A Survey on various approaches used in digital image watermarking using DWT SVD

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ABSTRACT

The recent advent in the field of multimedia proposed a many facilities in transport, transmission and manipulation of data. Along with this advancement of facilities there are larger threats in authentication of data, its licensed use and protection against illegal use of data. Digital watermarking is one of the most recent proposed systems to observe the authentication of licensed user over e-commerce applications and finds its uses in illegal applications like copying the multimedia data e.g. images, audio, video. The watermark indicates that data is containing copyright or not. To propose a measure against the illegal use of the images different available watermarking standards are studied. Then by taking the human visual system into consideration an algorithm is designed. This paper conducts a literature syrvey of watermarks and its various aspects. It describes the previous work done on digital watermarking schemes and their results. Potential applications are discussed, and implementation plan of the project is presented.

Keyword: *Digital Watermarking, Copyright Protection, Discrete Wavelet Transform (DWT), Singular Vector Decomposition(SVD), Security, Authentication.*

1. INTRODUCTION

Digital watermarking includes a number of techniques that are used to imperceptibly convey information by embedding it into the cover data. There has always been a problem in establishing the identity of the owner of an object. In case of a dispute, identity was established by either printing the name or logo on the objects. But in the modern era where things have been patented or the rights are reserved (copyrighted), more modern techniques to establish the identity and leave it in tampered have come into picture. Unlike printed watermarks, digital watermarking is a technique where bits of information are embedded in such a way that they are completely invisible. The problem with the traditional way of printing logos or names is that they may be easily tampered or duplicated. In digital watermarking, the actual bits are scattered in the image in such a way that they cannot be identified and show resilience against attempts to remove the hidden data. Watermarking, as opposed to steganography, has an additional requirement of robustness against possible attacks. An ideal steganographic system would embed a large amount of information perfectly securely, with no visible degradation to the cover object. An ideal watermarking system, however, would wmbed an amount of information that could not be removed or altered without making the cover object entirely or altered without making the cover object entirely unusable. Over the past few years, there has been tremendous growth in computer networks and more sprcifically, the World Wide Web. This phenomenon, coupled with the exponential increase of computer performance, has facilitated the distribution of multimedia data such as images. Publishers, artists, and photographers, however, may be unwilling to distribute pictures over the Internet due to lack of security; images can be easily duplicated and distributed without the owner's consent. Digital watermarks have been proposed as a way to tackle this tough issue. This digital signature could discourage copyright violation, and may help determine the authenticity and ownership of an image. This paper is a literature survey of digital watermarks. Its objective is to summarize the previous work done on digital watermarks and to detail the implementation plan of the project.

The working principle of the watermarking techniques is similar to the steganography methods. A watermarking system is made up of a watermark embedding system and a watermark extraction system. The embedding and

extraction processes of watermarking are shown:

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.

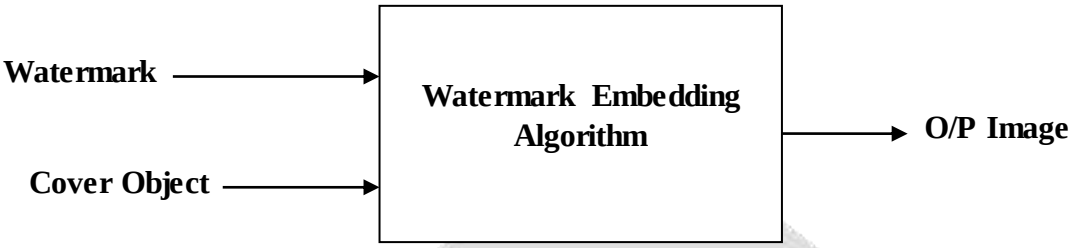

Figure 1.1: General Watermarking Block Diagram

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.

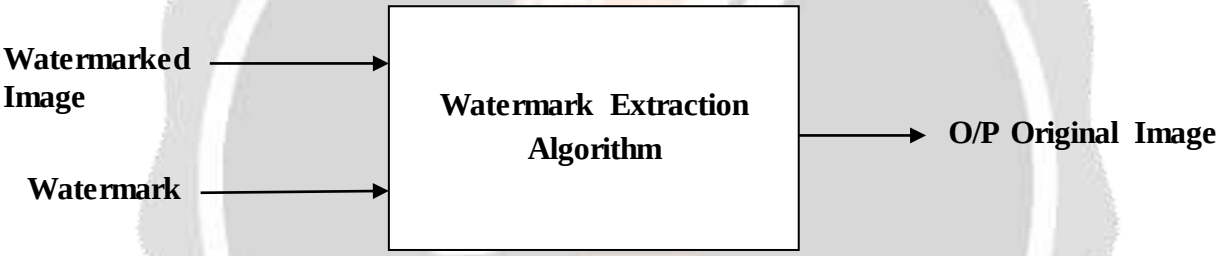

Figure:1.2 General Watermarking Decoding to recover Original Image

2. APPLICATIONS OF DIGITAL IMAGE WATERMARKING

Watermarking finds enormous interesting applications in the field of multimedia, ecommerce etc.. Some of the applications are:

a) Fingerprinting: Embedding a unique serial number-like watermark is a good way to detect customers who break their license agreement by copying the protected data and supplying it to a third party.

b) Copyright Protection & Owner identification: Digital watermarking helps by embedding the watermark in the form of bits and forming an integral part of the content. The device reads the CD and identifies the watermark. For having further access to the CD the owner should have a license or he should have paid a fee to access the copyrighted work.

c) Broadcast monitoring: Original watermarks can be inserted in data to be widely broadcasted on a network. It could assure that advertisers received the airtime they have paid for or make certain that musicians' property is not rebroadcast by pirate stations.

d) Data Authentication: Fragile watermarks are used to detect any corruption of an image or any other type of data.

e) Data Hiding (Covert Communications): It consists of implanting a strategic message into an innocuous one in a way that would prevent any unauthorized person to detect it.

3. TECHNIQUES OF IMAGE WATERMARKING

a) Discrete Wavelet Transform (DWT): DWT divides the image into low frequency quadrants and high frequency quadrants. The low frequency quadrant is again sp lit 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

b) 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.

4. PROPERTIES OF DIGITAL IMAGE WATERMARKING

a. Robustness: The watermarking scheme employed should be able to preserve the watermark under various attacks.

b. Quality of the image: Digital Watermark should not affect the quality of the image or the hidden data after watermarking.

c. Payload capacity of the image: It is very important to find the maximum amount of information that can be safely hidden in an image.

d. Imperceptibility: the original and watermarked data should be perceptually the same.

5. PERFORMANCE MEASURES

a. Mean Squared Error (MSE): To determine the resemblance between the actual image and equivalent watermarked image an inaccuracy is calculated by subtracting the watermarked image pixel intensity values from the actual image pixel intensity values, and after that calculating the mean of the inaccurate signal. The Mean Squared Error is described by equation

$$MSE = \frac{1}{MN}\sum_{i=1}^{M}\sum_{j=1}^{N}\big(x(i,j) - y(i,j)\big)^2$$

Where i and j are the pixel positions of the image having M number of rows & N number of columns and $x(i, j)$ is the pixel intensity values of actual image and $y(i, j)$ is the pixel intensity values of corresponding watermarked image. Mean Squared Error is zero when pixel intensities of both the images are same.

b. Peak Signal to Noise Ratio (PSNR): The units of Peak Signal to Noise Ratio are decibels and it is inversely relative to the MSE (Mean Squared Error). It is specified by means of the equation

$$PSNR = 10log_{10}\frac{255}{\sqrt{MSE}}$$

Larger the cost of Peak Signal to Noise Ratio (PSNR) better is the superiority of the watermarked image.

c. Normalised Correlation (NC): Comparability of extracted watermark with the original watermark is quantitatively analyzed by using
correlation coefficient. Value of ρ is between 0 and 1. The bigger the value of ρ, better is the robustness of watermark.

$$\rho(W,\overline{W}) = \frac{\sum_{t=1}^{r} W(i)\,\overline{W}(i)}{\sqrt{\sum_{t=1}^{r} \overline{W^2}(i)}\,\sqrt{\sum_{t=1}^{r} W^2(i)}}$$

Where *W* is the singular values of original watermark, is the extracted singular values and r=max(M1,N1).

6. 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.

Arash Saboori, S. Abolfazl Hosseini[2]: 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.

Aparna J R, Sonal Ayyappan [3]: 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.

Palak Patel, Yash Patel[4]: 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.

Divjot Kaur Thind, Sonika Jindal[5]: 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.

Shankar Thawkar [8]: This paper presents an invisible image watermarking scheme for copyright protection and temper detection. The secret key encryption algorithm is used for embedding the watermark using LSB technique. The verification (the watermark extraction) process uses the same key as in encryption, and hence it can be used for copyright protection of digital media such as images, audio and video.

Anuradha , Rudresh Pratap Singh [9]: A grayscale visual watermark image is inserted into the host color image using the Haar Wavelet Transform, where the copyright of Watermark is printed. This new technique has two properties high fidelity and robust.

Mr. Gaurav N Mehta, Mr. Yash Kshirsagar, Mr. Amish Tankariya (2012): This paper presents a digital image watermarking based on Discrete Wavelet Transform (DWT). In the proposed method, the watermark as well as the cover image seldom looses the quality in both embedding and extraction process. The embedding process is carried out by tetra-furcating the watermark and embedded into the sub-bands of cover image. Signal to Noise Ratio (SNR) and Peak Signal to Noise Ratio (PSNR) are computed to measure image quality for the DWT transform.

7. CONCLUSION

In this paper we have studied various techniques and approaches of Digital Image Watermarking. SVD and DWT perform better as compared to other approaches. But it has lack of Dynamic Scaling so further study can be conducted in Dynamic Scaling using optimization techniques as Genetic Algorithm(GA), VSO or Differential Evolution (DE).

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