

A BRIEF ANALYSIS ON DIGITAL WATERMARKING

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ABSTRACT

Even though diverse digital watermarking algorithms were developed to protect copyright information, existing algorithms vary in performances according to image characteristics. While varying types of techniques and methods are available for protecting gray-scale images, the need to evaluate the performance of various techniques is important. For the above purpose, several computing parameters are available for quality measurements. In this paper, performance evaluation metrics suitable for each image characteristic will be discussed by analyzing and classifying various metrics which evaluates watermarking algorithm.

Keywords: Digital Watermarking, Performance Metrics, Image Processing.

I. INTRODUCTION

More information is transmitted in a digital format now than ever, and the growth in this trend will not plateau in the foreseeable future. Digital information is susceptible to having copies made at the same quality as the original.

There are many types of digital information and data. The types concentrated in this analysis are:

- Digital Images
- Digital Audio, and
- Digital Videos

A watermark is a pattern of bits inserted in a cover image like images, audio or video signal to prevent unauthorized forgery and to protect copyright information. Digital Watermarking works by concealing information within digital data, such that it cannot be detected without special software with the purpose of making sure the concealed data is present in all copies of the data that are made whether legally or otherwise, regardless of attempts to damage/remove it [1].

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Watermarking [5] has been studied for several years as one of the widely used copyright protection methods. Schemes of embedding digital watermark into grayscale images have been researched and developed greatly. However, color images are more common in everyday life, and it contains more information than grayscale image and provides more information against the attack of illegal copyright [2]. So it is very important to embed the watermarking into color image for copyright protection.

The effective watermarking technique is one that sustains all kinds of attacks on it without losing its originality. Embedding watermark in spatial domain and frequency domain of the images are the two very popular approaches. Both the ways are accepted and practiced worldwide and have gained prominence due to their positive results.

II. METHODOLOGY OF WATERMARKING

Watermarking is a process that embeds watermark into the multimedia object such as image, audio and video such that the watermark can be extracted later at receiver side for authentication purpose [3]. Generally, watermarking process consists of three steps:

1. Watermark and Cover signal
2. The encoding algorithm (embedding watermark)
3. The decoding algorithm (extraction of watermark)

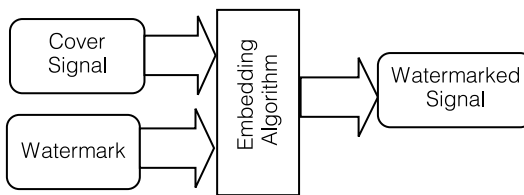


Fig. 1 Embedding Process

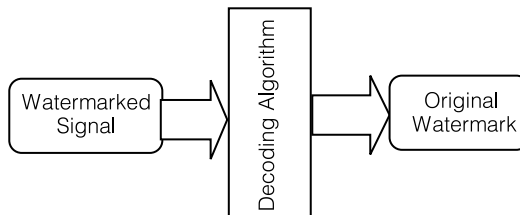


Fig. 2 Decoding Process

III. TYPES OF WATERMARKING

Watermarking can be broadly classified into four domains[6]:

Based on Type of Document

- (i) **Text Watermarking:** Here, the cover signal to be watermarked will be some kind of text.
- (ii) **Video Watermarking:** Video will be treated as cover signal.
- (iii) **Audio Watermarking:** The carrier signal in which watermark is to be embedded will be audio.
- (iv) **Image Watermarking:** This is one of the most used watermarking. Here, image is used as carrier signal for watermarking.

Based on Human Perception

- (i) **Visible Watermarking:** This is one of the most common type of watermarking executed in the market. Logos on the document is the example of visible watermark.
- (ii) **Invisible Watermarking:** Here, the watermark is intentionally hid from the human eyes. Invisible watermarking [4] is the process of hiding certain information into the carrier signal to prove ownership rights, integrity and some additional information. Invisible watermarking focusses on securing watermark from unauthorized attacks such as JPEG compression.

Based on Working Domain

I. **Spatial Domain:** Spatial domain mainly focused on modifying pixel values of one or two randomly selected subsets of images [7]. This algorithm directly loads or embed the raw data into image pixels. Some of the algorithm of spatial domain technique are LSB, Patchwork, text mapping coding, Additive watermarking etc.

(a) **Least Significant Bit Technique (LSB):** LSB technique is one of the simplest Technique to implement. During this process watermark bit is added to the least significant bit of each pixel. Only the last bit of each pixel is read to disclose the watermark data during extraction or detection method. In this method, even if the watermarked image is cropped the receiver can still get the required data, as the data is embedded number of times. This technique is very sensitive to noise and cannot be used for practical purposes.

Advantage of LSB Technique

1. Simplest method to implement.

2. Computational complexity of LSB is very less for both embedding and extraction of watermark.
3. Degradation of image quality is less.

Disadvantage of LSB Technique

1. This method is not very robust to various attack.
2. Attacks like cropping, shuffling, and scaling destroy the embedded watermark.
3. It is very sensitive to noise.

Transform Domain: This technique is also known as frequency domain. Values of some frequencies are changed from their original one. There are some common used frequency domains methods, such as DCT, DFT, DWT, and DHT.

- (a) **Discrete Cosine Transform (DCT):** In digital watermarking DCT technique is one of the most widely used technique. Robustness is more in this technique as compare to the spatial domain. Transform domain algorithms are robust against simple image processing operation like blurring, low pass filtering etc. But they are not so strong against some geometric attacks like rotation, scaling etc. Transform domain techniques are difficult to implement as its computational complexity is very high.

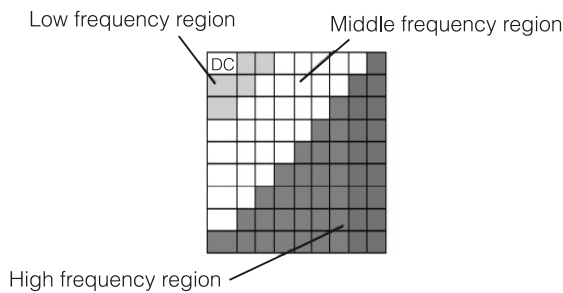


Fig. 3 DCT Transform regions

Advantage of DCT Transform

1. In this watermark is hidden into the coefficient of middle and high frequency, so the image visibility will not get affected and the watermark cannot be hacked or removed by anyone.

Disadvantage of DCT Transform

1. Some higher frequency component are suppressed during the quantization.
2. Under scaling attack this technique does not work.

Discrete Wavelet Transform (DWT): Discrete Wavelet Transform is a technique which is used in many different areas like digital image processing. DWT technique is based on small waves called as wavelet of variable frequency and limited duration. Decomposition of the image is take place into three different direction i.e. horizontal, vertical and diagonal. The process of decomposition is as follow: firstly, it divides the image into four wavelets (LL, LH, HL, HH), where H denotes the high pass filter and L denotes the low pass filter.

LL3	HL3	HL2	HL1
HL2	HH3		
LH2	HH2		
LH1		HH1	

Fig. 4 DWT Transform Bands

Advantages of DWT Technique

1. It is more robust to cropping.
2. It is effective in structural attacks.
3. Compression ratio is very high which is relevant to human perception.
4. DWT has multi resolution feature.

Disadvantages of DWT Technique

1. Computing cost is high.
2. It takes longer Compression Time.
3. Noise is present near edges of images.

IV. CONCLUSION

In this paper, a close look is given upon the basic concepts of digital watermarking, their types and classification based on three dimensions: types of document, human perception and working domains.

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