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Digital Image Watermarking and Its Techniques: Review

Neena Slathia
M. Tech. Scholar, Electronics and Communication, GNDU University, Regional Campus Gurdaspur, India
Dr. Anu Sheetal
HOD, Electronics and Communication, GNDU University, Regional Campus Gurdaspur, India
Rajneet Kaur
Assistant Professor, Electronics and Communication, GNDU University, Regional Campus Gurdaspur, India

Abstract:
In day to day life there is a use of digital watermarking. In this paper we are presenting about digital watermarking and its techniques. In Digital Watermarking, signals like image, song, video etc combined with other signal where one signal act as secondary and other act as primary. This technique helps in providing copyright protection, tamper detection and many others.

Keywords: *DCT, DWT, SVD*

1. Introduction

Digital watermarking is the technique for hiding information in a file without changing file contents. Due to fast growing internet traffic this technique is very important in keeping the information secret. Copyright protection and Content authentication are the main application of digital watermarking. In digital image watermarking, we hide information inside the image and that can be extracted by its owner. There are many types of techniques for hiding data under digital watermarking.

In this paper we will analyses domains of digital image watermarking and where it is applicable. This technique helps to keep the information secret so that it cannot be accessed by an unauthenticated user. Like in banks where secrecy is very important so that money cannot be transacted by the hackers. So study in digital watermarking is growing as there is increase in traffic of internet. Categories of digital watermarking techniques are spatial domain and transform domain. The simplest technique in spatial domain is LSB where in least significant bit we can hide the information in least significant bit [3].

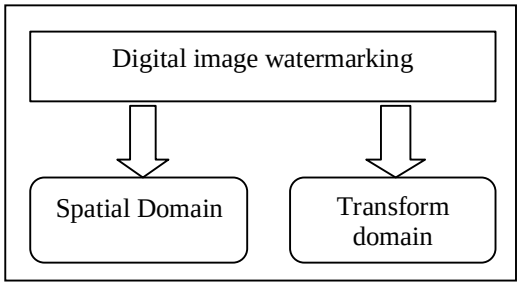

Figure 1: Domains of digital watermarking

This method is hardly robust but capacity of hiding data is high. From various attacks Watermarking technique is more secure and robust in transform domain. The main important domains in frequency domain are Discrete Fourier Transform (DFT) [6], Discrete cosine transform (DCT) and Discrete wavelet transform (DWT). All popular methods use any of popular variants for providing robust watermarks along with other methods like neural network, vector quantization etc. Methods which are gaining popularity are DWT and SVD than others.

Widely used method in watermarking techniques is matrix decomposition method called as Singular Value Decomposition (SVD). In this technique the watermark is embedded into the part of image or singular value of whole image. Only a single watermark is used in this technique which can be lost due to attacks [11]. So to improve this work from various varieties of attacks on DWT-based multiple watermarking argues that inserting a visual watermark in both low and high valued coefficients results in a robust technique. This robustness can be increased by inserting in low valued coefficients with respect to attacks that have low pass characteristics such as

filtering. Digital watermarking is a technique where watermark is embedded inside an image. It is similar to steganography in a number of ways. The major aim of digital image watermarking is to embed information imperceptibly and robustly in the cover image. This survey paper is discussed in the following ways. Techniques of digital image watermarking are discussed in section 2. Algorithms of Digital image Watermarking are discussed in section 3. Applications of Digital Image Watermarking are discussed in section 4. In section 5 we conclude this survey.

2. Digital Watermarking Techniques

Watermarking is an old phenomenon. In this modern era, as most of the world's information is stored as readily transferable bits so providing authenticity is becoming increasingly important. In Digital watermarking is a process where additional payload is imperceptible to the image observer we can encode arbitrary information in such a way. There are two categories of Watermarking algorithms. In Spatial-domain techniques we work directly with the pixel values. In Frequency-domain techniques employ various transforms. Several widely recognized techniques are subsequently described [12].

2.1. Spatial Domain Techniques

In this technique, there is a change in pixels or image characteristics because we insert a watermark in the cover image. Against the possibility of the watermark becoming visible the algorithm should carefully weigh the number of changed bits in the pixel.

In the paper proposed by Rahman and Harada they define a method to insert information in objects with layered 3D triangular meshes such as those reconstructed from CT or MI data. By the incorporation of parity checking the robustness against unauthorized alteration of a single bit in every consecutive 8-bits of length is enhanced. Here in this technique watermark message is cut into pieces and each piece of message is inserted at different spots, hence, if a piece of message is lost in ones pot, to possibly retrieve the same information from other spots the error correct decoding can be employed. Their method acted against unintentional attacks translation, rotation, arbitrary re-sectioning, scaling etc, and in a robust manner they left artefact after intentional attacks of local and global number re-arrangement. These are parity enhanced techniques so they have the ability to check the alteration of a single bit in every consecutive 8-bits length.

In the paper proposed by Kang et al. the data extraction process as one associated with a generalized channel of additive noise with a generally non-zero mean and fading by adaptively estimating the decision zone exploiting a training sequence and by using Fourier analysis method estimating the quantization step size. Their approach functions against common signal processing including Gaussian filtering, mean filtering, median filtering, sharpening, and jpeg compression with a quality factor of as low as 10, robustly.

In the paper proposed by Yuan and Lian we can attain both authentication and protection presented a multipurpose watermarking scheme. In hiding process they insert the watermark once which can be extracted in the direction process, invisibly for diverse applications. Their method includes the following three special features a) Based on the human visual system, The approximation information of a host image kept in the hiding process by utilizing masking thresholds defined, b) Robust watermarking accomplished, c) To achieve malicious tampering detection and non-malicious tampering tolerance a asymmetric robust range adopted for fragile watermarking.

In the paper proposed by Liu and Tain presented a new watermarking method. With the watermark the SVD domain of the original image is added. The estimation of the error between the original image and the watermarked image is performed mathematically. The performance of this is good in terms of both security and robustness. Moreover, their algorithm can resolve rightful ownership devoid of encryption. They employed Cox method [2] for comparison and to illustrate the results.

In this paper proposed by Lu and Lu provided a novel robust digital image watermarking scheme with the aid of sub sampling and nonnegative matrix factorization. Sub-sampling is originally employed to create a sequence of sub-image. Later on, factorization of non negative matrix is applied for the decomposition of the sequence on basis of the column similarity of the image of sub sequence. A sequence as Gaussian pseudo-random watermark is embedded in the factorized decomposition coefficients which owes to the high resemblance of sub-images and factorization which is meaningful for NMF, the composed scheme is capable of achieving better robustness, mainly towards common attacks.

Paper proposed by Lin et al which consist of a method to solve the problems of scale, rotation and translation. Their solution and the previous proposals in the Fourier-Mellin transform pattern recognition regarding invariants are associated. They observed that the alternative implementation can be employed by random transform. Their technique is resilient against mild jpeg compression as well. The efficiency of their method against cropping, an attack against which no steps could taken in the designing and illustrating through the results.

1) Least Significant Bits (LSB): This is the simpler approach, because the least significant bit carries least relevant information and their modification will not cause perceptible change. Among these approaches there are types using the salient points or types, which use some type of cryptography on the watermark message before the process of embedding.

2) SSM Modulation Based Techniques: the methods in which energy generated at more than one discrete frequency is deliberately distributed in time. This is done for various reasons, involving the establishment of secure communications, incrementation of resistance to natural interference and to prevent detection. SSM based watermarking algorithms is embed when applied to the context of image watermarking information by combining the host image with a pseudo noise signal which are small which are modulated by the embedded watermark.

2.2. Frequency Domain Techniques

Frequency domain techniques are more applied as compared to spatial domain techniques. The main aim of this technique is .To insert the watermarks in the spectral coefficients of the image is the main aim of this technique. Discrete Cosine Transform (DCT), Discrete Fourier Transform (DFT), and Discrete Wavelet Transform (DWT) are the most commonly used transforms. The most effective implementation in numerous digital images watermarking scheme is the discrete wavelet transforms (DWT) and the discrete cosine transforms (DCT). Following are the most commonly used transforms:

2.2.1. Discrete Cosine Transform (DCT)

Discrete Cosine Transform is same as Discrete Fourier Transform. Signal is converted into elementary frequency components in this technique [16]. Given matrix has 2-dimensional dct that gives another matrix containing frequency components. The right bottom most corner of the matrix represents the highest frequency coefficients while the left topmost corner represents the lowest frequency coefficients. DCT watermarking techniques are robust as compared to spatial domain techniques. On image processing operation like low pass filtering, brightness and contrast adjustment, blurring etc are robust. However geometric attacks like rotation, scaling etc are weak against it. Watermarking with DCT can be classified into Global DCT watermarking and Block based DCT watermarking.

2.2.2. Discrete Wavelet Transform (DWT)

Discrete Wavelet Transform is a mathematical tool for decomposing an image hierarchically. This technique is currently applied in a wide variety of signal processing applications, such as in audio and video compression, removal of noise in audio etc. Both frequency and spatial description of an image is provided in a wavelet transform. In wavelet transform there is a decomposition of the image in four channels which has same bandwidth.

2.2.3. Singular Value Decomposition (SVD)

It is a numeric analysis of linear algebra which is used in image processing applications. For robust image watermarking Singular Value Decomposition technique is shown to have powerful methods. When disturbances are added to the image the SVs remain intact. Both one-way and non-symmetric properties are preserved by SVD. SVs are able to represent intrinsic algebraic properties.

3. Algorithms

3.1. Algorithm Based on Wavelet Transforms

Both time and frequency information is carried by wavelet transform. In this technique digital image is divided into four frequency parts where there are three high frequency sub bands (LH, HL, HH) and one low frequency band act as (LL). This can be further decomposed till n level. Here we only divide once.

LL	HL
LH	HH

Table 1

Human eye is less sensitive to changes in edges, streaks and profiles. So it is easy to embed watermark in low frequency band.

3.2. Algorithm Based on DCT-DWT Technique:

On the basis of human vision character, here in dct and dwt based algorithm, the original image undergoes discrete wavelet transform where we hide the watermark image in high frequency band of the image where the information of digital watermarking has discrete cosine transformed.

Procedure:

1) Firstly images like original image and watermark image has to be selected.
2) Cover image that is RGB image converted into gray scale image.
3) Get the matrices of both images by reading them.
4) Using DCT transform the image.
5) Using 2D DWT, decompose the host image by L-levels.
6) Then low frequency band information and high frequency band information is obtained.
7) There is higher concealing effect in embedding watermark at higher level of DWT.
8) Key will be used to evaluate.
9) The wavelet coefficient values of chosen block of watermark image is used to amend to complete the watermark embedding.
10) After embedding the watermark image unite the information of low level frequency and mended the high frequency band. Watermark extraction is same but in reverse order.

4. Applications of Digital Image Watermarking

Here we present the review of some common applications:

1) Broadcasting Monitoring type of monitoring to transmit the data it is used to confirm the content. For example: commercial advertisements.

2) Owner Identification is a conventional form of intellectual ownership verification. For example: images having copyright registration symbol ©

3) In Fingerprinting watermarked object contains information about the owner permissions..

4) Publication Monitoring and Copy Control is the watermark that contains owner data and specifies the corresponding amount of copies allowed and contains owner data.

5) In Image and Content Authentication application the intent is to detect modifications to the data.

6) In Temper Detection Fragile watermarks are used for tamper detection.

5. Conclusions

In this paper, some recent algorithms have been reviewed, proposed a classification based on their internal features, inserting methods as well as extraction forms. Most of the watermarking algorithms are proposed in the literatures which show benefits in systems using DWT with SVD.

These marks have robustness against several different attacks. In this paper we are presenting a review of the different techniques in existence for watermarking those which are embedded in copyright protection. It also involves an introduction to digital watermarking, and domains of watermarking as well as its applications.

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