



A Scrutiny on Digital Watermarking Techniques

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Abstract— Though tremendous work has been done in the field of image processing concept digital watermarking plays an important role in image protection and its copyright issues. It is hindered from being beneficial to large-scale multimedia applications. This paper provides a survey on various image hiding techniques to address the challenges of copyright issues. We classify the watermarking approaches into two categories: Spatial domain and frequency domain.

Keywords— Color component, Digital watermarking, Image processing, spatial domain, Transform domain.

I. INTRODUCTION

Digital watermarking is based on the science of steganography or data hiding. It is a process of hiding predefined pattern or logo into multimedia components such as image, audio, or else video in a way that its originality is to be conserved. Generally this watermarking shall be visible, invisible-robust and invisible-fragile in appearance. Whereas this watermarking and fingerprint technique comes under the document marking in steganography. The watermarking techniques are done in these types namely spatial domain, frequency domain and spread spectrum. Spatial domain techniques are also known as image domain it uses the concept of LSB Substitution concept. The frequency domain is known to be as transform domain. Value of certain frequency is gets changed from original. In Frequency Domain Watermarking, Watermark is embedded in DFT, DCT and DWT domain coefficients areas. Spread Spectrum is a special technique that can be used for both spatial method and frequency domain concept. Spread spectrum communication could be defined as the process of spreading the bandwidth of a narrowband signal across a wide band of frequencies.

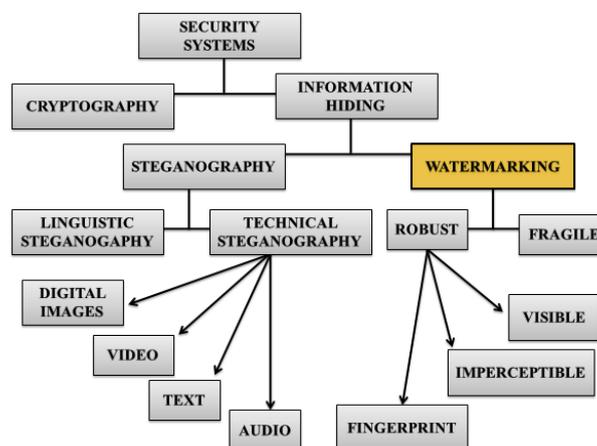


Fig. 1 Classification of Security Systems

This paper is organized as follows. Section 2 includes a discussion about spatial domain techniques; section 3 gives us a various techniques of frequency domain techniques and section 4 gives the conclusion of the paper.

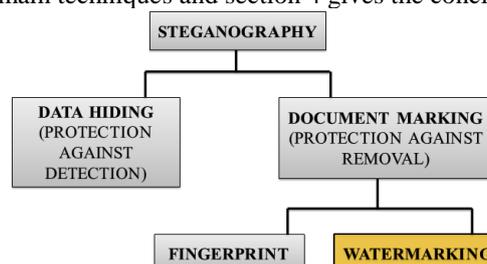


Fig. 2 Classification of Steganography

II. SPATIAL DOMAIN TECHNIQUE

This domain focuses on modifying the pixels of one or two randomly selected subsets of images. It directly loads the raw data into the image pixels. Some of the spatial domain algorithms are Additive Watermarking, LSB, SSM Modulation based technique and Texture mapping coding Technique.

A. Additive Watermarking

The most general method for embedding the watermark in spatial domain is to add pseudo random noise pattern to the intensity of image pixels. The noise signals are usually integers like (-1, 0, 1) or sometimes floating point numbers. The watermark can be detected, when the correlation between the numbers of different keys is very low, where key is considered as pseudo random noise.

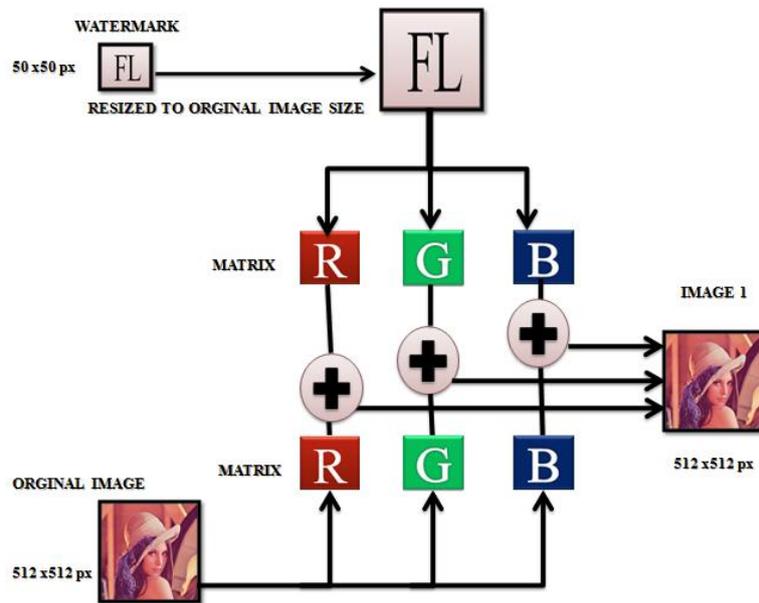


Fig. 3 Additive Pixel Technique

B. Least Significant Bit

Old popular technique embeds the watermark in the LSB of pixels. This method is easy to implement and does not generate major distortion to the picture. However, it is not considered to be very robust against attacks. The embedding of the watermark is performed by choosing a subset of image pixels and substituting the least significant bit of each of the chosen pixels with watermark bits. The watermark might be spread throughout the image or to a particular locations of the picture. But these basic techniques are vulnerable to attacks and the watermark shall be easily destroyed. Such an approach is very sensitive to noise and common signal processing and cannot be used in practical applications.

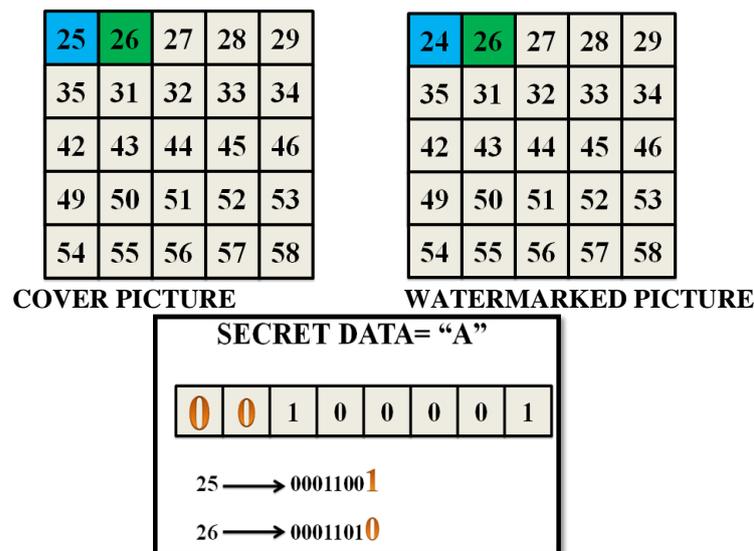


Fig. 4 LSB Substitution Technique

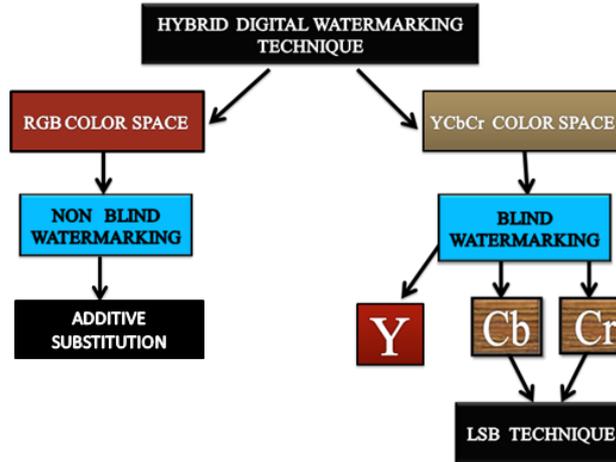
In Fig 3 Compare 0 from secret data and 1 from pixel value 25 after watermarking the pixel value may be changed to 24 or it remains as such. This LSB can store one bit in each pixel.

1) Limitations of LSB technique:

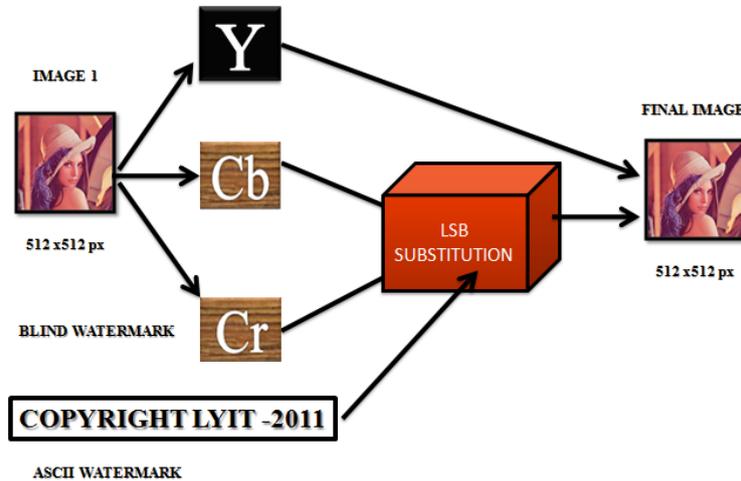
- It is easy to implement but limited in robustness.
- It can survive only for simple operation such as cropping, noise attack.

- Furthermore, if once the algorithm was discovered, it would be very easy to alter the watermark by hacker.

Karen Bailey et al. [1] has done research in spatial domain technique in which both additive pixel technique using RGB colour space and LSB Substitution technique in the YCbCr colour space are used for embedding watermark image in the host image in order to avoid the copyright issue. The combination of both additive pixel and LSB Substitution technique is termed to be as hybrid digital watermarking technique.



Fig, 5 Hybrid Digital Watermarking Technique



Fig, 6 LSB Substitution Technique in YCbCr Color space

C. SSM Modulation Based Technique

Spread-spectrum techniques are methods in which energy generated at one or more discrete frequencies is deliberately spread or distributed in time so SSM based watermarking algorithms embed information by linearly combining the host image with a small pseudo noise signal that is modulated by the embedded watermark.

D. Texture mapping coding Technique

In this method it is useful in only those images which have some texture part in it. This method hides the watermark in the texture part of the image. Demerit of this algorithm is only suitable for those areas with large number of arbitrary texture images and it cannot be done automatically.

Literally spatial domain method share the following characteristics,

- The watermark is applied in the pixel domain.
- No transforms are applied to the host signal during watermark embedding.
- Combination with the host signal is done in the pixel domain.
- Detection of the watermark is done by correlating the expected pattern along with its received signal.

III. FREQUENCY DOMAIN TECHNIQUE

While comparing with spatial-domain concept, frequency-domain methods are wider range of usage. The most commonly used transforms are listed as follows,

- Discrete Fourier Transform (DFT)
- Discrete Cosine Transform (DCT)
- Discrete Wavelet Transform (DWT)

1) Usual Steps in DCT Block Based Watermarking Algorithm :

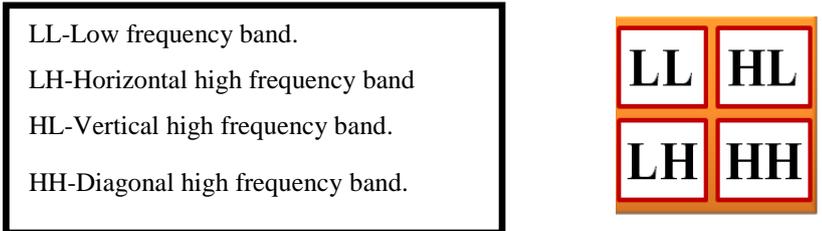
- Segment the image to blocks of 8x8

- Forward DCT to each of these blocks are done.
- Apply some block selection criteria (e.g. HVS)
- Apply coefficient selection criteria (e.g. highest)
- Embed watermark by modifying selected coefficients.
- inverse DCT transform on each block gets applied.

B. Discrete wavelet transforms (DWT)

Discrete Wavelet Transform is a modern technique which is frequently used in digital image processing, watermarking, compression etc. The transforms are based on small waves called wavelet of varying frequency and limited duration.

T. Narasimmalou et al. [2] has proposed a concept named as Robust discrete Wavelet Transform in which a three level DWT decomposition is done on a host image and the secret information is hidden by manipulating the approximation coefficients of the decomposed image.



G. Dayalin Leena et al. [3] proposed Robust image watermarking in frequency domain in which its Digital image is watermarked using 5 level wavelet transforms which is an efficient multi-resolution frequency domain concepts. Whereas The low frequencies of wavelet decomposition of the carrier image which is a color image is watermarked with a color logo shuffled using chaotic map technique. [4]

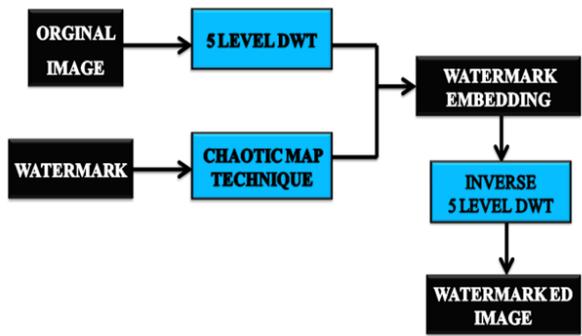


Fig. 7 5 Level DWT with Chaotic map technique

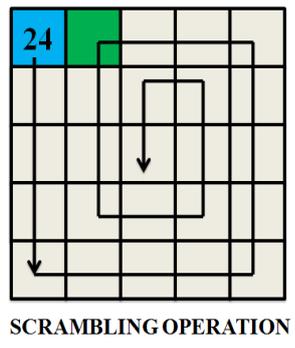


Fig. 8 Chaotic map technique

TABLE 1: CONTRASTING SPATIAL DOMAIN AND FREQUENCY DOMAIN [5] [6]

FACTORS	SPATIAL DOMAIN	FREQUENCY DOMAIN
Computation Cost	Low	High
Computation Time	Low	High
Computation complexity	Low	High
Robustness	Fragile	More Robust
Perceptual quality rate	High control	Low control
Capacity	High	Low

III. CONCLUSION

In this paper we have presented various aspects for digital watermarking. The Transform domain watermarking techniques are better robustness against image processing operations than the spatial domain techniques. So the main goal is to resist both geometric distortion and signal processing attacks, on combining frequency and spatial domain based watermarking techniques provides better result for robustness. Since no watermarking algorithm resists all the attacks. Still we can find better technique which will give more robust watermark.

REFERENCES

- [1] Frederic Lussion, Mark Leeney, Kevin Curran, Karen Bailey, 2012 “A novel approach to digital watermarking, exploiting colour spaces” in journal homepage: www.elsevier.com/locate/sigpro.
- [2] T. Narasimmalou, R. Allen Joseph, 2012 “Robust discrete Wavelet Transform Based Steganography” in International Journal of Power Control Signal and Computation IJPCSC Vol. 4. No.2. pp.102 -108 ISSN: 0976-268X.
- [3] G. Dayalin Leena and S. Selva Dhayanithy “Robust Image Watermarking In Frequency Domain” in International Journal of Innovation and Applied Studies ISSN 2028-9324 Vol. 2 No. 4 Apr. 2013, pp. 582-587.
- [4] Zhengjun, Yu Zhang, Wei Liu, Fanyi Meng, Qun Wu, Shutian Liu (2013) “A Mixed Scrambling Operation For Hiding Image” in journal homepage: www.elsevier.de/ijleo.
- [5] Jiang Xuehua, “Digital Watermarking and Its Application in Image Copyright Protection” on 2010 International Conference on Intelligent Computation Technology and Automation.
- [6] Mahmoud El-Gayyari, “Watermarking Techniques Spatial Domain Digital Rights Seminar ©”, Media Informatics University of Bonn Germany.

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