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COMPARATIVE ANALYSIS OF WATERMARKING IN DIGITAL IMAGES USING DCT,DWT &LSB

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ABSTRACT

Due to large use of internet and high speed development in technology,it is very difficult to transmit information safely from one place to other.For safe and secured transmission of information digital watermarking is used.Watermarking of digital images is a technique of hiding a data, also it gives security of data or identifying information in the digital data. The digital watermarking process embeds a signal into the media without significantly degrading its visual quality. In this paper there is a comparison of three methods i.e. DCT, DWT & LSB based algorithm for watermarking in digital images.

KEYWORDS: Digital Watermarking, Frequency Band,Robustness,Imperceptibility, Least Significant Bit(LSB), Discrete Wavelet Transform (DWT),Discrete Cosine Transform (DCT) .

INTRODUCTION

The digital devices and internet has profoundly changed daily lives and our society by making the capture, storage, and transmission of digital data extremely convenient and easy. This creates a big problem is how to secure data and preventing unauthorized use. For example the video and music industry loses millions of dollars per year due to downloading of copyrighted materials from the Internet and illegal copying. As a solution, Digital watermarking is used. Watermarking of Digital images is a technology that detects and creates invisible markings, which can be used to trace the origin and authenticity. Ideally, they should be, difficult to reproduce, hard to notice and impossible to remove without destroying the medium they protect. Future development of digital watermarking of images is like this: image authentication, copyright protection, copying protection cover-up communication, pirate tracking, [1].

Imperceptibility means, the inaudibility to human ears or the invisibility to human eyes, while robustness means that the watermark is able to withstand with some changes in the watermark-embedded signal. A good watermark algorithm should be by all means is simultaneously imperceptible and robust.

Watermarking algorithms are mainly divided into two groups: transform domain method which embed the data by modulating the transform domain coefficients and spatial domain method which embed the data by directly modifying the pixel values of the original images. In frequency-domain watermarking, frequencies of certain value is altered from their original & embeds the watermark into the transformed images. It is more robust than spatial domain techniques.

In frequency-domain technique multiple transforms used for watermarking purpose such as DFT, DCT, DWT. For digital watermarking DFT (Discrete Fourier Transform) DCT (Discrete Cosine Transform) and DWT (Discrete Wavelet Transform). Frequency domain watermarking is more useful for all practical & internet application. Discrete cosine transform based frequency domain watermarking useful in I-card of employee of companies, pan card, medical imaging, fingerprint identification, where is low cost required, whereas DWT based frequency domain watermarking mainly used to transfer more confidential matter through internet to anyone ,in government application, in military application , & banks application ,broadcast monitoring i.e. entertainment & advertisements [1].

Watermarking of digital images is popular, because of adding undetectable identifying marks, copyright information. The digital watermarking process embeds a signal into the data or media without degrading its quality. Watermarking of digital images is a process to embed some information called watermark into different kinds of media called Cover Work [9][3]. Its widely used application is copyright protection of digital information. Digital watermarking involves embedding a structure in a host signal to “mark” its ownership [11]. Digital watermarks are inside the information so that ownership of the information cannot be claimed by third party [7]. While some

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watermarks are visible [5], most watermarks are invisible [10].

LITERATURE SURVEY

The author Radhika.V. Totla et.al represent both methods i.e. DWT & DCT based algorithm for watermarking in digital images. In order to compare the imperceptibility & robustness of the both algorithms make use of simple attacks such as resizing, cropping & rotation [1].

The author Gurpreet Kaur et.al presents a watermarking technique which least significant bits (LSB), its steps and its process with matlab images[2].

The author B Surekha et.al presents a public video watermarking algorithm, in this robustness depend on the embedding energy.First the video sequences are segmented by each scene, then binary watermark is embedded into Discrete Wavelet Transform (DWT) domain of the randomly selected scene block. For increasing the security of the propose scheme, biary watermark is mapped to a noise like binary pattern using a chaotic mixing method. Simulation result show the watermark robustness and imperceptibility against several attacks, such as frame dropping, noise contamination, frame swapping and frame averaging; the evaluation results also show that the extracted watermark pattern is the watermarked video sequence may suffered several attacks although sufficiently clear [3].

TECHNIQUES OF WATERMARKING

Watermarking of digital images schemes mainly fall into two broad categories:

1. Spatial-domain techniques

The spatial –domain techniques are of following categories

a)Least-Significant Bit (LSB)

b) SSM-Modulation-Based Technique

The common algorithm by the use of spatial domain watermarking is LSB.

2. Frequency-domain techniques

The frequency-domain techniques mainly used for watermarking of the human visual system are better captured by the spectral coefficients.The frequency domain techniques are

(a) Discrete Wavelet Transformation (DWT)

(b) Discrete Cosine Transformation (DCT)

Least Significant Bit (LSB)

The simplest algorithm is Least Significant Bit (LSB) Insertion,in which with a bit from the watermark each 8-bit pixel's least significant bit is overwritten. [8] The high channel capacity of using the entire cover for transmission, object embedding takes place multiple times.[8].In a digital image, information can be inserted in the more busy areas of an image can be calculated so as to hide such messages in less perceptible parts of an image or it can be inserted directly into every bit of image information .

The algorithm proposed by Kurah and McHughes [6] to embed in the LSB and it was known as image downgrading [12]. An example of the less perceptible or less predictable is Least Significant Bit insertion. This explains how this works for an 8-bit grayscale image and the possible effects of altering such an image. The principle of embedding is effective and fairly simple . In a grayscale image each pixel is consist of 8 bits represented by 1 byte. It can represent 256 gray colors between the black which is 0 to the white which is 255. Principle of encoding use the Least Significant Bit of each of these byte, the bit on right side. Data is encoded to only the last two significant bits (which are the first and second LSB) of each color component it is most likely not going to be detectable; the human retina becomes the limiting factor in viewing pictures [6].

If 27 is a pixel value & 001100001 is a secret data then compare 0 from secret data &1 from pixel value.Then after watermarking the pixel value may be change to 26 or it remains as such. LSB can add one bit in each pixel.

Discrete Cosine Transform (DCT)

The Discrete cosine transform (DCT) is most popular because of many reasons. One of the reason is that most of the compression techniques are developed in the DCT domain (MPEG, MPEG1, and MPEG2 ,JPEG) & due to this image processing is more familiar with it. DCT is most common linear transformations in digital signal process technology.

The Discrete Cosine Transform allows an image to be broken up into different frequency bands, due to this it is much easier to embed watermarking information into the middle frequency bands of an image. In order to invisibly embed the watermark that can survive lossy data compressions, embed the watermark into the middle-frequency range of the image. Middle frequency bands are selected such that they have minimized that they avoid the most visual important parts of the image (low frequency) without over-exposing themselves to removal through noise attacks and compression. DCT domain watermarking can survive against the

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attacks such as sharpening ,noising, filtering and compression.

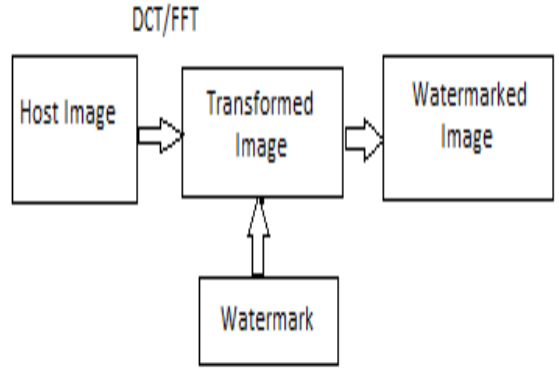

Fig.Watermark Embedding in DCT

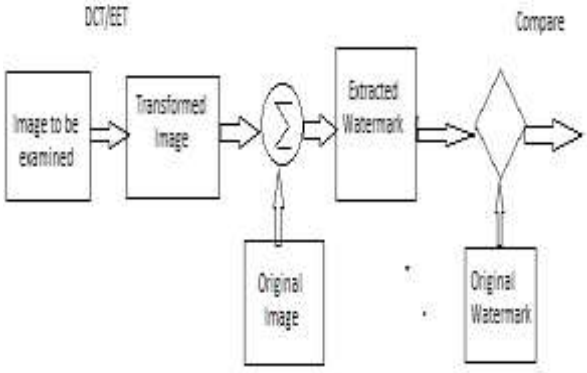

Fig.Watermark Detection in DCT

Application of DCT

DCT based watermarking useful in following application

- Medical image where low cost require
- I-card of employee of companies
- Fingerprint identification
- Pan card

Discrete Wavelet Transform (DWT)

Discrete wavelet transforms (DWT), which transforms a discrete time signal to a discrete wavelet representation. It converts an input series x0, x1, x2,xm, into one low-pass wavelet coefficient series and one high-pass wavelet coefficient series (of length n/2 each) given by:

$$H_i = \sum_{m=0}^{k-1} X_{2i-m*S_m}(z)$$

$$L_i = \sum_{m=0}^{k-1} X_{2i-m*t_m}(z)$$

Where

Sm (Z), tm (Z): wavelet filters,

K: the length of the filter, & i=0.12.3... [N/2]-1.

In practice, such transformation will be applied recursively on the low-pass series until the desired number of iterations is reached.

A signal is divided into two parts, first part is low frequencies and second part is high frequencies. The edge components of the signal are largely to the high frequency part. Low frequency part is divided again into two parts of low and high frequencies.

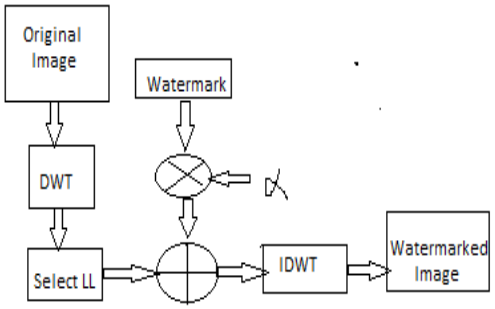

Fig.Watermark Embedding using DWT

First wavelet transform divides an image into four parts: HL, HH, LL and LH .

Where LL = low frequency coefficient

HH = high frequency coefficient diagonally

HL = high frequency coefficient vertically

LH = high frequency coefficient horizontally. Watermark must be embedded in low frequency coefficients.

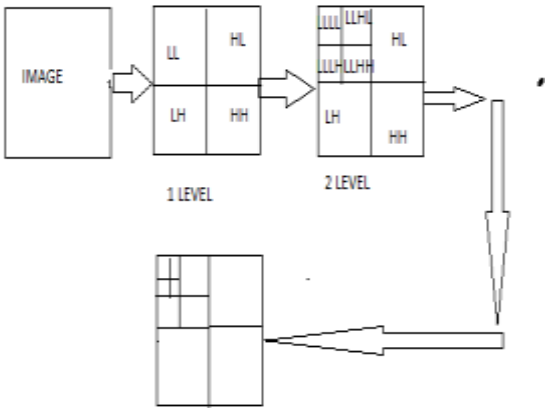

Fig.Flow of DWT Process

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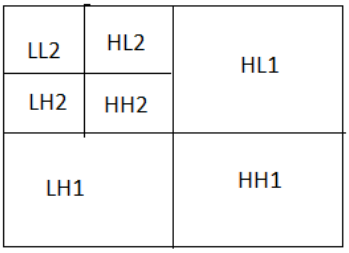

Fig.2.Dimensional DWT

The main advantage of the discrete wavelet transform is the watermarking method has hierarchical and multi resolution characteristics. In structural attacks DWT is more effective as compare to DCT. DWT has significant advantages over geometric attacks such as cropping compression & scaling. It is observed that DWT is more robust to cropping and it shows acceptable performance with scaling attacks whereas DCT technique doesn't work with scaling attacks.

Application of DWT

DWT based watermarking mainly used in following applications

- Banks application .[1]
- Government application
- Broadcast monitoring i.e. entertainment & advertisements
- In military application
- When we want to transfer confidential information through internet to anyone

Table.comparison of various technique/algorithm of Digital Image Watermarking:

Sr. no.	Parameter	DCT	DWT	LSB
1.	Imperceptibility	less	more	less
2.	Robustness	less	more	less
3.	PSNR (Peak Signal - to-Noise Ratio)	49.02	91.5	-
4.	Process	Complex	Complex	Simple

FUTURE SCOPE

In the future the main development of digital watermarking is like this:

- Copyright protection.
- Pirate tracking.
- Copying protection.
- Image authentication.
- Cover-up communication

CONCLUSION

In this report it is described that recent developments in the digital watermarking of images in which the watermarking technique is invisible and designed to exploit some aspects of the human visual systems. Imperceptibility obtained more in DWT as compare to DCT&LSB. DWT is more robust against attacks such as cropping and resizing as compare to DCT&LSB. There are different techniques used in watermarking for security of images. The spatial domain method LSB for security of image, which is effective, simple and easy method. Process of LSB is simple when used in MATLAB. Different image in MATLAB tells different process steps and their result.

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