Robust and Geometric Invariant Digital Image Watermarking

Yuan Xiao-Chen

Master of Science in E-Commerce Technology

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Faculty of Science and Technology
University of Macau

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Approved by _____

Supervisor

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Abstract

Robust and Geometric Invariant Digital Image Watermarking

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Three watermarking schemes were proposed in this thesis -- The Block and Gray Level Histogram Based Watermarking Scheme, in which, the block histogram is generated and the intensity-level histogram of each block is modified to make a specific distribution, according to which, the watermark data bits can be extracted. The Histogram and DWT Based Watermarking Scheme, which embeds the watermark in the approximation sub-band of the wavelet-decomposed image. The block histogram of the approximation sub-band is generated, and some pixels in block are moved to form a specific pattern in the coefficient histogram distribution, according to which, the watermark data bits can be extracted. And the Feature Extraction and Histogram Distribution Based Watermarking Scheme. The Adaptive Harris Detector is proposed based on the Harris Corner Detector, with which, the embedding regions can be produced; some pixels are moved to form a specific pattern in the intensity-level histogram distribution in each embedding region, which can be used for watermark extraction. The Rotation Restoration Algorithm is proposed to restore the image to its original un-rotated position. Experiments have been done towards these three proposed digital image watermarking schemes and the results show the proposed schemes are highly robust against JPEG compression, geometric attacks and some common signal processing, and outperform the existing methods in term of robustness.

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LIST OF ABBREVIATIONS

ACF. Auto-Correlation Function

DFT. Discrete Fourier Transform

DWT. Discrete Wavelet Transform

FFT. Fast Fourier Transform

FMT. Fourier-Mellin Transform

HOWA. Histogram-Oriented Watermarking Algorithm

IDWT. Inverse Discrete Wavelet Transform

IFFT. Inverse Fast Fourier Transform

ILPM. Inverse Log-Polar Mapping

LPM. Log-Polar Mapping

ML. Maximum LikelihoodFFT

MSE. Mean Square Estimation Error

QIM. Quantization Index Modulation

RBA. Random Bend Attack

RST. Rotation, Scaling, Translation

PREFACE

In this thesis, a detailed discussion was given on the geometric invariant digital image watermarking schemes. The algorithms which were used to implement the robust watermarking schemes have been illustrated by categories.

Based on the existing methods, three watermarking schemes were proposed in this thesis -- The Block and Gray Level Histogram Based Watermarking Scheme, in which, the block histogram is generated and the intensity-level histogram of each block is modified to make a specific distribution, according to which, the watermark data bits can be extracted. The Histogram and DWT Based Watermarking Scheme, which embeds the watermark in the approximation sub-band of the wavelet-decomposed image. The block histogram of the approximation sub-band is generated, and some pixels in block are moved to form a specific pattern in the coefficient histogram distribution, according to which, the watermark data bits can be extracted. And the Feature Extraction and Histogram Distribution Based Watermarking Scheme. The Adaptive Harris Detector is proposed based on the Harris Corner Detector, with which, the embedding regions can be produced; some pixels are moved to form a specific pattern in the intensity-level histogram distribution in each embedding region, which can be used for watermark extraction. The Rotation Restoration Algorithm is proposed to restore the image to its original un-rotated position. Experiments have been done towards these three proposed digital image watermarking schemes and the results show the proposed schemes are highly robust against JPEG compression, geometric attacks and some common signal processing, and outperform the existing methods in term of robustness.