Digital Watermarking Techniques: Review

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Abstract: Data security is most important for multimedia data because of duplication, manipulation and distribution of multimedia data. Digital watermarking is the solution to prevent manipulation, distribution and coping of multimedia data. This paper is the survey of existing watermarking techniques and it also represents comparison between different techniques on the basis of experimental results. In digital watermarking secret information is embedded into the original data for protecting from illegal usage of information. Digital watermarking can be dividing on the basis of domains like spatial domain, frequency domain and wavelet domain. This paper also discussed about advantages and disadvantages of these techniques.

Keywords: Digital watermarking, spatial domain, frequency domain and wavelet domain.

I. INTRODUCTION

Digital watermarking is the process of hiding the information into cover image. It is the digital data that can be embedded into any kind of media data like audio, video and images and it can be extracted later for authentication, copyright protection and content protection etc. Digital watermarking is a concept which is closely related to steganography, they both hide the message inside digital signal. But both do this differently watermarking hide the message related to digital content whereas steganography has no relation with data, it hides data by using cover image only sender and intended recipient can detect the message. Digital watermarking is of two types invisible watermarking and visible watermarking. In invisible watermarking information is not visible, but it can be detected by different means. It is used in copyright protection and source tracing. In visible watermarking information is visible on the image like logos. It is used in TV broadcast; logo of broadcast is visible at right side of screen. Steganography is typically invisible; it is allegedly used by terrorist and intelligence services. Watermarking keeps robustness as its priority whereas steganography aims for imperceptibility to human senses [2].

Digital watermarking has two algorithms one is embedding algorithm and detecting algorithm. Every watermarking technique uses these two algorithms. Embedded algorithm is used to embed watermark in the cover image. Detection algorithm is used to recover embed watermark [1].
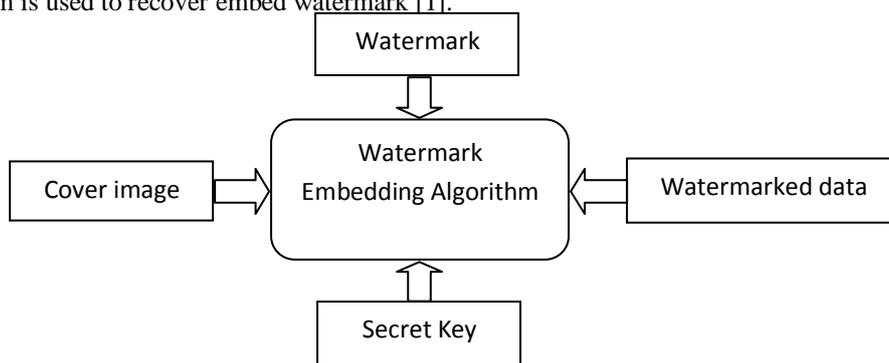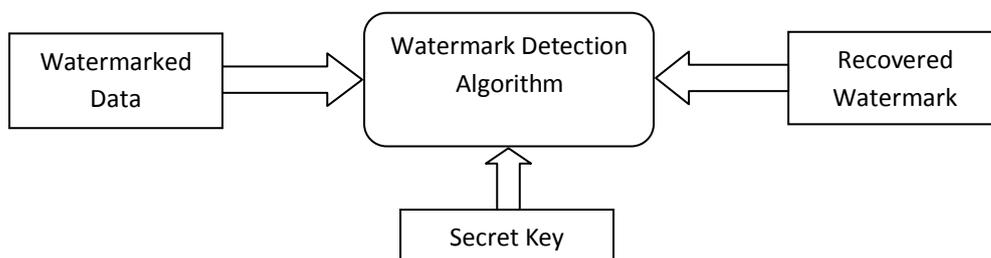

Figure 1: Watermark Embedding Process

Figure 2: Watermark Detection Process

This paper is categories into different sections. Section 2 describes working, Section 3 describes watermarking techniques, Section 4 draws conclusion.

II. DIGITAL IMAGE WATERMARKING WORKING

In digital signal processing digital watermarking is used to embed hidden information into multimedia data. Only extractor can see and extract this information. Hidden information is not visible. Firstly hidden information is embedded into digital image which generates watermarked image that is done by using digital watermarking. This watermarked image is more powerful against attack [1].

A. Embedding Stage

As shown in figure 1, in first stage by using watermarked algorithm and secret key watermark is embedding into original image. This stage is called as embedding stage after this stage data is ready to travel on the network.

B. Noise Stage

This is the second stage, in this stage data travels on the network some noise can be added to the data. This noise can modify or destroy watermarked data.

C. Detection Stage

In this stage by using some detection algorithms and secret key watermark and noise are extracted by detector from watermarked image.

III. DIGITAL IMAGE WATERMARKING TECHNIQUES

There are two domains spatial domain and transform domain for working with digital watermarking techniques. Spatial domain techniques works directly on the pixels, it loads the watermark directly on the pixels. LSB is the most common technique of spatial domain. Transform domain is also called frequency domain; it modified frequency of some pixels for embedding watermark data. DCT, DWT and DFT are some common frequency domain techniques.

A. Spatial Domain Watermarking

This domain directly works on the pixels. It embeds the watermark value into image by modifying the intensity and color values of some selected pixels. Spatial domain watermarking technique is simple and less time consuming but it is less powerful against attacks.

Least significant Bit (LSB)

This is mostly used method of spatial domain. In this method watermark bit is embed in the least significant bit of some selected pixels of original image. Watermark can be spread throughout the image or it can be in the selected location of pixels. This method does not degrade the quality of image. But this method is not powerful against the attacks and noise. Spatial domain is simpler than transform domain watermarking methods. Its only disadvantage is that it is not robust against attacks.

B. Transform Domain Watermarking

Transform domain methods are mostly used methods as compared to spatial domain. Image is represented in the form of frequencies in this method. There are three steps in this method.
- By using predefined transformation original image is converted into transformed image.
- Watermark is embedding into transformed image.
- Inverse transformation is applied to get the watermarked image.

Most common transform domain methods are Discrete Cosine Transform, Discrete Wavelet Transform and Discrete Fourier Transform.

i. Discrete Cosine Transform

It is used in signal processing. In this a signal is transformed from spatial domain to frequency domain. Discrete Cosine Transform watermarking is more powerful against attacks like noise. But they are difficult to implement because of more computations. It implements fast algorithms. There are some steps used in DCT [1].
1) Segment the image into non-overlapping blocks of 8x8.
2) Apply forward DCT to each of these blocks.
3) Apply some block selection criteria (e.g. HVS).
4) Apply coefficient selection criteria (e.g. highest).
5) Embedded watermark by modifying the selected Co-efficient.
6) Apply inverse DCT transform on each block.

ii. Discrete Wavelet Transform

Discrete Wavelet Transform used in digital image processing, watermarking etc. it is also used in signal processing applications like audio, video compression, removal of in noise etc. Discrete Wavelet Transform divides the image into two quadrants; high frequency quadrant and low frequency quadrant. After that lower quadrant again split into two quadrants high and low frequency quadrant and this process repeated again until the entire signal is decomposed [1].

Discrete Wavelet Transform is scalable in nature. DWT easily recognize the area in cover image in which watermark is embedded efficiently because of its spatial localization property.

There are some advantages of DWT over DCT like it gives better visual image quality, good localization property etc. But DWT also has some disadvantages like it is more complex, takes more computational time and computational cost is also high.

iii. Discrete Fourier Transform

DFT is stronger against geometric attacks like rotation, translation, scaling etc. It has two types of watermark embedded techniques: first one is direct embedding and other is template based embedding. In direct embedding technique watermark is embedded by modifying DFT phase and magnitude coefficients. In template based embedding template is embedded in DFT domain to estimate the transformation factor. After transformation this template is searched to resynchronize the image and then detectors are used to extract the embedded spread spectrum watermark.

DFT can be used to recover from geometric distortion whereas spatial domain, DCT and DWT are not RST invariant. But DFT has one disadvantage is that its output is always in complex value and its computational efficiency is very low [2].

IV. CONCLUSION

Digital watermarking is very useful for providing security to digital media. In this paper I have discussed the spatial domain (LSB) and transform domain (DWT, DCT, DFT). This survey analyses the working, advantages and disadvantages of digital watermarking techniques.

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