Ain Shams University
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A Study on Digital Image Watermarking Techniques

THESIS

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BY

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ملخص 1

ABSTRACT

A Study on Digital Image Watermarking Techniques
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Due to the powerful computing capabilities of modern computers and the increasing popularity of the Internet, digital multimedia products are used and distributed much easier and faster. However, illegal copying and manipulation of such media can cause considerable financial loss. As a result, copyright protection of digital media has recently become an active research area.

Recently, digital watermarking has been extensively studied for copyright protection of digital images. Basically, digital watermarking is the process of embedding hidden copyright information, the watermark, into digital data by making small modifications on these data without destroying its value.

There are two methods of performing image watermarking, one in spatial domain and the other in transform domain. In the spatial domain we can simply insert watermarks into a host image by changing the gray levels of some pixels in the host image. In transform domain, we can insert watermarks into coefficients of a transformed image, for example, using Discrete Fourier Transform (DFT) domain, Discrete Cosine Transform (DCT) domain or Discrete Wavelet Transform (DWT) domain.

The problem of choosing the best domain for embedding watermarks in digital images is very important. The main objective of this work is to make a study on digital image watermarking techniques in order to specify the best domain

for embedding watermarks in digital images with respect to the different applications of digital image watermarking.

In this thesis, seven image watermarking techniques are implemented and evaluated. The evaluated techniques are selected to represent the different approaches to embedding data in spatial domain, DFT domain, DCT domain, and DWT domain. The algorithms are also chosen to represent a range of computational complexities and implementation structures. The performance of the selected algorithms is evaluated with respect to perceptual quality, execution time, and robustness in face of nine different attacks. The chosen attacks are commonly used.

The simulation results and performance analysis show that the DWT domain is the most promising domain for embedding watermarks in digital images. The results show also that the two requirements, robustness and imperceptibility, are contrary to each other. Generally speaking, in the transform-domain watermarking techniques, embedding the watermark into the higher frequency coefficients is not robust, although the watermarked image quality is assured. In contrast, embedding the watermark into the lower frequency coefficients is more robust against common attacks such as low pass filtering and lossy compression but it will cause the resulting watermarked image quality greatly degrades to compare with the original image.

The second contribution of this thesis is that, a wavelet-based watermarking scheme combined with genetic algorithms (GA) is introduced. The objective of the proposed scheme is to improve the performance, not only in watermarked image quality, but also in robustness against a wide range of attacks using genetic training techniques. A fitness function based on the two conflicting requirements is defined and GA is used to optimize it. The simulation results and performance analysis show that the application of genetic algorithms in the watermarking problem is promising.

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LIST OF ABBREVIATIONS

A/D	Analog / Digital
BCR	Bit Correct Ratio
D/A	Digital / Analog
DCT	Discrete Cosine Transform
DFT	Discrete Fourier Transform
DVD	Digital Versatile (Video) Disk
DWT	Discrete Wavelet Transform
GA	Genetic Algorithm
HVS	Human Visual System
JND	Just Noticeable Distortion
JPEG	Joint Photographic Experts Group
LSB	Least Significant Bit
MSE	Mean Square Error
PRN	Pseudo Random Number
PSNR	Peak Signal-to-Noise Ratio
QF	Quality Factor

1

INTRODUCTION