

Fingerprint Recognition

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1. Introduction

Recognition of persons by means of biometric characteristics is an emerging phenomenon in modern society. It has received more and more attention during the last period due to the need for security in a wide range of applications. Among the many biometric features, the fingerprint is considered one of the most practical ones. Fingerprint recognition requires a minimal effort from the user, does not capture other information than strictly necessary for the recognition process, and provides relatively good performance. Another reason for the popularity of fingerprints is the relatively low price of fingerprint sensors, which enables easy integration into PC keyboards, smart cards and wireless hardware (Maltoni et al., 2009).

Fig. 1 presents a general framework for a general fingerprint identification system (FIS) (Ji & Yi, 2008). Fingerprint matching is the last step in Automatic Fingerprint Identification System (AFIS). Fingerprint matching techniques can be classified into three types:

- Correlation-based matching,
- Minutiae-based matching, and
- Non-Minutiae feature-based matching.

Minutiae-based matching is the most popular and widely used technique, being the basis of the fingerprint comparison.

2. Previous work and motivation

In (Bazen & Gerez, 2003), a novel minutiae matching method is presented that describes elastic distortions in fingerprints by means of a thin-plate spline model, which is estimated using a local and a global matching stage. After registration of the fingerprints according to the estimated model, the number of matching minutiae can be counted using very tight matching thresholds. For deformed fingerprints, the algorithm gives considerably higher matching scores compared to rigid matching algorithms, while only taking 100 ms on a 1 GHz P-III machine. Furthermore, it is shown that the observed deformations are different from those described by theoretical models proposed in the literature.

In (Liang & Asano, 2006), minutia polygons are used to match distorted fingerprints. A minutia polygon describes not only the minutia type and orientation but also the minutia shape. This allows the minutia polygon to be bigger than the conventional tolerance box without losing matching accuracy. In other words, a minutia polygon has a higher ability to

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Handbook of Research on Network Forensics and Analysis Techniques Shrivastava, Gulshan, Kumar, Prabhat, Gupta, B. B., Bala, Suman, Dey, Nilanjan, 2018-04-06 With the rapid advancement in technology myriad new threats have emerged in online environments The broad spectrum of these digital risks requires new and innovative methods for protection against cybercrimes The Handbook of Research on Network Forensics and Analysis Techniques is a current research publication that examines the advancements and growth of forensic research from a relatively obscure tradecraft to an important part of many investigations Featuring coverage on a broad range of topics including cryptocurrency hand based biometrics and cyberterrorism this publication is geared toward professionals computer forensics practitioners engineers researchers and academics seeking relevant research on the development of forensic tools *Handbook of Research on Social and Organizational Liabilities in Information Security* Gupta, Manish, Sharman, Raj, 2008-12-31 This book offers insightful articles on the most salient contemporary issues of managing social and human aspects of information security Provided by publisher

Forensic Testimony C. Michael Bowers, 2013-09-07 Forensic Testimony Science Law and Expert Evidence favored with an Honorable Mention in Law Legal Studies at the Association of American Publishers 2015 PROSE Awards provides a clear and intuitive discussion of the legal presentation of expert testimony The book delves into the effects processes and battles that occur in the presentation of opinion and scientific evidence by court accepted forensic experts It provides a timely review of the United States Federal Rules of Evidence FRE regarding expert testimony and includes a multi disciplinary look at the strengths and weaknesses in forensic science courtroom testimony The statutes and the effects of judicial uses or non use of the FRE Daubert Kumho and the 2009 NAS Report on Forensic Science are also included The presentation expands to study case law legal opinions and studies on the reliability and pitfalls of forensic expertise in the US court system This book is an essential reference for anyone preparing to give expert testimony of forensic evidence Honorable Mention in the 2015 PROSE Awards in Law Legal Studies from the Association of American Publishers A multi disciplinary forensic reference examining the strengths and weaknesses of forensic science in courtroom testimony Focuses on forensic testimony and judicial decisions in light of the Federal Rules of Evidence case interpretations and the NAS report findings Case studies some from the Innocence Project assist the reader in distinguishing good testimony from bad **Biometrics in a Data Driven World** Sinjini Mitra, Mikhail Gofman, 2016-12-01 Biometrics in a Data Driven World Trends Technologies and Challenges aims to inform readers about the modern applications of biometrics in the context of a data driven society to familiarize them with the rich history of biometrics and to provide them with a glimpse into the future of biometrics The first section of the book discusses the fundamentals of biometrics and provides an overview of common biometric modalities namely face fingerprints iris and voice It also discusses the history of the field and provides an overview of emerging trends and opportunities The second section of the book introduces readers to a wide range of biometric applications The next part

of the book is dedicated to the discussion of case studies of biometric modalities currently used on mobile applications. As smartphones and tablet computers are rapidly becoming the dominant consumer computer platforms, biometrics-based authentication is emerging as an integral part of protecting mobile devices against unauthorized access while enabling new and highly popular applications such as secure online payment authorization. The book concludes with a discussion of future trends and opportunities in the field of biometrics which will pave the way for advancing research in the area of biometrics and for the deployment of biometric technologies in real world applications. The book is designed for individuals interested in exploring the contemporary applications of biometrics from students to researchers and practitioners working in this field. Both undergraduate and graduate students enrolled in college level security courses will also find this book to be an especially useful companion.

Multimedia Security Technologies for Digital Rights Management Wenjun Zeng, Heather Yu, Ching-Yung Lin, 2011-07-28 Security is a major concern in an increasingly multimedia defined universe where the Internet serves as an indispensable resource for information and entertainment. Digital Rights Management (DRM) is the technology by which network systems protect and provide access to critical and time sensitive copyrighted material and/or personal information. This book equips savvy technology professionals and their aspiring collegiate protégés with the latest technologies, strategies and methodologies needed to successfully thwart off those who thrive on security holes and weaknesses. Filled with sample application scenarios and algorithms, this book provides an in-depth examination of present and future field technologies including encryption, authentication, copy control, tagging, tracing, conditional access and media identification. The authors present a diversified blend of theory and practice and focus on the constantly changing developments in multimedia applications, thus providing an admirably comprehensive book. Discusses state of the art multimedia authentication and fingerprinting techniques. Presents several practical methodologies from industry including broadcast encryption, digital media forensics and 3D mesh watermarking. Focuses on the need for security in multimedia applications found on computer networks, cell phones and emerging mobile computing devices.

Advanced Image Processing Techniques and Applications Kumar, N. Suresh, Sangaiah, Arun Kumar, Arun, M., Anand, S., 2017-02-10 Today the scope of image processing and recognition has broadened due to the gap in scientific visualization. Thus new imaging techniques have developed and it is imperative to study this progression for optimal utilization. *Advanced Image Processing Techniques and Applications* is an essential reference publication for the latest research on digital image processing advancements. Featuring expansive coverage on a broad range of topics and perspectives such as image and video steganography, pattern recognition and artificial vision, this publication is ideally designed for scientists, professionals, researchers and academicians seeking current research on solutions for new challenges in image processing.

Behavioral Biometrics for Human Identification: Intelligent Applications Wang, Liang, Geng, Xin, 2009-08-31 This edited book provides researchers and practitioners a comprehensive understanding of the state of the art of behavioral biometrics techniques, potential applications, successful

practice and available resources Provided by publisher **Biometrics** Francisco Liébana Cabanillas, Francisco Muñoz Leiva, Juan F. Prados Castillo, Elena Higuera-Castillo, 2025-07-25 The book provides a comprehensive overview of biometrics including its theoretical foundations and practical applications and offers valuable insights into its relevance and impact on various sectors of society It provides readers with a comprehensive view of how biometrics can shape future solutions that are secure user focused and technologically advanced The first part discusses the fundamentals and applications of biometric technology The second part discusses the challenges and future of biometric technologies Predicting Pregnancy Complications Through Artificial Intelligence and Machine Learning Satishkumar, D., Maniiarasan, P., 2023-09-25 Artificial intelligence models are being used to make labor and delivery safer for mothers and newborns Sensors are exploited to gauge health parameters and machine learning techniques are investigated to predict the health conditions of patients to assist medical practitioners This is a critical area of study as maternal and infant health are indispensable for a healthy society Predicting Pregnancy Complications Through Artificial Intelligence and Machine Learning considers the recent advances challenges and best practices of artificial intelligence and machine learning in relation to pregnancy complications Covering key topics such as pregnancy complications wearable sensors and healthcare technologies this premier reference source is ideal for nurses doctors computer scientists medical professionals industry professionals researchers academicians scholars instructors and students **Handbook of Research on Computational Forensics, Digital Crime, and Investigation: Methods and Solutions** Li, Chang-Tsun, 2009-11-30 This book provides a media for advancing research and the development of theory and practice of digital crime prevention and forensics embracing a broad range of digital crime and forensics disciplines Provided by publisher Handbook of Research on Securing Cloud-Based Databases with Biometric Applications Deka, Ganesh Chandra, 2014-10-31 Cloud technologies have revolutionized the way we store information and perform various computing tasks With the rise of this new technology the ability to secure information stored on the cloud becomes a concern The Handbook of Research on Securing Cloud Based Databases with Biometric Applications explores the latest innovations in promoting cloud security through human authentication techniques Exploring methods of access by identification including the analysis of facial features fingerprints DNA dental characteristics and voice patterns this publication is designed especially for IT professionals academicians and upper level students seeking current research surrounding cloud security **Statistical Machine Learning for Human Behaviour Analysis** Thomas Moeslund, Sergio Escalera, Gholamreza Anbarjafari, Kamal Nasrollahi, Jun Wan, 2020-06-17 This Special Issue focused on novel vision based approaches mainly related to computer vision and machine learning for the automatic analysis of human behaviour We solicited submissions on the following topics information theory based pattern classification biometric recognition multimodal human analysis low resolution human activity analysis face analysis abnormal behaviour analysis unsupervised human analysis scenarios 3D 4D human pose and shape estimation human analysis in virtual augmented reality

affective computing social signal processing personality computing activity recognition human tracking in the wild and application of information theoretic concepts for human behaviour analysis In the end 15 papers were accepted for this special issue These papers that are reviewed in this editorial analyse human behaviour from the aforementioned perspectives defining in most of the cases the state of the art in their corresponding field

International Conference on Multimodal Interfaces, 2003

Advancements in Computer Vision Applications in Intelligent Systems and Multimedia Technologies Sarfraz, Muhammad, 2020-05-29 Two significant areas of study that are continually impacting various dimensions in computer science are computer vision and imaging These technologies are rapidly enhancing how information and data is being exchanged and opening numerous avenues of advancement within areas such as multimedia and intelligent systems The high level of applicability in computer vision and image processing requires significant research on the specific utilizations of these technologies *Advancements in Computer Vision Applications in Intelligent Systems and Multimedia Technologies* is an essential reference source that discusses innovative developments in computational imaging for solving real life issues and problems and addresses their execution in various disciplines Featuring research on topics such as image modeling remote sensing and support vector machines this book is ideally designed for IT specialists scientists researchers engineers developers practitioners industry professionals academicians and students seeking coverage on the latest developments and innovations in computer vision applications within the realm of multimedia systems

Cyber Crime and Forensic Computing Gulshan Shrivastava, Deepak Gupta, Kavita Sharma, 2021-09-07 This book presents a comprehensive study of different tools and techniques available to perform network forensics Also various aspects of network forensics are reviewed as well as related technologies and their limitations This helps security practitioners and researchers in better understanding of the problem current solution space and future research scope to detect and investigate various network intrusions against such attacks efficiently Forensic computing is rapidly gaining importance since the amount of crime involving digital systems is steadily increasing Furthermore the area is still underdeveloped and poses many technical and legal challenges The rapid development of the Internet over the past decade appeared to have facilitated an increase in the incidents of online attacks There are many reasons which are motivating the attackers to be fearless in carrying out the attacks For example the speed with which an attack can be carried out the anonymity provided by the medium nature of medium where digital information is stolen without actually removing it increased availability of potential victims and the global impact of the attacks are some of the aspects Forensic analysis is performed at two different levels Computer Forensics and Network Forensics Computer forensics deals with the collection and analysis of data from computer systems networks communication streams and storage media in a manner admissible in a court of law Network forensics deals with the capture recording or analysis of network events in order to discover evidential information about the source of security attacks in a court of law Network forensics is not another term for network security It is an extended phase of network

security as the data for forensic analysis are collected from security products like firewalls and intrusion detection systems. The results of this data analysis are utilized for investigating the attacks. Network forensics generally refers to the collection and analysis of network data such as network traffic, firewall logs, IDS logs, etc. Technically, it is a member of the already existing and expanding field of digital forensics. Analogously, network forensics is defined as the use of scientifically proved techniques to collect, identify, examine, correlate, analyze, and document digital evidence from multiple active processing and transmitting digital sources for the purpose of uncovering facts related to the planned intent or measured success of unauthorized activities meant to disrupt, corrupt, and/or compromise system components as well as providing information to assist in response to or recovery from these activities. Network forensics plays a significant role in the security of today's organizations. On the one hand, it helps to learn the details of external attacks, ensuring similar future attacks are thwarted. Additionally, network forensics is essential for investigating insiders' abuses that constitute the second costliest type of attack within organizations. Finally, law enforcement requires network forensics for crimes in which a computer or digital system is either being the target of a crime or being used as a tool in carrying a crime. Network security protects the system against attack, while network forensics focuses on recording evidence of the attack. Network security products are generalized and look for possible harmful behaviors. This monitoring is a continuous process and is performed all through the day. However, network forensics involves post-mortem investigation of the attack and is initiated after crime notification. There are many tools which assist in capturing data transferred over the networks so that an attack or the malicious intent of the intrusions may be investigated. Similarly, various network forensic frameworks are proposed in the literature.

Emerging Technologies in Intelligent Applications for Image and Video Processing Santhi, V., Acharjya, D. P., Ezhilarasan, M., 2016-01-07

Image and Video Processing is an active area of research due to its potential applications for solving real-world problems. Integrating computational intelligence to analyze and interpret information from image and video technologies is an essential step to processing and applying multimedia data. *Emerging Technologies in Intelligent Applications for Image and Video Processing* presents the most current research relating to multimedia technologies including video and image restoration and enhancement as well as algorithms used for image and video compression, indexing, and retrieval processes and security concerns. Featuring insight from researchers from around the world, this publication is designed for use by engineers, IT specialists, researchers, and graduate-level students.

Unification of Evidence Theoretic Fusion Algorithms: A Case Study in Level-2 and Level-3 Fingerprint Features Mayank Vatsa, Richa Singh, Afzel Noore, This paper formulates an evidence theoretic multimodal unification approach using belief functions that takes into account the variability in biometric image characteristics. While processing non-ideal images, the variation in the quality of features at different levels of abstraction may cause individual classifiers to generate conflicting genuine/impostor decisions. Existing fusion approaches are non-adaptive and do not always guarantee optimum performance improvements.

Design and Implementation of

Healthcare Biometric Systems Kisku, Dakshina Ranjan,Gupta, Phalguni,Sing, Jamuna Kanta,2019-01-11 Healthcare sectors often deal with a large amount of data related to patients care and hospital workforce management Mistakes occur and the impending results are disastrous for individuals personal identity information However an innovative and reliable way to safeguard the identity of individuals and provide protection of medical records from criminals is already in effect Design and Implementation of Healthcare Biometric Systems provides innovative insights into medical identity theft and the benefits behind biometrics technologies that could be offered to protect medical records from hackers and malicious users The content within this publication represents the work of ASD screening systems healthcare management and patient rehabilitation It is designed for educators researchers faculty members industry practitioners graduate students and professionals working with healthcare services and covers topics centered on understanding the practical essence of next generation healthcare biometrics systems and future research directions

Biometric Systems ,2021-02-10 Biometrics are used widely in various real life applications today There are a number of potential biometric applications that include different areas such as personal recognition identification verification and others It may be needed for safety security permission banking crime prevention forensics medical applications communication face finding and others This book is specifically dedicated to biometric research applications techniques tools and algorithms that originate from different fields such as image processing computer vision pattern recognition signal processing artificial intelligence intelligent systems and soft computing The main objective of this book is to provide the international community with an effective platform in the area of people identity verification and authentication from physiological and behavioral aspects This publication provides an effective platform for helping and guiding readers professionals researchers academicians engineers scientists and policy makers involved in the area of biometrics

Violent Extremism: Breakthroughs in Research and Practice Management Association, Information Resources,2018-10-05 Advances in digital and other technologies have provided ample positive impacts to modern society however in addition to such benefits these innovations have inadvertently created a new venue for terrorist activities Examining violent extremism through a critical and academic perspective can lead to a better understanding of its foundations and implications Violent Extremism Breakthroughs in Research and Practice is a critical source of academic knowledge on the social psychological and political aspects of radicalization and terrorist recruitment Highlighting a range of pertinent topics such as counterterrorism propaganda and online activism this publication is an ideal reference source for researchers analysts intelligence officers policymakers academicians and graduate level students interested in current research on violent extremism

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