

A Survey of Digital Image Watermarking Techniques

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ABSTRACT

Multimedia security is important for internet technology because the number of problems developed in multimedia data like duplication, distribution. The digital watermarking is an area of information which hide the crucial information in the original data for protection illegal duplication and distribution of multimedia. There are number of techniques for hiding the information in the form of digital contents like text, image, audio or video. Basically it is a method for embedding some secret (important) information and additional information in the cover image which can later be extracted or detected for various purposes like authentication, owner identification, copyright protection, content protection etc. The image watermarking techniques may divide on the basis of domain like spatial domain or transform domain (frequency domain) on the basis of wavelets. Digital image watermarking is actually drive from Steganography, a process in which digital content is hide with the other content for secure transmission of Digital data. In this paper the topic under discussion is about digital image watermarking and its techniques i.e. DCT, DWT, SVD.

Keywords— Digital image watermarking, Discrete Wavelet Transform (DWT), Discrete Cosine Transform(DCT), Singular vector decomposition(SVD), security.

I. INTRODUCTION

Digital Watermarking used as hiding of information. It is an invisible signature image to show authenticity and ownership. It is better than cryptography and stenography because it can protect content even after it is decrypted. Digital Watermarking schemes has two domains, namely spatial domain and transform (frequency) domain. In spatial domain method, the watermark bits are embedded directly into the pixels of cover image. In transform domain, the watermark is embedded by changing the coefficient magnitude in a transform domain using discrete cosine transform (DCT), discrete wavelet transform (DWT), and singular value decomposition (SVD) technique. In digital watermarking there are mainly two images i.e. cover image and watermark image. With these two images digital watermarking has processes: Embedding Process and Extraction Process.

Embedding Process: In which the watermark is embedded in the original image i.e. cover image by using the embedding algorithm. Then the watermarked image is generated. So the watermarked image is transmitted over the network.

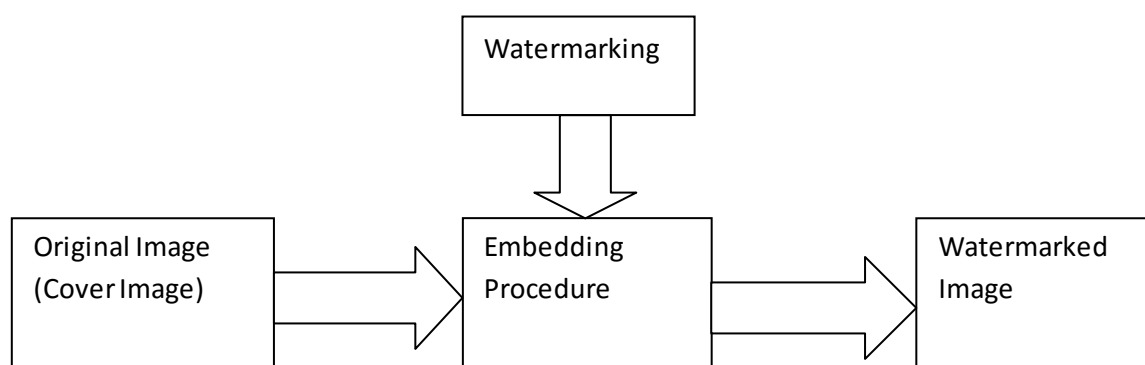


Figure 1: Embedding Process

Extraction Process: In this process, the watermark is detected or extracted by the dedicated detector from the watermarked image by applying some extraction algorithm. In addition to this, noise is also detected.

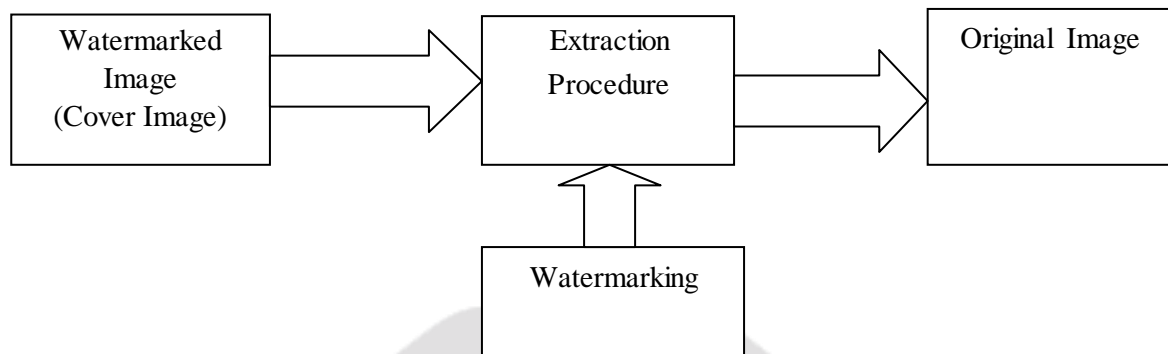


Figure 2: Extraction Process

II. APPLICATIONS OF DIGITAL IMAGE WATERMARKING

- A. *Broad Cast Monitoring*: We can use watermarks for broadcast monitoring by putting a unique watermark in each video or sound clip. Automated monitoring stations can then receive broadcasts, look these watermarks, identifying when and where each clip appears.
- B. *Copyright Protection*: In Copyright protection, Digital Watermarking is used to unalterably and permanently mark the image so that the credit is beyond dispute.
- C. *Digital Rights*: A Document can be used by a user with a license that matches the watermarked signature.
- D. *Tamper Proofing*: In tamper proofing, Digital Watermark is used to find out the data was tampered or not.
- E. *Quality Assessment*: Digital Watermarking helps in the loss of Visual Quality.

III. TECHNIQUES OF IMAGE WATERMARKING

A. *Discrete Cosine Transform(DCT)*: Discrete Cosine Transform (DCT) used for the signal processing. It transforms a signal from the spatial domain to the frequency domain. In many fields like data compression, pattern recognition and every field of image processing DCT are applied. The main steps which used in DCT:

- 1).Segment the image into 8*8 blocks.
- 2).Apply forward DCT on each of these blocks.
- 3).After that, apply block selection criteria.
- 4).Apply some coefficient selection criteria.
- 5).Embedd Watermark by modified selected coefficients.
- 6).Apply inverse DCT on each block of image.

B. *Discrete Wavelet Transform(DWT)*: DWT divides the image into low frequency quadrants and high frequency quadrants. The low frequency quadrant is again split into two more parts of low and high frequencies and this process is repeated until the signal has been entirely decomposed. The digital wavelet transform are scalable in nature. DWT transformed 2-D image into four sub bands i.e. Low Low(LL),High Low(HL),Low High(LH),High High(HH). The LL sub band again split into these four sub bands and this process are known as 2DWT. The reconstruct of the original image from the decomposed image is performed by IDWT .

C. *Singular Value Decomposition(SVD)*: SVD is a decomposition technique. SVD is used to get singular value coefficients. It provides high robustness. The SVD is popular mathematical technique that provides tool for analysis of matrices. It is good way for extracting algebraic features from an image. When a small changes is added to an image, SVs does not vary largely In SVD based watermarking, SVD of the original image is taken and then singular values of the matrix are modified by introducing the singular values of watermark .The properties of SVD are as follows:

- 1): It does not affect the image quality.

- 2): They are robust from various types of attacks like rotation, cropping, altering etc.
 3): It preserves non symmetric properties.

IV. PROPERTIES OF DIGITAL IMAGE WATERMARKING

- A. Robustness:* In which, Watermark can easily be removed by some image processing operations like gamma correction, contrast etc. Hence watermark is robust against number of attacks.
B. Transparency: The digital watermark cannot affect the cover image quality after it is watermarked.
C. Capacity: It describes how many bits should be embedded as watermark in the cover image to detect during extraction.

V. PERFORMANCE MEASURES

A. Mean Square Error (MSE): The mean squared error (MSE) in an image watermarking is to estimate or measures the average of square of the errors between cover image and watermark image.

$$MSE = \frac{1}{MN} \sum_i^M \sum_j^N (W_{ij} - H_{ij})^2$$

Where M, N is pixel values in host image

W_{ij} = Pixel value of Watermarked Image

H_{ij} = Pixel value of Cover Image

B. Peak Signal Noise Ratio (PSNR): PSNR is used to determine the Efficiency of Watermarking with respect to the noise. The noise will degrade the quality of image.

It is given by:

$$PSNR = 10 * \log(P^2 / MSE)$$

Where p= maximum value in cover image.

VI. RELATED WORK

Madhuri Rajawat, D S Tomar [1], This paper presents digital watermarking for their applications, techniques, attacks, classifications and tempering detection. With the help of these techniques they improve the security of image. This paper worked on RGB components such as red, green, blue for enhancing robustness and security. 2-DWT applied on RGB components for good results. The author concluded that tampering detection and watermarking method is very important for protection against attacks.

Aparna J R, Sonal Ayyappan [2], introduced a block based image watermarking algorithm which uses the cryptographic algorithm to find out the position of the cover image in which watermark is to be embedded. The two different keys are generated using Diffie Hellman Key Exchange Algorithm and using these keys the position of cover image to which the watermark are to be embedded are found out. The embedding is done after block dividing the cover image and watermark image.

The experimental results show that the proposed method is robust.

Divjot Kaur Thind, Sonika Jindal[3], In this paper a latest digital video watermarking scheme is proposed which combines Discrete Wavelet Transform(DWT) and Singular Value Decomposition(SVD) in which watermarking is done in the high frequency sub band and then various types of attacks have been applied. The watermark object has been embedded in each frame of the original video. Since in each frame, watermark is embedded and it provides robustness against attacks.

Abhilasha Sharma, Amit Kumar Singh and S P Gherra[4], The proposed watermarking technique is based on two transform domain techniques, discrete cosine transform(DCT) and discrete wavelet transform(DWT). In embedding process, the cover image is divided into two separate parts, region of interest(ROI) and non region of interest(NROI). In order to enhance the security of the text watermark, Rivest Shamir Aldeman(RSA) encryption techniques is applied to the text watermark before embedding and the encrypted ERP data is embedded into the NROI portion of cover medical image. The simulated results, it is verified that the proposed work is robust against the various signal processing attacks.

Ms. Mahejabi Khan, Mr. Ajay Kushwaha, Mr. Toran Verma[5], introduced a secure and robust watermarking algorithm based on the combination of image interlacing, DWT & DCT techniques. After the formation of watermarked image. Firstly, With the help of EBCOT algorithm, compression is done. Secondly, Error correcting codes are used to reduce noise over the channel by correcting and detecting errors. The uncompressed image needs more storage and bandwidth

than compressed image. With EBCOT(Embedded block coding optimal truncation) algorithm image compression is done effectively.

Urvi H. Panchal, Rohit Srivastava[6], This paper provides comprehensive survey on various digital image watermarking techniques in different domains and their requirements. The author introduced the survey and classified the different requirements, benefits and limitations. It has been concluded that to minimize distortions and to increase capacity, techniques in frequency domain must be combined with another techniques which has strong robustness and high capacity against different types of attacks.

Arash Saboori, S. Abolfazl Hosseini[7], In this paper a new method is proposed using the combination of DCT and PCA transform in order to reduce the low frequency band for the color image in YUV color space. The Y (luminance) is divided into non-overlapping blocks and the low band coefficients of each block are placed in the matrix data than PCA transform are applied on it. This method eliminates the disadvantage of low band based on the combination of DCT and PCA transform.

Hwai-Tsu Hu, Ling- Yuan Hsu[8], This paper presents a novel scheme capable of providing robust, high capacity and transparent blind audio watermarking. An algorithm is developed to maintain the energy balance in frequency band. A scheme has been proposed to attain high performance watermarking by exploiting perceptual masking in DCT domain. The audio signal is partitioned into non-overlapping frames of length 4160.

D. Vaishnavi, T.S.Subashini[9], introduce two methods for invisible and robust watermarking proposed in RGB color space. In the first method, gray scale watermark is embedded on the blue color channel and in second method, blue color watermark is embedded on the blue color channel element and than SVD applied on the blue channel of host image to retrieve singular values. They concluded that first method gives a good robustness for median filtering attacks, for motion blur etc. and second method gives good robustness for Gaussian noise, salt-pepper noise etc.

Surbhi Singh, Anand Mohan et.al[10], authors have introduced an secure and robust data hiding algorithm based on hiding in random coefficient of DWT and student t-distribution. Performance evaluation for imperceptibility and robustness of proposed algorithm has been made using peak signal to noise ratio (PSNR) and Bit Error Rate (BER) value for different watermark and images such as Lena, Gibbon and Fruit images. The result achieves higher security and robustness against jpeg compression as well as many attacks such as rotation, cropping etc.

Palak Patel, Yash Patel[11], In this paper authors have combined the strategy of Steganography, Digital watermarking and cryptography using DCT, DWT and SVD algorithm which provide security of images as a well as authenticity of the image. DWT transformed 2-D image into four sub bands i.e. Low Low(LL), High Low(HL), Low High(LH), High High(HH). The LL sub band again split into these four sub bands and this process are known as 2DWT. Authors enhanced their research by encrypting image data using RSA algorithm.

Saeid Fazli et.al[12], In this paper, divide the host image into four overlapping rectangular segments known as sub images and the watermark is independently embedded into each of them, using hybrid scheme. The redundancy reduces the effect of cropping image. Authors proposed an synchronization technique to recover geometrically attacked image via. detection of desired image corner.

VII. CONCLUSION

In this paper, We surveyed the latest literature review on digital image watermarking. we gave brief discussion of Digital Image Watermarking and its techniques used in frequency domain like DCT, DWT, SVD. DWT transformed 2-D image into four sub bands i.e. Low Low(LL), High Low(HL), Low High(LH), High High(HH). The LL sub band again split into these four sub bands and this process are known as 2DWT. DWT and its sub bands can be used in future work. In future work we cannot work not only on LL band but we can work on all sub bands like LL, HL, LH, HH.

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