DIGITAL IMAGE WATERMARKING TECHNIQUES: A SURVEY

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ABSTRACT

Nowadays Internet becomes most popular and synergistic for degeneration of information. The expansion of the internet has frequently increased the accessibility of multimedia data such as audio images and videos to the public. Due to the explosive growth in internet technology, digital data can be easily plagiarized, modified or deleted without proper authentication and authorization. In current scenario protection of multimedia digital content has become an important issue. Digital watermarking promises to address these issues. Digital watermarking is the method of embedding data into digital multimedia content .This paper reviews different methods of digital watermarking for protecting digital information.

Keywords—DCT, DWT, DFT,JOINT DWT-DCT.

I.INTRODUCTION

Digital Image Processing is a highly developing area with various rising applications in Computer Science. It is a very prominent field for the research work as its techniques are used in almost all kinds of tasks like human computer interface, medical visualization, image enhancement, law enforcement, artistic effect, image restoration and digital watermarking for security purposes.

The term digital watermarking was firstly used by TIRKEL in 1993[1]. TIRKEL presented two watermarking techniques to hide the watermark data in the images. Digital watermark is a kind of marker which is used in hiding digital information in a carrier signal. Digital image watermarking is a process of information hiding. Information is in the form of digital content like image, text, audio & video. Basically digital watermarking is a method for embedding some secret information and additional information in the cover image which can be later extracted or detected for different purposes like authentication, owner identification content protection and copyright protection etc [2]. The main aim of watermarking is to embed information imperceptibility and robustly in the cover data .Basically digital watermarking is used for security of digital content. Digital watermarking is a very development field and used in various applications which have been proved to be successful .The digital watermarking has been applied in a number of image process techniques. The aim of every application is to providing security of the digital contents . The digital watermarking applications are broadcast monitoring[3] , digital fingerprinting[4] , transaction tracking [5],copyright protection[6], temper detection[7] ,data hiding [8]and authentication[9] etc. This paper includes the survey of the latest methods that are used for the digital watermarking .These techniques can also be used for music files as well as video files.

This paper is organized in different sections. In section 2 we have discussed working of digital image watermarking .Section 3 defines the digital watermarking techniques and its classification. Finally section 4 draws conclusion.

II. DIGITAL WATERMARKING WORKING PRINCIPLE

Every Digital watermarking technique follows the two algorithms .First one as the embedding and other one as the detecting algorithm. These two processes are same for all the type of watermarking techniques.

In Embedding process the watermark is embedded in the cover image by using the embedding algorithm Figure 1 shows the watermarking embedding process.
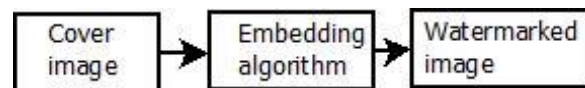
Figure 1

In detection or extraction process the embedded watermark is detected or recovered by using the detection algorithm. Figure 2 shows the watermark detection process.
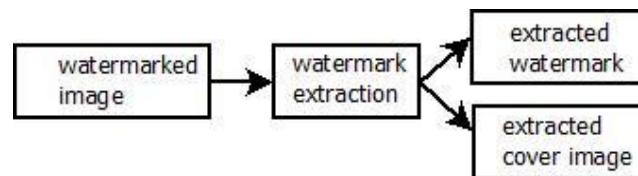
Figure 2

III. CLASSIFICATION OF WATERMARKING TECHNIQUES

Digital watermarking techniques can be categorized into multiple categories dependent upon the various domains. According to working domain watermarking technique is divided into two domains named as spatial domain and frequency domain. According to human perception watermarking technique is categorized into invisible watermarking technique and visible watermarking technique. Based on application domain watermarking technique is divided into source based watermarking technique and destination based technique .In this paper we focused on only working domain based watermarking techniques. The spatial domain techniques deal with the pixels. In frequency domain image is segmented into multiple frequency bands. Commonly used spatial domain techniques are LSB , predictive coding scheme & correlation based techniques. Mostly used frequency domain techniques are DWT ,DFT ,DCT . In comparison to spatial domain techniques frequency domain techniques are better in terms of robustness and imperceptibility .

Table1.Comparison between spatial domain and frequency domain[10,11].

Factors	Spatial Domain	Frequency Domain
Computation Cost	Low	High
Robustness	Fragile	More Robust
Perceptual Quality	High Control	Low Control
Computational Complexity	Low	High

Computational Time	Less	More
Capacity	High	Low
Example of Application	Mainly Authentication	Copy Rights

3.1 Spatial domain watermarking

In spatial domain watermarking image is represented in the form of pixels. In this process embedding is performed after changing the pixels values[12]. In this techniques intensity values and color values of some selected pixels are modified .Commonly used method in the spatial domain techniques is least significant bit. Following are the main steps that are used to perform LSB process[12].

1. Select the host image and watermark image.
2. Choose the number of bits of host image so that it can maintain the quality of the image.
3. Quality of image depends upon the number of bits chosen. Embed the MSB of watermark or secret image in LSB of host image.1. Select the cover image and watermark image

- **Host image**

 (10011010 00010000 10111111 01010101)

- **Watermark image**

 (1   1   0   0)

- **Watermarked image**

(10011011 00010001 10111110 010101000

- **Frequency domain watermarking**

Frequency domain watermarking is preferred over the spatial domain watermarking because the watermark placed by them cannot be easily destroyed and changed by the attackers. In the frequency domain the watermark is embedded by changing the magnitude of coefficients in a transform domain. Frequency domain also known as time domain. Time domain based watermarking techniques provide high capacity and high robustness against many geometrical attacks. Due to the embedding of watermark into the changed coefficients of the transformed image, it is more robust as comparison to spatial domain.[13]

- *Discrete cosine transform(DCT)*

Discrete cosine transform represents a finite sequence of data points in term of a sum of cosine functions oscillating at different frequencies. It transform the spatial domain in to the frequency domain.It is more robust and same as DFT. DFT uses complex number and DCT uses resal numbers.DCT divides an image into different frequency bands which are high, middle and low frequency bands.

Steps in DCT block based watermarking algorithm are following [14]

1. Divide the image into non overlapping blocks of 8*8.
2. At each block apply forward DCT.
3. Implement some block selection criteria.
4. Implement coefficient selection criteria.
5. Embed the watermark by modifying the selected coefficient.

6. Apply inverse DCT transform on each block

- **Discrete Fourier transform (DFT)**

By using DFT continuous functions are transformed into its corresponding frequency domain components. It decomposes an image in sine and cosine wave form. There are two types of embedding procedures are used in DFT. One is the direct embedding technique and the second one is template based technique. In direct embedding technique embedding of watermark is performed after modification of DFT magnitude phase coefficients. In template based technique templates are used . It is used to calculate the transformation factor.DFT is useful for the periodic, digital signals or discrete time [15].

In this complex values are used. It can be recovered from geometric distortion due to RST invariant.

- **Discrete wavelet transform (DWT)[16]**

Discrete wavelet analysis is multi resolution analysis. It splits the image into wavelet coefficients and scaling function. It divides the image into four sidebands. One part is low frequency of original image, the one bottom left contains vertical detail of the original image. Top right contains high frequency of original image. This process is repeated until the whole signal has been completely decomposed. DWT is more robust in comparison to DFT because it works in time as well as in frequency .Fourier transform only deals with frequency component.

LL Approximation sub band	HL Horizontal sub band
LH Vertical sub band	HH Diagonal sub band

Figure 3: one level DWT decomposition.

3.3 Joint DWT-DCT-

  DWT –DCT based hybrid watermarking algorithm improved thewatermarking performance in comaprison to DCT based approach.It s highly robust and more secured technique. Arnold transform is used to improve the security and robustness, because in this approach watermark is firstly scrambled.The reason of using hybrd approach is based on the fact that join transform could make up fo the drawbacks of each other.The application of joint DWT-DCT results in higher imperceptibility and robustness[17,18]. In the DWT-DCT based approach following steps are followed.

1.   Apply DWT to original image and chose LL subband at level 1.
2.   Divide this LL subband into 8*8 blocks.
3.   Apply DCT to each block and then find mid band frequency coefficients.

IV.CONCLUSION

Digital watermarking provides security to the digital content. Today digital watermarking focus various issues with respect to and its strength against various attacks on the digital images.This paper shows the literature survey of various Digital watermarking techniques under time and transform domain.This paper throughly

covers and discusss various digital image watermarking techniques both in the spatial and transform domain.The transform domain based techniques provide robustness and the paper discuss the different levels of robustnesss for different attacks.The paper comprises that existing techniques should be merged together to provde better security in solutions to the existing problems

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