Performance improvement of simple LSB watermarking using SVD

Sanjeev Kumar

Department Computer Science & Engg.

Amritsar College of Engg. and Technology

Amritsar, India

sarangal.sanjeev@gmail.com

Tanupreet Singh

Department of Electronics and Communication & Engg.

Amritsar College of Engg. and Technology

Amritsar, India

tanupreet.singh@gmail.com

Abstract- **Watermarking is a technique of embedding information or logo into a cover image which is used to verify the identity of its owner. Digital watermarking is the process of data hiding which provide security of data. Its used application is copyright protection of digital information. This paper explains the concept of LSB and modified LSB using SVD. This paper also represents the comparative analysis of simple LSB image and modified LSB image.**

Keyword- Watermarking, Spatial domain, LSB.

I. INTRODUCTION

Watermarking is the process of hiding logo or information in digital information. The information or logo which is embedded in image is called watermarked image. The image where the logo or information is embedded is called host image [1]. The watermarking embeds information into the media without degrading its visual quality. Digital watermarking used to hide information inside the host image which cannot be extracted by the third party. Digital watermarks are inside the information so that ownership of the information cannot be claimed by third party. While some watermarks are visible and most are invisible [2]. The image watermarking consists of a watermark embedded and a watermark detector as shown in figure 1.

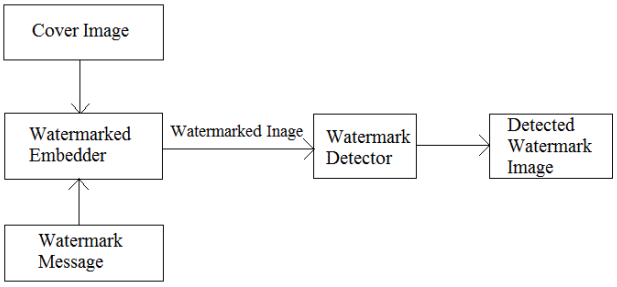


Figure 1. Digital image watermarking

The watermark embedder inserts a watermark into the host image and the detector detects the watermark information or logo.

II. TYPES OF WATERMARKING

There are various types of watermarking which are given below:

A. Inserted Media

Watermarking techniques can be used on the basis of whether they are used for text, image, audio or video.

B. Robust and fragile

In robust watermarking, the modification to the watermarked content will not affect the watermark while fragile watermarking in watermark gets destroyed if watermarked content is modified.

C. Asymmetric and symmetric Watermarking

In asymmetric different keys are used to embed and detect the watermark while in symmetric watermarking same key is used to embed and detect the watermark.

D. Visible and Transparent Watermarking

Visible watermarks are visible when the contents are viewed. Transparent watermarks are imperceptible and the cannot detected by viewing the digital content.

III. TECHNIQUES OF WATERMARKING

Digital watermarking technique can be classified into two categories [3]:

- Spatial domain watermarking
- Frequency domain watermarking

IV. SPATIAL DOMAIN WATERMARKING

In spatial domain watermarking the information is added by changing the pixel value of host image. Least significant bit (LSB) is the example of this category. Any watermarking algorithm has two parts: embedding algorithm and extraction algorithm [4].

V. FREQUENCY DOMAIN WATERMARKING

In frequency domain the watermark is embedded into frequency coefficients of host image. It is more robust than spatial domain due to embedding of watermark into the altered frequency coefficient of the transformed image. Frequency domain watermarking is Discrete Fourier Transform (DFT), Discrete Cosine Transform (DCT) and Discrete Wavelet Transform (DFT) [4].

VI. SIMPLE LSB TECHNIQUE

The least significant bit algorithm is simple, strong and less perceptive. In LSB technique embed the watermark in the least significant bit of pixels. The embedding of watermark is per formed choosing a subset of image pixels and substituting the least significant bit of each of the chosen pixels with watermark [5].

Pixel value of image: 11001010 00110101 00011010……

Watermark: 1 1 1…..

Watermarked image: 11001011 00110101 00011011……

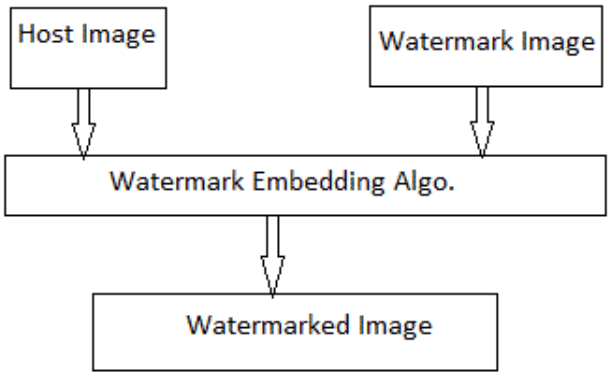


Figure 2. Watermark Embedded

In extraction, we extract the most significant bits of the watermark that we have embedded in the original image. The extracted bits do not exactly match with the inserted bits. A correlation bit vectors can be calculated. If the correlation of extracted bits and inserted bits is above a certain threshold, then the extraction algorithm can decide that the watermark is detected [6].

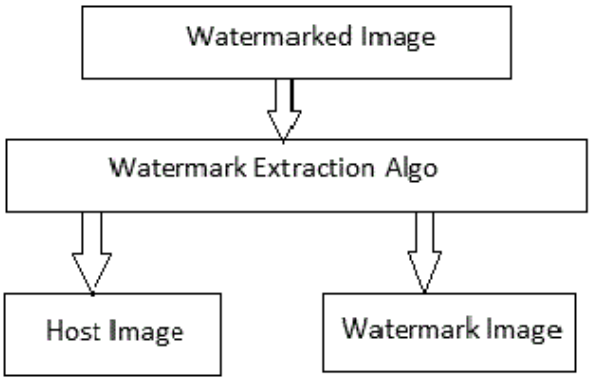


Figure 3. Watermark Extraction

VII. PROPOSED LSB TECHNIQUE

In the proposed image watermarking technique we modified the LSB Algorithm. The modified LSB uses image compression algorithm. We compress the logo image before we embed the logo in the host image. We compress the logo image using Singular Value Decomposition (SVD) technique. The main objective of SVD is to compress the logo image. Singular value decomposition can be performed on any real (m, n) matrix. In this technique factoring a matrix A into three different matrices U, S and V in such a way that A=USV. Where U and V are orthogonal matrices and S is a diagonal matrix [7]. We also compare the results of simple LSB algorithm and modified LSB algorithm.

VIII. RESULTS

In our experimental result we take images of colleges (im1 to im4) as cover image and its logo as watermark. The algorithms are implemented in MATLAB. We measure the quality of watermarked images in terms of PSNR (Peak Signal to Noise Ratio) and MSE (Mean Square Error). In ideal case PSNR should be infinite and MSE should be zero. Practically, large PSNR and small MSE are desirable. The PSNR and MSE value between original and watermarked image is calculated as

$$\mathrm{MSE} = \frac{\sum_{M,N}\left(\mathrm{T}(r,c) - \mathrm{T}'(r,c)\right)^2}{\mathrm{M} * \mathrm{N}} \qquad (1)$$

$$\mathrm{PSNR} = 10\log_{10}\left[\frac{\mathrm{R}^2}{\mathrm{MSE}}\right] \qquad (2)$$

Where T(r, c) is the original image and T'(r, c) is the resultant watermarked image, r and c are the number of rows and columns in the input image. R is the maximum fluctuation in input image data type or maximum intensity value of image. The performance of watermarking are

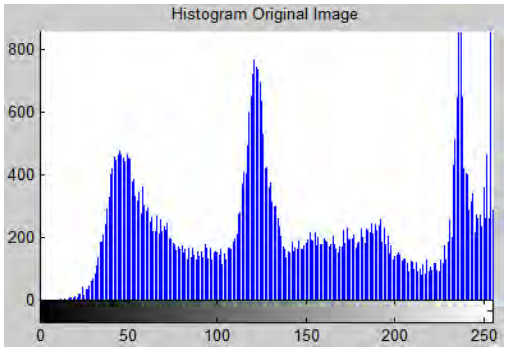
evaluated using various images. In the figure 8.1, (a) input cover image (b) Logo/watermark image (c) resultant watermark image (d) extracted logo from watermarked image.

(a) (b)

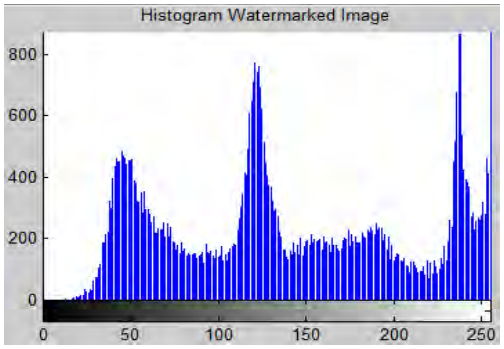
(c) (d)

(e) (f)

Figure 4. LSB watermarking (a) Original Image (b) Logo (c) Watermarked Image (d) Extracted Watermark (e) Noisy Watermarked Image (f) Noisy image Extracted Watermarked.



(a) Original Image



(b) Watermarked Image

Figure 5. Histogram of (a) Original Image and (b) Watermarked Image

Table I. LSB Watermarking Performance Evaluation

Images	Without Noise		With Noise	
	PSNR	***MSE***	***PSNR***	***MSE***
Image 1	51.8003	0.4296	17.7008	1.1041e+003
Image 2	51.8003	0.4296	16.8166	1.3534e+003
Image 3	51.8003	0.4296	17.8301	1.0717e+003
Image 4	51.8003	0.4296	17.8552	1.0655e+003

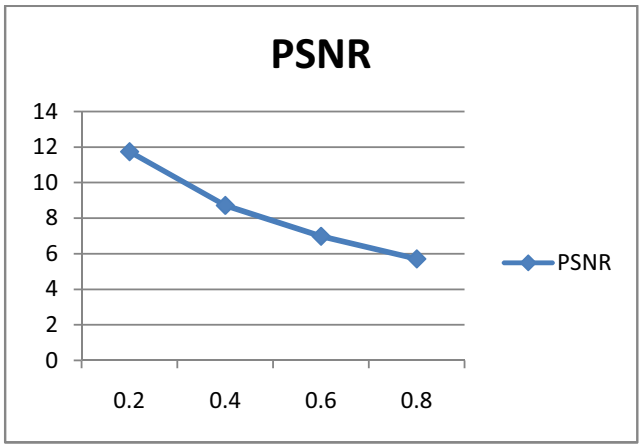


Figure 6. LSB Watermarking PSNR with Noise

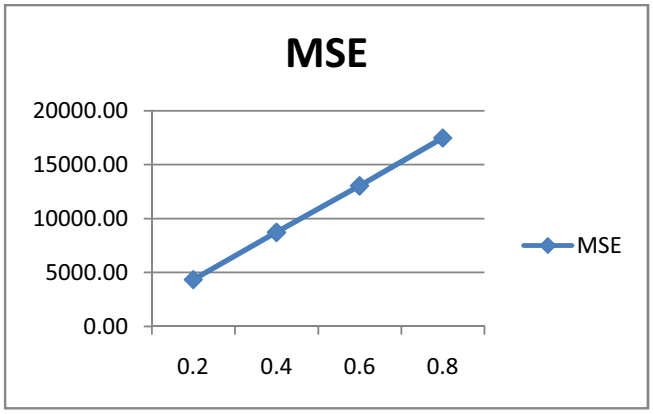


Figure 7. LSB Watermarking MSE with Noise

(a)

(b)

(c)

(d)

(e)

(f)

Figure 8. Modified LSB (a) Original Image (b) Logo (c) Watermarked Image (d) Extracted Watermark (e) Noisy watermarked Image (f) Noisy Image Watermark Image.

Table II. Modified LSB Watermarking performance Evaluation

Images	Without Noise		With Noise	
	PSNR	***MSE***	***PSNR***	***MSE***
Image 1	52.1630	0.3952	17.882	1.1032e+003
Image 2	52.1630	0.3952	16.8526	1.3422e+003
Image 3	52.1630	0.3952	17.9028	1.0539e+003
Image 4	51.8003	0.4296	17.8960	1.0555e+003

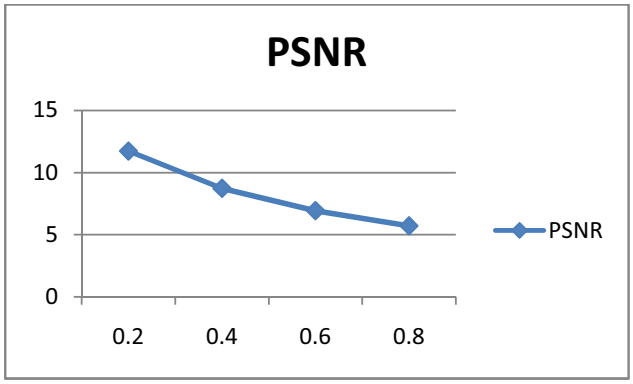


Figure 9. Modified LSB watermarking PSNR with Noise

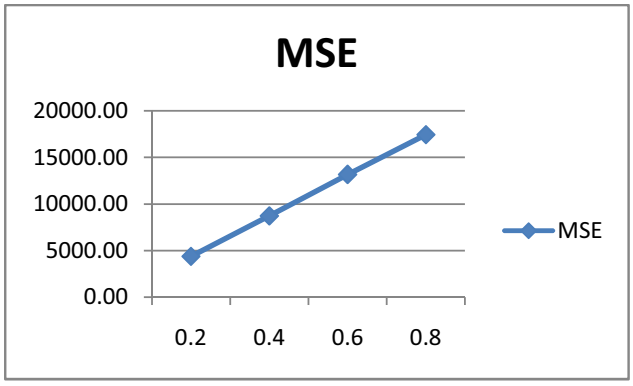


Figure 10. Modified LSB watermarking MSE with Noise

Table III. Comparative Performance Evaluation

Images	Without Noise		Without Noise	
	PSNR	***MSE***	***PSNR***	***MSE***
Simple LSB	51.8003	0.4296	17.8301	1.0717e+003
Modified LSB	52.1630	0.3952	17.9028	1.0539e+003

From Table III we can see the difference between Simple LSB and Modified LSB. As we know that for better image quality PSNR should be large and MSE should be small. In our experimental study modified LSB gives better result as compared to simple LSB.

IX. CONCLUSION

This paper represents the basic of watermarking and watermarking techniques. This paper represents the detailed study of Least Significant Bit (LSB). The experimental study represents modified LSB with SVD. This paper represents how watermark image is embedded in the host image by using the modified LSB with SVD method. By using the singular value decomposition method we compress the logo image and then embed the logo into the host image. This paper also gives the comparison between the simple LSB and modified LSB. This paper also calculates the image quality measure by using the PNSR and MSE between the simple LSB and modified LSB.

REFERENCES

[1] Anubha Aggarwal, Ramnik Singh "Performance evaluation of modified LSB digital image watermarking technique" IJETT, vol. 9 number 5, March 2014.

[2] Gurpreet kaur, Kamaljeet kaur "Image watermarking using LSB" international journal of advanced research in computer science and software engineering, vol.3 issue 4, April 2013.

[3] Menu Singh, Abhishek Singhal "Digital image watermarking techniques: A survey" International journal of computer science and telecommunications, vol. 4, issue 6, June 2013.

[4] Prabhishek Singh, R S Chadha "A survey of digital watermarking techniques, applications and attacks" International journal of engineering and innovative technology, vol. 2 issue 9, March 2013.

[5] Koushik Pal, Goutam Ghosh "A comparative study between LSB and Modified bit replacement watermarking technique in spatial domain for biomedical image security" International journal of computer application and technology, Vol. 1 Issue 1, 2012.

[6] Ankita sengar, Preeti verma "A comparative study on LSB based watermarking and VSS based watermarking" International journal of research in computer application and robotics, vol.1 issue 2, March-April 2013.

[7] Rajesh A Jadav, Shailesh S Patel "Application of Singular Value Decomposition in image processing" Indian journal of science and technology, Vol. 3 No.2 , Feb 2010.