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Positioning of Visible Watermark based on Variance

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ABSTRACT

The growth of number of users excessing the internet has increase enormously in past decade, so a need has arrive to protect the digital content. Digital watermarking is an art of hiding information into digital content. Visible watermark are used to discourage the unauthorized usage of the digital image. If a visible watermark is embedded in the texture region of an image, it didn't cause any degradation in the perceptual quality of the image, to hide image in the high texture we use variance, Variance of the image is higher in the high texture area of the image block. Using this concept we developed a scheme to insert the watermark in the high texture area using Discrete Fourier Transform (DFT). Experimental results show the scheme is able to achieved high PSNR value of the watermarked image and SSIM suggested that the watermarked image is similar that of the original image.

Keywords: Visible watermarking, Variance, PSNR, DFT, SSIM.

I. INTRODUCTION

Digital watermark is an art of putting some information for the protection of digital media from unauthorized uses. As of late the extraordinary development of internet has increase concerned over the authentic use of digital data moreover digital data can also be duplicated and distributed without the knowledge of the digital media owner. Though cryptography can be used to prevent the unauthorized uses by making the content of digital meaning less using a key, but there is a problem with cryptography, once the content of the digital media is decrypted the owner cannot trace the duplication and distribution of its media content. Digital watermarking come in handy for the copyright protection of the digital data. Like steganography digital watermarking is adding some king of owner information along with the digital content. The main different between digital watermark and steganography is in term of robustness. Steganography is a secret mean of communicating between two parties without the knowledge of the third party, once the third party came know about the secret information steganography fail. Not much thought about the robustness is given in steganography but how the information is to be hidden is given the priority in steganography. One more point that distinguishes digital watermark from steganography is the hidden message, in case of steganography the hidden message has nothing to do with the cover image. In Digital watermark, robustness, which mean the ability of detecting the hidden information or watermark after common image processing operation, is the main requirement of digital watermark. Robustness is one of the basic requirement of digital image watermarking. Other than robustness, imperceptibility, capacity and security are also the basic requirement of digital watermark. Imperceptibility or fidelity refer to the perceptual similarity between the original cover work and watermarked image or in other word addition of watermark should hampered or degrades the quality of the cover work. Capacity or data payload mean the amount of information bit that can be embedded onto a cover work. Lastly security refer

the ability of the watermark to withstand against intentional and unintentional attacks [1, 2, 3, 4].

Digital watermark can be categories into visible and invisible watermark according to the perceptibility of the watermark on the cover object. In visible watermarking of images, a secondary image is embedded into a cover image such that the watermark is intentionally perceptible along with cover image. On the invisible watermark, the embedded data is not perceptible. Visible watermark provide an immediate claim ownership of the cover image. Given below are some of the characteristic of visible watermarking [4, 5, 6]:

1. A visible watermark should be obvious for both color and monochrome image.
2. The watermark should be spread in a large or important area of image in order to prevent deletion by clipping.
3. The watermark should be visible but should not obscure the image details beneath in it.
4. The watermark must be difficult to remove. Removing a watermark should be expensive and labor intensive than purchasing the image from the owner.
5. The watermark should be applied automatically with little human intervention and labor.

II. LITERATURE SURVEY

In this section, we have done a survey on visible watermark. IBM digital library organization implemented spatial domain visible watermarking technique to watermark the digitized pages of the manuscript from the Vatican archive [7]. Meng and Cheng 1998 [8] presented a compress domain visible watermarking approach for MPEG-1 and MPEG-2 video stream in which the visible watermark is inserted into the DCT (Discrete Cosine Transform) coefficient which is adaptive to local video feature. Kankankalli and Rajmohan 1999[9] also used DCT to insert visible watermark in which the content of the cover image is used to determine the location and strength of the watermark. They make used of texture, edge and luminance information of the image. Mohanty et al. [6] improved Kankankalli and Rajmohan scheme by using a mathematical model to calculate the embedding and scaling factor for adaptively strengthening the visible watermark. Hu et al 2001[10] proposed a wavelet based visible watermarking scheme in which the luminace masking and spatial activity level of each pixels in the high frequency sub band are used to calculate the scaling factor and calculated luminance value is scaled to adjust watermark strength. Image fusion based visible watermarking is proposed by Hu and Kwong [11], which uses DWT domain and it classified block into different percetual classes based on feature. It uses truncated Guassian function to approximate the effect of luminance masking in the embedding rule and insertion of watermark take place pixel wise. Another DWT (Discrete Wavelet Transform) based visible watermarking scheme is proposed by Yong et al [12]. In this scheme the change in the parameter of the integer wavelet and hash function was used to guarantee the security of the watermark. Yang et al [13] proposed a reversible visible watermarking scheme in which the visible watermark was removable and able to lossesly recover the original host image. In this scheme the watermark was inserted in the region selected by user by adaptively adjusting the pixels value beneath the watermark and the scaling factor are obtained by exploiting the contrast sensitiveness. Huang et al.[14] proposed a visible watermarking scheme in which the strength of the watermark varies from the underlying content of the host image and human sensitiveness to the spatial frequencies by considering the image content such as texture, edges, smooth areas and wavelet coefficient contrast sensitive function in order to vary the strength of the watermark and to maintain the perceptual uniformity after the insertion of the watermark. Tsai 2009[4] presented a visible watermarking scheme using DWT. The scheme can obtain the optimal watermark position and strength by utilizing the

characteristic of the host and watermark image and obtain high PSNR value for the watermarked image. Tsai et al 2011[15] proposed a visible watermarking by utilizing the underlying content either the DC coefficient or both DC and AC coefficient were used for calculating the embedding and scaling factor in block transform domain. Tsai and Chang 2010[16] proposed a secured reversible visible watermarking approach. They designed a pixel mapping function to superpose a binary watermark image. At the same time an almost inverse function generate the recovery data. In their method the recovery data and hash value for reversibility and authentication are embedded using reversible data hiding. In 2014, Lin [17] proposed imperceptible visible watermarking scheme in which the visible watermark added in cover which is imperceptible but can be made visible by performing a histogram operation in the watermarked image.

III. PROPOSED METHOD

The formula for embedding a visible watermark is given below

$$I' = \alpha I + \beta w \qquad (1)$$

Where I' is the resultant watermark cover image, I is the original cover image and w is the watermark. α and β are the scaling factor and embedding factor respectively.

Variance is measure for the spread of a set of numbers. Lower variance indicates that the data point are close to the average, whereas a higher variance implies that the data point are spread out over large range of values. The standard deviation is a measure of variation from the mean and is define as

$$S_N = \sqrt{\frac{1}{N}\sum_{i=1}^{N}(x_i - \bar{x})^2} \qquad (2)$$

The variance is the square of the standard deviation and thus can be written as

$$\sigma^2 = \frac{1}{N}\sum_{i=1}^{N}(x_i - \bar{x})^2 \qquad (3)$$

In term of image, variance is used as a parameter for reflecting the complexity of the image texture. The image sub-block with low variance contain simple texture, while the image block with high variance contain more complex texture or edges. The alteration in the high texture region is less noticeable than that in the low texture region.

In this paper we make used of the properties of the variance of the image section. We approach a block based method for the inserting the watermark. The insertion of watermark is done in the DFT domain of the images. The details algorithm is given below.

I. Cover image is divided into block and variance of the each block is calculated
II. We take the block with highest variance and position of the block is found out in the spatial domain.
III. We perform DFT on both the watermark and cover image.
IV. We add the watermark using the equation given above.
V. Inverse DFT is taken to get the visibly watermarked cover image.

IV. EXPERIMENTAL RESULTS

The simulation of the proposed scheme was run in many standard grey scaled image. We kept the scaling factor to 0.1 which was found manually to achieve high PSNR value of the watermarked image. Peak Signal to Noise Ratio is utilized to find the fidelity of the image after the insertion of watermark into the cover image and is given by:

$$PSNR = 10log_{10}\left(\frac{MAX_i^2}{MSE}\right) \qquad (4)$$

Where MAX_i is the maximum fluctuation in the input image. MSE is the mean square error and to calculate the MSE, the equation is given below:

$$MSE = \frac{1}{MN}\sum_{i=0}^{M-1}\sum_{j=0}^{N-1}[I(i,j) - I'(i,j)]^2 \qquad (5)$$

Where M, N are the dimension of the images and I is the original cover image and I' is the visibly watermarked image.

We also used structural similarity ratio to compare the similarity between the original host image and watermarked image. Structural Similarity index (SSIM) is an image quality metric that assesses the visual impact of three characteristics of an image: luminance, contrast and structure. The Structural Similarity Index quality assessment index is based on the computation of three terms, namely the luminance term, the contrast term and the structural term. The overall index is a multiplicative combination of the three terms.

$$SSIM(x,y)=[l(x,y)]^{\alpha}\cdot[c(x,y)]^{\beta}\cdot[s(x,y)]^{\gamma} \quad (6)$$

Where

$$l(x,y)=\frac{2\mu_x\mu_y+c_1}{\mu_x^2+\mu_y^2+c_1} \quad (7)$$

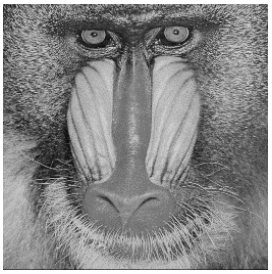
$$c(x,y)=\frac{2\sigma_x\sigma_y+c_2}{\sigma_x^2+\sigma_y^2+c_2} \quad (8)$$

$$s(x,y)=\frac{\sigma_{xy}+c_3}{\sigma_x\sigma_y+c_3} \quad (9)$$

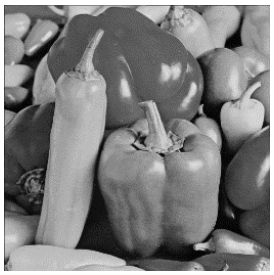
Where μ_x, μ_y, σ_x,σ_y, and σ_{xy} are the local means, standard deviations, and cross-covariance for images x, y. If $\alpha = \beta = \gamma = 1$ (the default for Exponents), and $C_3 = C_2/2$ (default selection of C_3) the index simplifies to:

$$SIM(x,y)=\frac{(2\mu_x\mu_y+c_1)(2\sigma_{xy}+c_2)}{(\mu_x^2+\mu_y^2+c_1)(\sigma_x^2+\sigma_y^2+c_2)} \quad (10)$$

In the experiment we used some of the standard gray-scaled image with size 512X512.



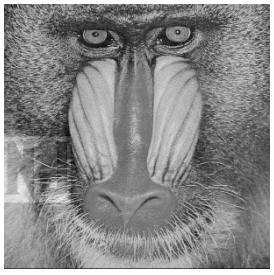

(a). Baboon (b). Lena

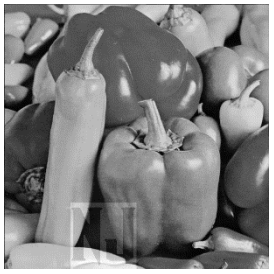
(c). Jet (d). Pepper

Figure 1. Some of the test images used

Figure 2. Watermark used




(a). Baboon (b). Lena

(c). Jet (d). Pepper

Figure 3. Watermarked images

Table 1. The Watermark Transparency For Various Test Images

Images	PSNR(in dB)	SSIM
a. Baboon	30.3253	0.9909
b. Lena	30.8364	0.9837
c. Jet	30.3253	0.9856
d. Pepper	30.2117	0.9811

From the table above we got a steady PSNR value for different images. The proposed scheme can achieve good visual quality of the watermark. The watermark is positioned at block which have high variance value base on the host image used. The SSIM determine the structural similarity between the cover image and the watermarked image and value obtained in our scheme is almost one for all the image used.

Robustness against attacks: To test the robustness of watermarking scheme we introduce some common signal processing attacks histogram equalization, mean filtering, JPEG compression, contrast enhancement, median filtering etc. on the watermarked image. Figure below illustrate resultant of the attacks on the watermarked image.

(a).Histogram Equalization (b). Average Filtering

(c).JPEG compression(Quality Factor 5) (d). Median Filtering

(e). Salt and Pepper noise addition (f). Guassian Blurring

Figure 4. Resultant images of Lena after undergoing different type of signal processing attacks.

From the figure above the visible watermark is hard to remove under common signal processing attacks.

V. CONCLUSION

In this paper, we present a visible watermarking scheme by selecting the high texture region of the image such that the perceptual quality of the original image is preserve. The scheme proposed has low computational complexities. The experimental result of the scheme suggested that the scheme is robust against many signal processing attacks and provide high PSNR value for the watermarked image. The watermarking scheme can be used on digital image, videos etc.

VI. REFERENCES

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