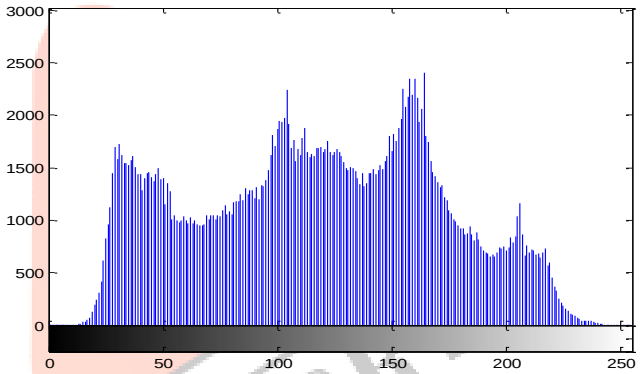
Table-1 simulation results without attacks

Cover Image	MSE	RMSE	PSNR(dB)	NCC
Barbara	7.3242e-04	0.0271	79.51	0.9949
Lena	4.8828e-04	0.0221	81.27	0.9997

Table .1 shows the values of calculated parameters at mixing parameter = 0.02 for RJIT logo as a watermark using Barbara and Lena used as a cover image.

(a) Watermarked image

(b) Recovered image

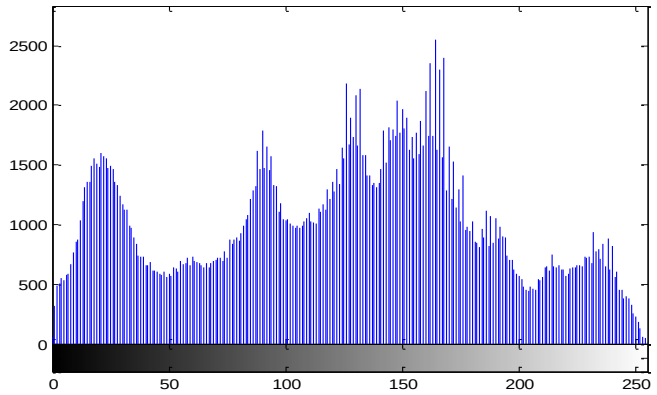


(a) Histogram of Barbara watermarked image

(c) Watermarked image

(d) Recovered image

Fig.3 shows the visual representation simulation results of at SF=0.02.



(b) Histogram of Lena watermarked image

Fig.4 shows the Histogram of watermarked images at SF=0.02.

4. Analysis under noisy environment

To test the proposed method under noisy environment, we have applied a variety of attacks on Barbara watermarked image. The values of PSNR and attacked watermarked images under various attacks has been shown in Fig.4

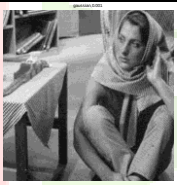
Attacks	Attacked Watermarked image
Salt & Pepper Noise 0.001	
PSNR	35.2395 dB
Gaussian Noise 0.001	
PSNR	20.1830 dB
Speckle Noise 0.001	
PSNR	35.9137 dB
Poisson Noise 0.001	
PSNR	27.4561 dB
Resize attack (512 →256 → 512)	
PSNR	Inf dB
Median Filter [3*3]	
PSNR	36.8986 dB
Median Filter [5*5]	
PSNR	31.3930 dB
Rotate 1	
PSNR	16.9925 dB
Rotate 5	
PSNR	11.3577 dB

Fig.4 shows the visual representation of attacked watermarked images and PSNR values under various attacks. From simulation results shown in fig.4, it has been concluded that the proposed method is also perform good under different kind of attacks like noises, filtering and scaling. The simulated experimental results also assessed with visual representation of watermarked and extracted watermark image.

5. Conclusions

In this paper, analysis of two dimensional data hiding technique in noisy environment has been done. The prime aim of this work is to have good stability and ability to perfect reconstruction of secret data. Firstly this analysis has been performed without applying any attacks as shown Table 1. Thereafter, this analysis has been performed under various geometrical and non-geometrical attacks, such as; Noise addition, resizing of image

and filtering. The value of mixing factor (k) = 0.02 has been set for applying various attacks. From the results shown in tables and figures, it can be seen that proposed work has resistance and good imperceptibility against geometrical and non-geometrical attacks.

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