

A Survey of Digital Watermarking Techniques

Neha Singh, Mamta Jain, Sunil Sharma

Abstract—The enormous popularity of the World Wide Web in the early 1990's demonstrated the commercial potential of offering multimedia resources through the digital networks. Since commercial interests seek to use the digital networks to offer digital media for profit, they have a strong interest in protecting their ownership rights. Since the threat of using multimedia information, digital forgeries, and unauthorized sharing (piracy) of digital content have increased among content creators, distributors and users. Today multimedia information piracy alone has subjected all the industries to multi-billion revenue losses. Traditional digital content protection techniques, such as encryption and scrambling, alone cannot provide adequate protection of copyrighted contents, because these technologies are unable to protect digital content once they are decrypted. One way to discourage illegal duplication is to insert information known as watermark, into potentially vulnerable data in such a way that it is impossible to separate the watermark from the data. Digital watermarking is the process of inserting a digital signal or pattern inside a digital image, which provides evidence of authenticity. This paper presents a survey on various information hiding techniques and describes classification of digital Watermarking techniques.

Index Terms— Copyright Protection, Embedding, Information Hiding, Watermarking.

I. INTRODUCTION

Editing, distribution and reproduction of the private digital multimedia are becoming extremely easier and faster with the existence of the internet and the availability of pervasive and powerful multimedia tools. The problems of illegal duplication, fake currency, business security, protecting intellectual property etc. are becoming more and more important. Digital watermarking has emerged as a possible method to tackle these issues. Digital images are the most popular carrier file format among various available formats like audio files, video files, and text files because of their frequency on the Internet. Until now, intellectual property and value has always been bound to some physical container that could not be easily duplicated, thereby guaranteeing that the creator benefits from his work. Therefore information hiding techniques plays a vital role for providing copyright authentication.

II. HISTORY OF INFORMATION HIDING

In ancient times, the messages were sent on foots. There are only two options to hide a message: hide it on the messenger, or have the messenger memorize it.

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The practice and idea of information hiding has a long history. According to Greek historian Herodotus around 440 B.C., the famous Greek tyrant Histiaeus [1]-[3], while in prison, used to send message to his son-in-law by shaving the head of his trusted slave to tattoo a message on his scalp. He dispatched the slave with the hidden message when the hair grew back.

The second story also came from Herodotus, which says that a soldier named Demeratus [1] used wax-covered tablet to send a message to Sparta that Xerxes intended to invade Greece. He removed the wax from the tablet and wrote the secret message on the underlying wood and then recovered the tablet with wax to make it appear as a blank tablet and finally sent the document without being detected.

Hiding messages using invisible ink was also very popular. Ancient Romans used to write their secret messages between the blank lines by invisible ink that is generally prepared by fruit juices, milk, and urine etc. When heated, the invisible ink would darken and becomes visible. Ovid in his "Art of Love" suggests using milk to write invisibly. During World War II, it was also reported that the Nazis [3] invented several information hiding methods such as Microdots, and have reused invisible ink and null ciphers. As an example a message was sent by a Nazi spy that read:

"Apparently neutral's protest is thoroughly discounted and ignored. Isman Hard hit. Blockade issue affects pretext for embargo on by-products, ejecting suets and vegetable oils." By collecting the 2nd letter from each word the secret message reveals:

"Pershing sails from NY June 1"

The monk Johannes Trithemius, founders of modern cryptography, described an extensive system for concealing secret messages within innocuous texts in his three volume work Steganographia, written around 1500. Later in 1665 Gaspari Schott wrote a four hundred pages book Steganographica from the idea of Trithemius. Further in 1883, Auguste Kerchoffs' published Cryptographie militaire which is mostly about cryptography. But during twentieth century the information hiding techniques actually came into existence.

III. DISCIPLINES OF INFORMATION HIDING

A wide range of problems beyond the embedding messages in content have been encircled by the general term Information *hiding* (or *data hiding*). The term *hiding* can refer to either for information secrecy (Steganography) or information imperceptibility (Watermarking). Two important sub disciplines of information hiding are Watermarking and Steganography [4] that are closely related to each other but with different underlying properties, requirements and designs, thus result in different

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Srinivasan Ramakrishnan



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Digital Image Watermarking Surekha Borra,Rohit Thanki,Nilanjan Dey,2018-12-07 The Book presents an overview of newly developed watermarking techniques in various independent and hybrid domains Covers the basics of digital watermarking its types domain in which it is implemented and the application of machine learning algorithms onto digital watermarking Reviews hardware implementation of watermarking Discusses optimization problems and solutions in watermarking with a special focus on bio inspired algorithms Includes a case study along with its MATLAB code and simulation results

Color Image Watermarking Qingtang Su,2016-12-05 This book presents watermarking algorithms derived from signal processing methods such as wavelet transform matrix decomposition and cosine transform to address the limitations of current technologies For each algorithm mathematical foundations are explained with analysis conducted to evaluate performances on robustness and efficiency Combining theories and practice it is suitable for information security researchers and industrial engineers

Digital Watermarking Mohammad Ali Nematollahi,Chalee Vorakulpipat,Hamurabi Gamboa Rosales,2016-08-08 This book presents the state of the arts application of digital watermarking in audio speech image video 3D mesh graph text software natural language ontology network stream relational database XML and hardware IPs It also presents new and recent algorithms in digital watermarking for copyright protection and discusses future trends in the field Today the illegal manipulation of genuine digital objects and products represents a considerable problem in the digital world Offering an effective solution digital watermarking can be applied to protect intellectual property as well as fingerprinting enhance the security and proof of authentication through unsecured channels

Medical Image Watermarking Amit Kumar Singh,Basant Kumar,Ghanshyam Singh,Anand Mohan,2017-08-11 This book presents medical image watermarking techniques and algorithms for telemedicine and other emerging applications This book emphasizes on medical image watermarking to ensure the authenticity of transmitted medical information It begins with an introduction of digital watermarking important characteristics novel applications different watermarking attacks and standard benchmark tools This book also covers spatial and transform domain medical image watermarking techniques and their merits and limitations The authors have developed improved novel watermarking techniques for telemedicine applications that offer higher robustness better perceptual quality and increased embedding capacity and secure watermark The suggested methods may find potential applications in the prevention of patient identity theft and health data management issues which is a growing concern in telemedicine applications This book provides a sound platform for understanding the medical image watermarking paradigm for researchers in the field and advanced level students Industry professionals working in this field as well as other emerging applications demanding robust and secure watermarking will find this book useful as a reference

Digital Watermarking and Steganography Frank Y. Shih,2017-12-19 Every day millions of people capture store transmit and manipulate digital data Unfortunately free access digital multimedia communication also provides virtually

unprecedented opportunities to pirate copyrighted material Providing the theoretical background needed to develop and implement advanced techniques and algorithms Digital Watermarking and Steganography Demonstrates how to develop and implement methods to guarantee the authenticity of digital media Explains the categorization of digital watermarking techniques based on characteristics as well as applications Presents cutting edge techniques such as the GA based breaking algorithm on the frequency domain steganalytic system The popularity of digital media continues to soar The theoretical foundation presented within this valuable reference will facilitate the creation on new techniques and algorithms to combat present and potential threats against information security

Digital Watermarking Techniques in Curvelet and Ridgelet Domain Channapragada Rama Seshagiri Rao, Munaga V.N.K. Prasad, 2016-05-20 This book describes the design development and testing of a novel digital watermarking technique for color images using Magic Square and Ridgelet transforms The novel feature of the method is that it generates and uses multiple copies of the digital watermark The book describes how the method was tested for embedding digital watermarks into color cover images resulting in very high PSNR value and yielding comparable results with existing watermarking techniques To reach this new method eight different techniques are designed developed and tested First the authors test two digital watermarking techniques based on encryption Image Watermark Using Complete Complementary Code Technique CCCT and Image Watermarking Using CCC Fast Walsh Hadamard Transform Technique CCC FWHTT Next four digital watermarking techniques based on curvelet transforms are discussed Image Watermarking Using Curvelet Transform WCT Watermark Wavelets in Curvelets of Cover Image WWCT Resized Watermark into Curvelets of Cover Image RWCT and Resized Watermark Wavelets into Curvelets of Cover Image RWWCT Then two final techniques are presented Image Watermarking Based on Magic Square MST and Image watermarking based on Magic Square and Ridgelet Transform MSRTT Future research directions are explored in the final chapter Designed for professionals and researchers in computer graphics and imaging Digital Watermarking Techniques in Curvelet and Ridgelet Domain is also a useful tool for advanced level students

Reversible Digital Watermarking Ruchira Naskar, Rajat Subhra Chakraborty, 2022-06-01 Digital Watermarking is the art and science of embedding information in existing digital content for Digital Rights Management DRM and authentication Reversible watermarking is a class of fragile digital watermarking that not only authenticates multimedia data content but also helps to maintain perfect integrity of the original multimedia cover data In non reversible watermarking schemes after embedding and extraction of the watermark the cover data undergoes some distortions although perceptually negligible in most cases In contrast in reversible watermarking zero distortion of the cover data is achieved that is the cover data is guaranteed to be restored bit by bit Such a feature is desirable when highly sensitive data is watermarked e g in military medical and legal imaging applications This work deals with development analysis and evaluation of state of the art reversible watermarking techniques for digital images In this work we establish the motivation for research on reversible watermarking using a couple of case studies with medical and military images We

present a detailed review of the state of the art research in this field We investigate the various subclasses of reversible watermarking algorithms their operating principles and computational complexities Along with this to give the readers an idea about the detailed working of a reversible watermarking scheme we present a prediction based reversible watermarking technique recently published by us We discuss the major issues and challenges behind implementation of reversible watermarking techniques and recently proposed solutions for them Finally we provide an overview of some open problems and scope of work for future researchers in this area

Digital Image and Video Watermarking and Steganography

Srinivasan Ramakrishnan,2019-09-18 Authenticating data such as image video and audio is an important task in digital communication Another critical task is establishing ownership of the copyright Digital watermarking is a technique used to provide authentication and ownership of the copyright to the data Too much digitalization of data in the form of image video and audio communicated through various web and mobile applications makes authentication a challenging task Steganography the art of hiding tiny pieces of data in image video and audio can also help in copyright protection authentication and access control This book provides three watermarking and two steganography methods and will be a useful resource for graduate students researchers and practicing engineers in the field of electrical engineering

Digital

Watermarking Techniques in Image Processing Inna Sonya Lyatskaya,2006 Multimedia Watermarking Aditya Kumar Sahu,2024-02-21 Multimedia watermarking is a key ingredient for integrity verification transaction tracking copyright protection authentication copy control and forgery detection This book provides an extensive survey from the fundamentals to cutting edge digital watermarking techniques One of the crucial aspects of multimedia security is the ability to detect forged tampered regions from the multimedia object In this book we emphasized how tampering detection localization and recovery of manipulated information not only limits but also eliminates the scope of unauthorized usage Finally this book provides the groundwork for understanding the role of intelligent machines and blockchain in achieving better security in multimedia watermarking Readers will find it easy to comprehend the wide variety of applications theoretical principles and effective solutions for protecting intellectual rights soon after reading this book Image Watermarking Techniques Talbi Mourad,2023-09-05 This book investigates the image watermarking domain analyzing and comparing image watermarking techniques that exist in current literature The author's goal is to aid researchers and students in their studies in the vast and important domain of image watermarking including its advantages and risks The book has three chapters image watermarking using data compression speech modulation for image watermarking and secure image watermarking based on LWT and SVD In addition this book Investigates the image watermarking domain analyzing and comparing current image watermarking techniques Includes detail on image encryption and mathematical tools used for image watermarking Covers image watermarking using data compression speech modulation for image watermarking and more

A Digital Image

Watermarking Technique on Multiple Transform Methods Meekyeong Kim,2017 Copyright protection of digital content

has emerged as one of the most pressing issues in the digital content marketplace Digital watermarking may provide an effective method for identifying the copyright ownership of digital content such as images audio and video against unauthorized use and distribution The basic idea of digital watermarking involves embedding or hiding the copyright and ownership information of digital content imperceptibly as a watermark within the content itself Our study proposes the development of an efficient digital image watermarking algorithm based on a multiple transform method that combines the benefits of the frequency decomposition ability of the discrete wavelet transform DWT and the unpredictable random distribution property of the discrete fractional random transform DFRNT while using a 2D barcode to improve the algorithm's robustness imperceptibility security and extraction performance As the first step in developing the proposed system we implement our watermark generation process by adopting a two dimensional 2D barcode as an information hiding method and a self designed block code pattern in order to ensure the extraction performance of watermarks A generated 2D barcode is then converted through block code encoding and scrambling conversion which increase the hidden computational complexity of information thus bolstering the security of the algorithm The 2D barcode and block code also feature a self error correction function that can correct the bit error in the process of extracting watermark Next we implement the multiple transform process by adopting the DWT DFRNT transform method in order to ensure the robustness and security of the watermarking algorithm A host image is used as the input signal into 2D DWT and is decomposed into four frequency sub bands The generated sub band's coefficients are used as input data into DFRNT Using the quantization technique we then embed the generated watermark image into the DWT DFRNT transformed image transforming the quantized signal through the inverse DFRNT IDFRNT and the inverse DWT IDWT sequentially Finally the watermarked image signal is generated as the output Experimental results present that our proposed algorithm improves extraction performance by accurately extracting the hidden information in the 2D barcode from the detected watermark The findings also show that combining the dual transform method DWT and DFRNT improves the security and robustness of the watermarking algorithm in defending against basic image signal processing and common attacks

Advanced Techniques in Multimedia Watermarking: Image, Video and Audio Applications Al-Haj, Ali Mohammad, 2010-05-31 This book introduces readers to state of art research in multimedia watermarking in the different disciplines of watermarking addressing the different aspects of advanced watermarking research modeling and theoretical analysis advanced embedding and extraction techniques software and hardware implementations and performance evaluations of watermarking systems Provided by publisher

Digital Watermarking for Digital Media Juergen Seitz, 2005-01-01 The book discusses new aspects of digital watermarking in a worldwide context Provided by publisher

Multimedia Security: Steganography and Digital Watermarking Techniques for Protection of Intellectual Property Lu, Chun-Shien, 2004-07-31 Multimedia security has become a major research topic yielding numerous academic papers in addition to many watermarking related companies In this emerging area there are

many challenging research issues that deserve sustained study towards an effective and practical system This book explores the myriad of issues regarding multimedia security including perceptual fidelity analysis image audio and 3D mesh object watermarking medical watermarking error detection authentication and concealment fingerprinting digital signature and digital right management

An Investigation of Digital Image Watermarking Technique Based on RDWT Jian-Guo Cao,2000 *Digital Watermarking in Cloud Environments For Copyright Protection* Kumar, Ashwani,de Alexandria, Auzuir Ripardo,Yadav, Satya Prakash,Galletta, Antonino,2025-08-15 As cloud based platforms become more necessary for digital content ensuring the protection of intellectual property has also become a necessity for organizations Digital watermarking has emerged as a vital technique for embedding copyright information in media content and offers a robust layer of security The advancements in digital watermarking for copyright protection within cloud infrastructures better safeguard digital assets in a highly connected world Digital Watermarking in Cloud Environments For Copyright Protection delves into digital image watermarking techniques exploring their various classifications including robust fragile blind and non blind watermarking It highlights the importance of securing sensitive data in the ciphertext domain to prevent data theft during transmission Covering topics such as adaptive watermarking algorithms copyright vulnerability and quantum cryptography this book is an excellent resource for researchers academicians practitioners managers and more

Multimedia Watermarking Techniques and Applications Darko Kirovski,2006-04-18 Intellectual property owners must continually exploit new ways of reproducing distributing and marketing their products However the threat of piracy looms as a major problem with digital distribution and storage technologies Multimedia Watermarking Techniques and Applications covers all current and future trends in the design of modern

Digital Watermarking and Steganography Frank Y. Shih,2017-04-10 This book intends to provide a comprehensive overview on different aspects of mechanisms and techniques for information security It is written for students researchers and professionals studying in the field of multimedia security and steganography Multimedia security and steganography is especially relevant due to the global scale of digital multimedia and the rapid growth of the Internet Digital watermarking technology can be used to guarantee authenticity and can be applied as proof that the content has not been altered since insertion Updated techniques and advances in watermarking are explored in this new edition The combinational spatial and frequency domains watermarking technique provides a new concept of enlarging the embedding capacity of watermarks The genetic algorithm GA based watermarking technique solves the rounding error problem and provide an efficient embedding approach Each chapter provides the reader with a fundamental theoretical framework while developing the extensive advanced techniques and considering the essential principles of the digital watermarking and steganographic systems Several robust algorithms that are presented throughout illustrate the framework and provide assistance and tools in understanding and implementing the fundamental principles

Intelligent Watermarking Techniques Hsiang-Cheh Huang,Jeng-Shyang Pan,L. C. Jain,2004 Watermarking techniques involve the concealment of

information within a text or images and the transmission of this information to the receiver with minimum distortion. This is a very new area of research. The techniques will have a significant effect on defence, business, copyright protection and other fields where information needs to be protected at all costs from attackers. This book presents the recent advances in the theory and implementation of watermarking techniques. It brings together for the first time the successful applications of intelligent paradigms including comparisons with conventional methods in many areas. The accompanying CD Rom provides readers with source codes and executables to put into practice general topics in watermarking.

Reviewing **A Survey Digital Image Watermarking Techniques Sersc**: Unlocking the Spellbinding Force of Linguistics

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