

Automatic Fingerprint Recognition Systems

David D. Zhang

Automatic Fingerprint Recognition Systems:

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foreground boundary contour is located by a convex hull of the remaining Harris points and spurious boundary minutiae are discarded Thinning based minutiae detection algorithms are computationally intensive and have the problem of minutiae shifting by the ridge width Irregularities and aberrations in the ridge flow also tend to cause spurious minutiae We have developed two thinning free minutiae extraction methods based on chain code contour tracing and run length scanning Our image processing framework has been tested on the FVC2002 DB1 and DB4 datasets each containing 800 fingerprints and compared with benchmark software developed by the National Institute of Standards and Technology NIST We have achieved an equal error rate EER improvement of 15% on the DB1 set and 37% on the DB4 set in the comparative tests

Handbook of Fingerprint Recognition Davide Maltoni, Dario Maio, Anil K. Jain, Jianjiang Feng, 2022-07-04 A major new professional reference work on fingerprint security systems and technology from leading international researchers in the field Handbook provides authoritative and comprehensive coverage of all major topics concepts and methods for fingerprint security systems This unique reference work is an absolutely essential resource for all biometric security professionals researchers and systems administrators Reliable Fingerprint Recognition Li Wang, 2014 Fingerprints have been used for personal identification for centuries because of their uniqueness and consistency over time Fingerprint recognition is one of the most popular methods for personal identification due to its high accuracy cost efficiency and ease of acquisition Automated fingerprint recognition has the advantages of fast processing and high accuracy but its performance deeply depends on the quality of the collected fingerprint images The matching accuracy of current automatic fingerprint recognition systems decreases dramatically when the quality of fingerprint images is poor For example a fingerprint image may contain massive noise cleaves or inks In these cases manual fingerprint recognition achieves better matching results than automatic systems. One of the major challenges in fingerprint recognition is how to improve the performance of an automatic fingerprint recognition system in terms of reliability and accuracy especially for low quality images The motivation of this research is derived from the raised need for fingerprint recognition techniques with better matching accuracy and reliability How to improve the accuracy and reliability of an automatic fingerprint recognition system when processing low quality fingerprint images is the major objective of this research work Because feature extraction and feature matching are two main components in a fingerprint recognition system the above objective could be restated as i to design reliable and accurate feature extraction techniques suitable for low quality images and ii appropriate matching methods or matching metric with high tolerance for image noise and feature extraction errors In order to achieve the above objectives effort has been made to improve the matching accuracy of an automatic fingerprint recognition system by introducing the following methods i a fingerprint image pre processing method in the spatial domain ii two different singular point detection approaches and iii a new matching metric named binarized minutiae block for fingerprint matching Firstly we have investigated current fingerprint enhancement techniques A typical fingerprint enhancement module is composed of an image pre processing stage and a contextual filtering stage Traditionally image pre processing or called pixel wise enhancement techniques are used to improve the contrast of an image rather than removing noise In this study we found that removing noise and improving the image quality in this stage enables the subsequent contextual filtering stage to obtain a better clarity of ridge and valley structure especially for poor quality fingerprint images particularly suitable for wet and smudged fingerprint images based on experimental observation Therefore we proposed an image pre processing approach using contrast stretching and power law transformation techniques to improve the quality of fingerprint images The metric goodness index which is used to evaluate the image quality is used to evaluate this method. The experimental results show that this approach is able to improve the clarity of ridge and valley structures especially for wet and smudged fingerprints The average goodness index value obtained from the experiment is improved by 14% compared to other reported methods In addition it enables the subsequent contextual filtering e g Gabor filtering stage for better image enhancement results and ultimately improve the reliability of feature extraction e q minutiae extraction Secondly we have investigated feature extraction techniques especially singular point detection which is a global feature in a fingerprint The performance of current singular point detection techniques is relatively low for poor quality images mostly around 90% of correct detection rate and much lower for Poincar Index based approaches As a consequence it becomes the major bottle neck for fingerprint recognition techniques which rely on singular points such as reference point based fingerprint global pre alignment and fingerprint classification In order to address this issue we first investigated the popular Poincar Index based approaches The Poincar Index technique highly depends on image quality and suffers from the problem of a large number of spurious singular points especially for low quality images As a consequence we designed a rule based post proccessing technique to validate and remove spurious singular points The experimental results show that the correct detection rate on average is 89 48% on DB1a and DB2a of Fingerprint Verification Competition FVC 2002 datasets These datasets contain fingerprint images with various quality levels and are especially suitable for evaluation of fingerprint recognition algorithms It is around 3% improvement over other reported Poincar Index based approaches in terms of overall correct detection rate However one limitation of the Poincar Index technique is that it processes data locally while singular points are global features which are easily influenced by local noise and may cause a number of spurious singular points especially for low quality images Therefore we have proposed a new singular point detection method globally over the whole image based on the analysis of local ridge orientation maps In addition this method is also able to locate a reference point for arch type fingerprints which is useful for fingerprint pre alignment as a reference point as well as for fingerprint classification The experimental results show that the correct detection rate on average is 94 05% on the datasets of FVC 2002 DB1a and DB2a This experimental result is superior to any other reported methods in terms of correct detection rate of singular points Finally we have investigated the current fingerprint matching methods and proposed a new matching metric named binarized minutiae block

for fingerprint matching Current matching methods could be classified as minutiae based correlation based and other non minutiae based methods Among these methods correlation and other non minutiae based methods have better tolerance to image noise and feature extraction errors than minutiae based methods However minutiae based methods have better tolerance to non linear distortion and obtain better matching results on medium or high quality images This new metric utilizes the minutiae and its surrounding texture information Thus it has high tolerance to image noise and feature extraction errors as well as non linear distortion These binarized minutiae blocks are normalized to the same minutiae direction for easy comparison Then the local similarities are calculated by the dissimilarities between each pair of binarized minutiae blocks In addition four global similarity calculation methods are designed and implemented using this matching metric The experimental results show that this method achieves overall matching accuracy of 98 24% 97 87% and 98 19% on the datasets FVC2002 DB1a DB2a and FVC2006 DB2a As a consequence the results suggest that using binarized minutiae blocks is an alternative way to obtain accurate and reliable matching results other than correlation based grey scale texture information minutiae based and other non minutiae based methods Compared to other state of the art matching methods this metric achieves better experimental results in terms of matching accuracy than most reported matching methods on the same testing databases In conclusion this thesis focuses on the research of how to improve the overall matching accuracy of a fingerprint recognition system even for low quality images Several methods have been developed to achieve this research objective The experimental results show that these proposed fingerprint recognition techniques are able to improve the Alternative Matching Schemes for Automatic Fingerprint Identification Systems recognition accuracy significantly Michael Jason Futer, 2010 Biometrics is a recognition technology that uses the unique behavioral and physiological traits of the human body as identifiers The fingerprint is one of the oldest and most widely used forms of biometric identifiers In this thesis an automatic fingerprint identification system designed by a previous Electrical Engineering graduate student at The University of Texas at Arlington is upgraded with the purpose of improving matching accuracy A review of the baseline automatic fingerprint identification system is provided as a reference point for improvements in the system Then improvements to the image enhancement stage of the baseline system are discussed They include replacing the simple transformation contrast stretching algorithm with the contract and stretch algorithm and upgrading the threshold variance in image segmentation to a threshold variance to mean ratio Next improvements to the feature extraction and fusion stage of the baseline system are covered A new method for quantizing ridge direction estimates in the direction image is included in this section Finally alternative matching schemes are implemented in the correlation based matching stage of the baseline system The new matching schemes include direction only feature density only feature two channels with addition type fusion two channels with multiplication type fusion and two templates per class At the end simulations are performed in order to test the performance of the improvements implemented in the automatic fingerprint identification system **Automated**

Fingerprint Identification Systems (AFIS) Peter Komarinski,2005-01-20 An easy to understand synopsis of identification systems presenting in simple language the process of fingerprint identification from the initial capture of a set of finger images to the production of a Rapsheet No other single work exists which reviews this important identification process from beginning to end We examine the identification process for latent crime scene prints and how they are identified with these systems While the primary focus is automated fingerprint identifications the book also touches on the emergence and use of fingerprints in other biometric systems Criminal justice administrators policy makers and students of forensic science and criminal justice will find a reference to the known limitations and advantages of these systems This book provides information as to the critical and continual need for properly trained individuals as well as an understanding of the direct and indirect costs associated with maintaining these systems An understanding of the entire system and what it means will prove invaluable Why are there missed identifications Why are identifications made on one database that are not made on another database Key terms and issues are included and well as suggestions for improving the overall number of identifications The book will go beyond process and also discuss issues such as interoperability management strategies for large databases contract development lights out verification and several other issues which impact automated identifications The first comprehensive title on this subject area Outlines in detail the entire process of fingerprint gathering and identity verification The future of AFIS will is discussed including national standards in developing multi agency cooperation interoperability U S in addition to the use of AFIS identification world wide An Analysis of Automatic Fingerprint Identification Systems **Biometric Technology for Human Identification**, 2007 Elizabeth Berdeski-Johnson, 2008 **Fingerprint Identification** Robert D. Foote, 1974 A survey of present technology automated applications and potential for future Advances in Biometrics N. K. Ratha, Venu Govindaraju, 2007-10-06 Biometrics technology continues to development stride forward with its wider acceptance and its perceived need in various new security facets of modern society Biometrics is being required to meet the growing challenges of identity management While biometrics finds use in all diverse applications the research challenges continue to grow as the user community expects a fully automatic system to cover the whole universal population with almost no errors Recent advances in biometrics include new developments in sensors modalities and algorithms As new sensors are designed newer challenges emerge in the algorithms for accurate recognition New modalities have been discovered in addition to the fusion of existing modalities to improve accuracy and wider coverage Written for researchers advanced students and practitioners to use as a handbook this volume captures the very latest state of the art research contributions from leading international researchers in the field Advances in Mechatronics, Robotics and Automation II Prasad Yarlagadda, 2014-04-04 Selected peer reviewed papers from the 2014 2nd International Conference on Mechatronics Robotics and Automation ICMRA 2014 March 8 9 2014 Zhuhai China Automated Fingerprint Identification Edward P. Jackson, 2015 From its inception more than 100 years ago fingerprint

technology has come a long way This book provides background on and traces the recent history of automated fingerprint identification systems Included in the book is a brief examination of standards and the role of algorithms In its history fingerprints have been used to identify criminal and terrorist suspects perform background checks and monitor immigration status among other applications Prints found at the scene of a crime referred to as latent prints are compared with fingerprint records of known individuals who have been convicted of or arrested for a crime Law enforcement agencies have been working to automate this comparison process This book also provides the current landscape of latent Automated Fingerprint Identification System AFIS interoperability meaning the ability to share information between networks systems components etc The book addresses essential elements of interoperability outlines recent advances in the field and provides a high level strategic plan for Federal agencies to implement the necessary requirements for interoperability to enhance Automated Biometrics David D. Zhang, 2013-11-11 Biometrics based authentication and identification are emerging as the most reliable method to authenticate and identify individuals Biometrics requires that the person to be identified be physically present at the point of identification and relies on something which you are or you do to provide better security increased efficiency and improved accuracy Automated biometrics deals with physiological or behavioral characteristics such as fingerprints signature palmprint iris hand voice and face that can be used to authenticate a person s identity or establish an identity from a database With rapid progress in electronic and Internet commerce there is also a growing need to authenticate the identity of a person for secure transaction processing Designing an automated biometrics system to handle large population identification accuracy and reliability of authentication are challenging tasks Currently there are over ten different biometrics systems that are either widely used or under development Some automated biometrics such as fingerprint identification and speaker verification have received considerable attention over the past 25 years and some issues like face recognition and iris based authentication have been studied extensively resulting in successful development of biometrics systems in commercial applications However very few books are exclusively devoted to such issues of automated biometrics Automated Biometrics Technologies and Systems systematically introduces the technologies and systems and explores how to design the corresponding systems with in depth discussion The issues addressed in this book are highly relevant to many fundamental concerns of both researchers and practitioners of automated biometrics in computer and system security The Impact of National Goals on Basic Research Sino-German Centre for Science, 2000-06-29 This volume contains a collection of the contributions to the German Chinese conference Impact of National Goals on Basic Research which took place at Berlin in March 1999 Referees from both countries report about the importance of basic research especially in the context of national goals. The articles cover a broad range of various aspects regarding these topics like the role of universities in basic research social acceptance of scientific progress and interdisciplinary research Optical Engineering, 1995 Publishes papers reporting on research and development in optical

science and engineering and the practical applications of known optical science engineering and technology **Parliamentary Debates (Hansard).** Great Britain. Parliament. House of Commons,1989

Fingerprint Classification

and Matching Using a Filterbank Salil Prabhakar,2001

Unveiling the Magic of Words: A Overview of "Automatic Fingerprint Recognition Systems"

In a world defined by information and interconnectivity, the enchanting power of words has acquired unparalleled significance. Their capability to kindle emotions, provoke contemplation, and ignite transformative change is actually awe-inspiring. Enter the realm of "**Automatic Fingerprint Recognition Systems**," a mesmerizing literary masterpiece penned with a distinguished author, guiding readers on a profound journey to unravel the secrets and potential hidden within every word. In this critique, we shall delve into the book is central themes, examine its distinctive writing style, and assess its profound effect on the souls of its readers.

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