

# 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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**Oscar Reinoso, Luis Payá**



## **Fingerprint Recognition Springer Research Papers 22:**

**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     *Digital Image Security* Amit Kumar Singh,Stefano Berretti,Ashima Anand,Amrit Kumar Agrawal,2024-05-14 This book will highlight cutting edge research with a particular emphasis on interdisciplinary approaches novel techniques and solutions to provide digital image security for applications in diverse areas It further discusses important topics such as biometric imaging big data security and privacy in healthcare security and privacy in the internet of things and security in cloud based image processing This book Presents new ideas approaches theories and practices with a focus on digital image security and privacy solutions for real world applications Discusses security in cloud based image processing for smart city applications Provides an overview of innovative security techniques that are being developed to ensure the guaranteed authenticity of transmitted shared or stored digital images Highlights approaches such as watermarking blockchain and hashing to secure digital images in artificial intelligence machine learning cloud computing and temper detection environments Explains important topics such as biometric imaging blockchain for digital data security and protection systems against personal identity theft It will serve as an ideal reference text for senior undergraduate graduate students academic researchers and professionals in the fields including electrical engineering electronics communications engineering and computer engineering     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

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

The Promise of New Technologies in an Age of New Health Challenges A.J. Maeder, K. Ho, A. Marcelo, 2016-11-24 There is a changed emphasis in many health services with conventional pressures such as budget and workforce constraints combined with the indirect forces of social change and strategic direction bringing about the need for more flexible approaches for the longer term By enabling different care models and delivery channels telehealth offers demonstrably effective and sustainable solutions for issues such as access to and quality of care This book presents 18 papers delivered at the 5th Global Telehealth Conference held in Auckland New Zealand in November 2016 The theme chosen for Global Telehealth 2016 is The Promise of New Technologies in an Age of New Health Challenges and the papers included here cover a wide variety of topics from theoretical and abstract contributions through to discussions of practical projects and highly specific applied contributions The book also includes two invited papers which detail recent contributions to two global issues in which telehealth plays a major role universal health coverage and personal health monitoring With papers ranging in scope from computer assisted screening technology for diabetic retinopathy to behavior change through computer games this book will be of interest to all those involved in the design and provision of healthcare services

**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

*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 the field of digital forensics Analogously network forensics is defined as The use of scientifically proved techniques to collect fuses identifies examine correlate analyze and document digital evidence from multiple actively 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

**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      *Applied Artificial Intelligence* Swati V. Shinde,Varsha Bendre,D. Jude Hemanth,M.A. Balafar,2023-09-29 This book explores the advancements and future challenges in biomedical application developments using breakthrough technologies like Artificial Intelligence AI Internet of Things IoT and Signal Processing It will also contribute to biosensors and secure systems and related research *Applied Artificial Intelligence A Biomedical Perspective* begins by detailing recent trends and challenges of applied artificial intelligence in biomedical systems Part I of the book presents the technological background of the book in terms of applied artificial intelligence in the biomedical domain Part II demonstrates the recent advancements in automated medical image analysis that have opened ample research opportunities in the applications of deep learning to different diseases Part III focuses on the use of cyberphysical systems that facilitates computing anywhere by using medical IoT and biosensors and the numerous applications of this technology in the healthcare domain Part IV describes the different signal processing applications in the healthcare domain It also includes the prediction of some human diseases based on the inputs in signal format Part V highlights the scope and applications of biosensors and security aspects of biomedical images The book will be beneficial to the researchers industry persons faculty and students working in biomedical applications of computer science and electronics engineering It will also be a useful resource for teaching courses like AI ML medical IoT signal processing biomedical engineering and medical image analysis

**Practical Biometrics** Julian Ashbourn,2004 Biometrics or the practice of using body markers such as fingerprinting to identify users is becoming increasingly relevant in the current global climate This book examines the practical implications for implementing biometric solutions in business and suggests ideas for managing the issues raised      *Handbook of Research on Intelligent Data Processing and Information Security Systems* Bilan, Stepan Mykolayovych,Al-Zoubi, Saleem Issa,2019-11-29 Intelligent technologies have emerged as imperative tools in computer science and information security However advanced computing practices have preceded new methods of attacks on the storage and transmission of data Developing approaches such as image processing and pattern recognition are susceptible to breaches in security Modern protection methods for these innovative techniques require additional research The Handbook of Research on Intelligent Data Processing and Information Security Systems provides emerging research exploring the theoretical and practical aspects of cyber protection and applications within computer science and telecommunications Special attention is paid to data encryption steganography image processing and recognition and it targets professionals who want to improve their knowledge in order to increase strategic capabilities and organizational effectiveness As such this book is ideal for analysts programmers computer engineers software engineers mathematicians data scientists developers IT specialists academicians researchers and students within fields of information technology information security robotics artificial intelligence image processing computer science and telecommunications      **Leveraging Computer Vision to Biometric Applications** Arvind Selwal,Deepika Sharma,Mukesh Mann,Sudeshna Chakraborty,Valentina E. Balas,Ouh Eng Lieh,2024-10-07 Computer

vision is an effective solution in a diverse range of real life applications With the advent of the machine and deep learning paradigms this book adopts machine and deep learning algorithms to leverage digital image processing for designing accurate biometrical applications In this aspect it presents the advancements made in computer vision to biometric applications design approach using emerging technologies It discusses the challenges of designing efficient and accurate biometric based systems which is a key issue that can be tackled via computer vision based techniques

**Key Features**

- Discusses real life applications of emerging techniques in computer vision systems
- Offers solutions on real time computer vision and biometrics applications to cater to the needs of current industry
- Presents case studies to offer ideas for developing new biometrics based products
- Offers problem based solutions in the field computer vision and real time biometric applications for secured human authentication
- Works as a ready resource for professionals and scholars working on emerging topics of computer vision for biometrics

The book is for academic researchers scholars and students in Computer Science Information Technology Electronics and Electrical Engineering Mechanical Engineering management academicians researchers scientists and industry people working on computer vision and biometrics applications

Big data analytics for smart healthcare applications Celestine Iwendu, Thippa Reddy Gadekallu, Ali Kashif Bashir, 2023-04-17

Integrating a Usable Security Protocol into User Authentication Services Design Process Christina Braz, Ahmed Seffah, Bilal Naqvi, 2018-11-08

There is an intrinsic conflict between creating secure systems and usable systems But usability and security can be made synergistic by providing requirements and design tools with specific usable security principles earlier in the requirements and design phase In certain situations it is possible to increase usability and security by revisiting design decisions made in the past in others to align security and usability by changing the regulatory environment in which the computers operate This book addresses creation of a usable security protocol for user authentication as a natural outcome of the requirements and design phase of the authentication method development life cycle

*Autonomy of Migration?* Stephan Scheel, 2019-03-20

Examining how migrants appropriate mobility in the context of biometric border controls this volume mobilises new analytics and empirics in the debates about the politics of migration and provides an analytically effective and politically significant tool for the study of contemporary migration Drawing from the tension between the EU's attempt to achieve watertight border controls by means of biometric technologies and migrants persistence to move to and live in the EU the volume pursues two interrelated objectives first it studies the encounters between migrants and the Visa Information System VIS one of the largest biometric databases in the world from the perspective of mobility in order to investigate how migrants appropriate mobility via Schengen visa within and against this biometric border regime Second it addresses criticisms of autonomy of migration in order to develop it as a viable approach for border migration and critical security studies Hence the book is driven by two interrelated research questions what does the assertion of moments of autonomy of migration refer to in the context of border regimes that use biometrics to turn migrants bodies into a means of mobility

control And how do migrants appropriate mobility via Schengen visa within and against biometric border regimes This book will be of great interest to scholars in border migration and critical security studies as well as researchers engaged in citizenship studies surveillance studies political theory critical IR theory and international political sociology Security of Internet of Things Nodes Chinmay Chakraborty,Sree Ranjani Rajendran,Muhammad Habibur Rehman,2021-08-30 The book Security of Internet of Things Nodes Challenges Attacks and Countermeasures covers a wide range of research topics on the security of the Internet of Things nodes along with the latest research development in the domain of Internet of Things It also covers various algorithms techniques and schemes in the field of computer science with state of the art tools and technologies This book mainly focuses on the security challenges of the Internet of Things devices and the countermeasures to overcome security vulnerabilities Also it highlights trust management issues on the Internet of Things nodes to build secured Internet of Things systems The book also covers the necessity of a system model for the Internet of Things devices to ensure security at the hardware level **The Art of Identification** Rex Ferguson,Melissa M. Littlefield,James Purdon,2021-08-13 Since the mid nineteenth century there has been a notable acceleration in the development of the techniques used to confirm identity From fingerprints to photographs to DNA we have been rapidly amassing novel means of identification even as personal individual identity remains a complex chimera The Art of Identification examines how such processes are entangled within a wider sphere of cultural identity formation Against the backdrop of an unstable modernity and the rapid rise and expansion of identificatory techniques this volume makes the case that identity and identification are mutually imbricated and that our best understanding of both concepts and technologies comes through the interdisciplinary analysis of science bureaucratic infrastructures and cultural artifacts With contributions from literary critics cultural historians scholars of film and new media a forensic anthropologist and a human bioarcheologist this book reflects upon the relationship between the bureaucratic scientific and technologically determined techniques of identification and the cultural contexts of art literature and screen media In doing so it opens the interpretive possibilities surrounding identification and pushes us to think about it as existing within a range of cultural influences that complicate the precise formulation meaning and reception of the concept In addition to the editors the contributors to this volume include Dorothy Butchard Patricia E Chu Jonathan Finn Rebecca Gowland Liv Hausken Matt Houlbrook Rob Lederer Andrew Mangham Victoria Stewart and Tim Thompson *Machine Learning and Biometrics* Jucheng Yang,Dong Sun Park,Sook Yoon,Yarui Chen,Chuanlei Zhang,2018-08-29 We are entering the era of big data and machine learning can be used to analyze this deluge of data automatically Machine learning has been used to solve many interesting and often difficult real world problems and the biometrics is one of the leading applications of machine learning This book introduces some new techniques on biometrics and machine learning and new proposals of using machine learning techniques for biometrics as well This book consists of two parts Biometrics and Machine Learning for Biometrics Parts I and II contain four and three chapters respectively The



book is reviewed by editors Prof Jucheng Yang Prof Dong Sun Park Prof Sook Yoon Dr Yarui Chen and Dr Chuanlei Zhang

**Visual Sensors** Oscar Reinoso, Luis Payá, 2020-03-27 Visual sensors are able to capture a large quantity of information from the environment around them A wide variety of visual systems can be found from the classical monocular systems to omnidirectional RGB D and more sophisticated 3D systems Every configuration presents some specific characteristics that make them useful for solving different problems Their range of applications is wide and varied including robotics industry agriculture quality control visual inspection surveillance autonomous driving and navigation aid systems In this book several problems that employ visual sensors are presented Among them we highlight visual SLAM image retrieval manipulation calibration object recognition navigation etc *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

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