



UNIVERSITY OF M'SILA
FACULTY OF MATHEMATICS AND COMPUTER SCIENCE
Computer Science Department

**Dissertation submitted in partial fulfilment of the requirements for
the Degree of MASTER**

Domain : Mathematics and Computer Science

Branch : Computer Science

Specialty : Network

By: ZEMOURI Khadidja

TOPIC

**Identifying Individuals using Robust Iris Recognition
Techniques**

Publicly defended: / /2015 before a Jury composed of:

Last and first Name of teachers

Dr. ASSAS Ouarda

University of M'sila

Supervisor

Mr. BENOUIS Mohamed

University of M'sila

Supervisor

.....

University of M'sila

Chair

.....

University of M'sila

Examiner

.....

University of M'sila

Examiner

Academic Year : 2014 /2015

Table of Contents

Lists of figure	IV
Lists of Tables.....	VI
General Introduction.....	1
<i>Chapter 1:Introduction to biometrics</i>	
1 Introduction.....	3
2 Biometrics definition	3
3 Biometric Characteristics:	3
4 Biometric System:.....	4
5 Biometric Functionalities.....	5
6 Biometrics technologies	6
6.1 Fingerprint recognition	7
6.2 Hand geometry recognition.....	7
6.3 Facial recognition	8
6.4 Iris.....	8
6.5 Voice recognition.....	8
6.6 Keystroke recognition.....	8
6.7 Signature recognition	8
6.8 Gait recognition.....	9
6.9 DNA	9
6.10 Odor.....	9
7 Applications of Biometric Systems	10
8 The human iris.....	10
9 the reason of choice of the human iris	11
10 Conclusion	11
<i>chapter 2:Iris recognition system</i>	
1 Introduction.....	12
2 History.....	12
3 Iris Recognition System.....	12
4 Image Acquisition.....	13
5 Preprocessing.....	14
5.1 Binarization.....	14

5.2	Localization.....	14
5.2.1	Integro-differential operator.....	14
5.2.2	Hough Transform.....	15
5.2.3	Discrete Circular Active Contours.....	15
5.3	Normalisation.....	16
6	Feature Extraction.....	17
6.1	Local Binary Pattern.....	17
6.2	Wavelet Encoding.....	19
6.3	Principal Component Analysis (PCA).....	19
6.4	LDA - Linear Discriminant Analysis.....	20
7	Feature Matching (comparison).....	20
7.1	Distance Measures:.....	21
8	Conclusion.....	22

Chapter 3 :Intoduction to multibiometrics

1	Introduction.....	23
2	Fusion in biometrics.....	23
3	Taxonomy of multibiometric systems.....	24
4	Levels of fusion.....	26
4.1	Fusion prior to matching.....	26
4.2	Fusion after matching.....	26
5	Fusion rules.....	27
6	Iris recognition using fusion.....	28
6.1	Multi-algorithm systems.....	28
6.2	Fusion of Face and Iris Biometrics.....	29
6.2.1	Sensor Level Fusion:.....	30
6.2.2	Score level fusion.....	31
7	Conclusion.....	32

Chapter 4:Exprimental results and discusion

1	Introduction.....	33
2	development environment:.....	33
3	Structure of the implemented system:.....	34
3.1	Acquisition.....	35

3.2 Feature Extraction	35
3.2.1 Preprocessing.....	36
3.3 Recognition.....	43
4 Performance measure of the biometrics system.....	43
5 Experiments results and discussion	43
5.1 Iris recognition without fusion.....	43
5.2 Iris recognition with fusion.....	44
5.2.1 Multimodal (fusion of Face and Iris Biometrics).....	44
6 Application.....	47
7 Conclusion.....	50
General Conclusion.....	51
Bibliographies.....	53
system, through the "Daugman rubber-sheet" model.....	17
Figure 2. 4: Example of computing LBP _{8,1} : a pixel neighbourhood (left), its thresholded version (middle), and the corresponding binary LBP pattern with the computed LBP code (right).....	18
Figure 2. 5: The rectangular neighbourhoods of LBP used. Grey-shaded rectangles refer to the pixels belonging to the corresponding neighborhood.....	18
Figure 2. 6: Conceptual depiction of PCA classification versus LDA. DP_{CA} and DL_{DA} represent decision thresholds.....	20
Figure 3. 1: various sources of information in a multibiometric system.....	23
Figure 3. 2: Fusion can be accomplished at various levels in a biometric system.....	27
Figure 3. 3: of fusion using two types and three types of feature vectors.....	28
Figure 3. 4: A diagram of multi-biometric system.....	31
Figure 3. 5: Algorithm structure for fusing face + Iris biometrics.....	32
Figure 4. 1: Structure of the implemented system.....	34
Figure 4. 2 : Examples of Iris images from the CASIA Database.....	35
Figure 4. 3: the binary iris image.....	37
Figure 4. 4 : Example of obtained results for the localization of pupil and iris.....	38
Figure 4. 5: Applying IDO on some samples of the CASIA IrisV1 database.....	39
Figure 4. 6: the normalize iris image.....	39
Figure 4. 7 : Iris normalization.....	41

General Introduction

Security and the authentication of individuals is necessary for many different areas of our lives, with most people having to authenticate their identity on a daily basis; examples include ATMs, secure access to buildings, and international travel. Biometric identification provides a valid alternative to traditional authentication mechanisms such as ID cards and passwords, whilst overcoming many of the shortfalls of these methods; it is possible to identify an individual based on "who they are" rather than "what they possess" or "what they remember".

Biometrics is to identify a person from physical or behavioral characteristics such as iris, signature, fingerprint, voice, face, gait, and hand gesture. These features, as they are innate or acquired iris such as signature, are attached to each individual and therefore do not suffer from weaknesses methods based on knowledge or possession. Indeed, a physical or behavioral attribute can not be forgotten or lost. In general, they are very difficult to guess or steal and to duplicate.

Iris recognition is a particular type of biometric system that can be used to reliably identify a person by analyzing the patterns found in the iris. The iris is so reliable as a form of identification because of the uniqueness of its pattern. Although there is a genetic influence, particularly on the iris color, the iris develops through folding of the tissue membrane and then degeneration (to create the pupil opening) which results in a random and unique iris, also it's protected from the external environment, yet it is easily visible from within one meter of distance makes it a perfect biometric for an identification system with the ease of speed, reliability and automation.

Information fusion refers to the reconciliation of evidence presented by multiple sources of information in order to generate a decision. In the context of biometrics, evidence reconciliation plays a pivotal role in enhancing the recognition accuracy of human authentication systems and is referred to as multibiometric. Multibiometric systems combine the information presented by multiple biometric sensors, algorithms, samples, units, or traits. Besides enhancing matching performance, these systems are expected to improve population coverage, deter spoofing and impart fault tolerance to biometric applications.

Based on the nature of these sources, a multi biometric system can be classified into one of the following six categories: multi-sensor, multi-algorithm, multi instance, multi-sample, multimodal and hybrid. And based on the type of information available in a certain module, different levels of fusion may be defined. The various levels of fusion are categorized into two broad categories: fusion before matching and fusion after matching. before matching schemes

include fusion at the sensor and the feature levels while after matching schemes include fusion at the match score, rank and decision levels. The objective of this work is to developing and implementing a power person recognition system using his two modalities Face and Iris (multimodal system), with the goal of improving recognition.

This work include four chapter, which allow us to present the various aspects of our work.

- In the chapter one, we will discuss about the biometric system, its characteristics, different technologies and the biometric based on iris specially.
- In the chapter two, the Iris recognition system is described with its different phases.
- In the chapter three, we will discuss about the multibiometrics based a multimodal.
- In the chapter four, we present the experimental results obtained for each stage of the system made and the different discussions about these results.

A general conclusion will take stock of our work and we will unveil our outlook.

General Conclusion

A biometric system provides automatic recognition of an individual based on some unique feature or characteristic possessed by the individual. Biometric systems have been developed based on fingerprints, facial features, voice, hand geometry, handwriting, the retina and the one presented in this work, the iris.

Human identification via multibiometrics is a very promising approach to improve the overall system's accuracy and recognition performance. In recent years, several approaches toward studying the fusion strategies of different biometric evidence have been proposed.

In this work, we have implemented some of Iris recognition methods, which are PCA and LBP. Three measures of distance (L1, L2 and COS) are used for evaluating the similarity between two iris images and the experiments are carried out on the CASIA V1 iris database.

We have introduced as well as the multibiometric system since unibiometric systems fail in some cases. To improve the performance of the identification system, we have utilized multimodal fusion scenario between Face and Iris based on four fusion rules: minimum, maximum, mean, and product.

All of our experiments are implemented in the C# language. We have developed a graphical user interface (GUI) for testing the adopted approaches.

- We have compared between PCA and LBP methods; we have found also that LBP 45 % outperforms PCA 42.5%.
- Experimental results show that the multimodal fusion scenario (Iris + Face) with the application of LBP and LDA on the iris and face respectively has given a recognition rate of 98.33% using mean rule of fusion.
- The performance of multimodal fusion scenario 98.33% improve the unimodal one 45%.

Some perspectives that may help extend the work in this work are:

- ✓ Use another database like BATH, (ICE), WVU Databases and the other criteria such as the false acceptance rate (FAR) and the false rejection rate (FRR) for evaluate the system performance.
- ✓ In the implemented system, the recognition was done without detection of the Iris region. We suggest improve normalization step to obtain a more robust system.

✓ In this work, we have chosen the iris as biometrics, we propose to see other biometrics such as retina, signature ...etc.

(1) Prof. ✓ **Implementing supervised algorithms like Artificial Neural Network (ANN), Support Vector Machine (SVM) for an eventual comparison.**

[2] John D. Woodward, Jr., Christopher Horn, Julius Gatune, and Aryn Thomas, "Biometrics: A Look at Facial Recognition", document (briefing by RAND) Public Safety and Justice for the Virginia State Crime Commission, 2003.

[3]. K. Jain, A. Ross, S. Prabhakar, "An Introduction to Biometric Recognition", IEEE Transactions on Circuits and Systems for Video Technology, Vol. 14, No. 1, 2004

[4] Anil K. Jain, A. Ross, K. Nandakumar, "Introduction to biometrics" Springer, New York Dordrecht Heidelberg London, 2011.

[5] NSTC, "Biometrics Technology Introduction", www.biometrics.gov.

[6] A. Jain, L. Hong, and S. Pankanti, "biometric identification", communications of the ACM February 2000/Vol. 43, No. 2.

[7] L. ALLANO, "La Biométrie multimodale : stratégies de fusion de scores et mesures de dépendance appliquées aux bases de personnes virtuelles", l'INSTITUT NATIONAL DES TELECOMMUNICATIONS, l'école doctorale SITEVRY en co-accréditation avec l'UNIVERSITE D'EVRY-VAL D'ESSONNE, 12 Janvier 2009.

[8] Ravi Das, " An introduction to biometrics", Keesing Journal of Documents & Identity, Issue 17, 2006.

[9] R. Adjoudj¹, A. Boukelif², " Artificial Neural Network & Multilevel 2-D Wavelet Decomposition Code-Based Iris Recognition ". ¹Evolutionary Engineering and Distributed Information Systems Laboratory, EEDIS, Computer Science Department, University of Sidi Bel-Abbès, Algeria, ²Digital Signal processing laboratory, Electronic Department, University of Sidi Bel-Abbès, Algeria.

[10] G. Melfe Mateus Santos, "Non-cooperative Iris Recognition", University of Beira Interior Department of Computer Science, August 2009.

[11] Azad Ali, "Iris Recognition Based on a Secure Security System", Department of Electrical Engineering, Pakistan Institute of Engineering and Applied Sciences, Nilore, Islamabad, Pakistan, AUGUST, 2009.

Bibliography

- [1] Prof. Marios Savvides, "Introduction to Biometric Technologies and Applications", ECE & CyLab, Carnegie Mellon University.
- [2] John D. Woodward, Jr., Christopher Horn, Julius Gatune, and Aryn Thomas, "Biometrics a Look at Facial Recognition", documented briefing by RAND Public Safety and Justice for the Virginia State Crime Commission, 2003.
- [3]. K. Jain, A. Ross, S. Prabhakar, "An Introduction to Biometric Recognition", IEEE Transactions on Circuits and Systems for Video Technology, Vol. 14, No. 1, 2004
- [4] Anil K. Jain, A. Ross, K. Nandakumar, "Introduction to biometrics" Springer, New York Dordrecht Heidelberg London, 2011.
- [5] NSTC, "Biometrics Technology Introduction", www.biometrics.gov.
- [6] A. Jain, L. Hong, and S. Pankanti, "biometric identification", communications of the ACM February 2000/Vol. 43, No. 2.
- [7] L. ALLANO, "La Biométrie multimodale : stratégies de fusion de scores et mesures de dépendance appliquées aux bases de personnes virtuelles", l'INSTITUT NATIONAL DES TELECOMMUNICATIONS, l'école doctorale SITEVRY en co-accréditation avec l'UNIVERSITE D'EVRY-VAL D'ESSONNE, 12 Janvier 2009.
- [8] Ravi Das, "An introduction to biometrics", Keesing Journal of Documents & Identity, issue 17, 2006.
- [9] R. Adjoudj¹, A. Boukelif², "Artificial Neural Network & Multilevel 2-D Wavelet Decomposition Code-Based Iris Recognition", ¹Evolutionary Engineering and Distributed Information Systems Laboratory, EEDIS, Computer Science Department, University of Sidi Bel-Abbès, Algeria, ²Digital Signal processing laboratory, Electronic Department, University of Sidi Bel-Abbès, Algeria.
- [10] G. Melfe Mateus Santos, "Non-cooperative Iris Recognition", University of Beira Interior Department of Computer Science, August 2009.
- [11] Azad Ali, "Iris Recognition Based Biometric Security System", Department of Electrical Engineering, Pakistan Institute of Engineering and Applied Sciences, Nilore, Islamabad, Pakistan, AUGUST, 2005.

- [12] Frankin Cheung, "Iris Recognition ", Department of Computer Science and Electrical Engineering The University of Queensland, October 1999.
- [13] Shelly, "Iris Recognition on Hadoop", Thesis of Master of Technology, Delhi Technological University, 2011.
- [14] Eri Prasetyo Wibowo, Karmila Sari, Wisnu Sukma Maulana and Sarifudin Madenda, "Ocular Biometric System Focused on Iris Localization and Embedded Matching Algorithm", International Journal of Computer and Electrical Engineering, Vol.2, No.6, December, 2010
1793-8163
- [15] Qichuan Tian¹, Hua Qu², Lanfang Zhang and Ruishan Zong³, " Personal Identity Recognition Approach Based on Iris Pattern", ¹College of electronic and information engineering, Taiyuan University of Science and Technology, ²College of Science, Tianjin Polytechnic University, ³Taiyuan University of Science and Technology China, www.intechopen.com.
- [16] Nouredine Cherabit*, Fatma Zohra Chelali, Amar Djeradi, " Circular Hough Transform for Iris localization", Science and Technology 2012, 2(5): 114-121.
- [17] Milena Bueno Pereira Carneiro, Antônio Cláudio P. Veiga, Edna Lúcia Flôres and Gilberto A. Carrijo, " Solutions for Iris Segmentation", Federal University of Uberlândia – Department of Electrical Engineering, Brazil
- [18] Libor Masek, " Recognition of Human Iris Patterns for Biometric Identification", University of Western Australia, 2003.
- [19] Nouredine Cherabit*, Fatma Zohra Chelali, Amar Djeradi, "Circular Hough Transform for Iris localization", Science and Technology 2012, 2(5): 114-121.
- [10] Gil Melfe Mateus Santos, "Non-cooperative Iris Recognition", University of Beira Interior, Department of Computer Science, August 2009.
- [20] Matti Pietikäinen, Abdenour Hadid, Guoying Zhao, Timo Ahonen, " Computer Vision Using Local Binary Patterns", Springer-Verlag London Limited 2011.
- [21] K N Pushpalatha, Aravind Kumar Gautham, D.R. Shashikumar and K.B ShivaKumar⁴, " Iris Recognition System with Frequency Domain Features optimized with PCA and SVM Classifier", IJCSI International Journal of Computer Science Issues, Vol. 9, Issue 5, No 1, September 2012.

- [22] Nadjat RADJI" Biometric system: face recognition", UNIVERSITY M'HAMED BOUGARA OF BOUMERDES,2010
- [23] Arun Ross, an introduction to Multibiometric, Appeared in Proc. of the 15th European Signal Processing Conference (EUSIPCO), (Poznan, Poland), September 2007, page 1-2.
- [24] A run A, Ross, Karthik Nandakumar, Anil K. Jain, Handbook of Multibiometric, 2006 Springer Science + Business Media, LLC, page 45-50.
- [25] Harbi Almahafzah, Mohammad Imran and H.S. Sheshadri, Multibiometric: Feature Level Fusion Using FKP Multi-Instance biometric, University of Mysore.
- [26] Ryan Connaughton, Kevin W. Bowyer and Patrick Flynn, Fusion of Face and Iris Biometrics from a Stand-Off Video Sensor, University of Notre Dame Department of Computer Science and Engineering Notre Dame, IN 46556.
- [27] Zhijian Zhang, Rui Wang, KePan, StanZ. Liand Peiren Zhang, Fusion of Near Infrared Face and Iris Biometrics, Institute of Automation, Chinese Academy of Sciences, Beijing 100080, China, p175-176.
- [28] Rishabh Parashar, Sandeep Joshi, "Comparative Study of Iris Databases and UBIRIS Database for Iris Recognition Methods for Non-Cooperative Environment", International Journal of Engineering Research & Technology (IJERT) Vol. 1 Issue 5, July – 2012
- [29] Y.SAMAI, "Reconnaissance de l'Iris humain en utilisant les méthodes de l'Intelligence Artificielle ", UNIVERSITE EL HADJ LAKHDAR BATNA, 01/07/2012.
- [30] E. Mattar, "Principal Components Analysis Based Iris Recognition and Identification System ",International Journal of Soft Computing and Engineering (IJSCE) ISSN: 2231-2307, Volume-3, Issue-2, May 2013
- [31] P. S. R. Chandra Murty¹ and E. Sreenivasa Reddy² "Iris Recognition system using Principal Components of Texture Characteristics", TECHNIA – International Journal of Computing Science and Communication Technologies, VOL. 2, NO. 1, July 2009. (ISSN 0974-3375).

ملخص

الحاجة المتزايدة لحماية المعلومات حاز على اهتمام لمجال البيومترية الية التعرف الشخصي. من المقاربات الموجودة التعرف على حدقة العين هو من أكثر المقاربات الواعدة. ويقترح هذا العمل طريقة التعرف على الحدقة باستخدام نمط ثنائي المحلي وتحليل العنصر مع قياس المسافة. واقترحنا استخدام نظام من متعدد القياسات الحيوية بالأخص نظام متعدد الوسائط كوسيلة لتحسين أداء نظام الحدقة. من أجل صلاحية هذا العمل استخدمنا قاعدة البيانات CASIA الطبعة الأولى. وقد أظهرت النتائج المتحصل عليها أن دمج الوسائط المتعددة (الحدقة +الوجه) بتطبيق نمط ثنائي المحلي و تحليل التمايز الخطي على الحدقة و الوجه على التوالي منحت أفضل نتيجة من 98.33%، باستخدام قاعدة الدمج المتوسط
كلمات المفتاحية: التعرف على الحدقة، الوجه، البيومترية، LBP، PCA، LDA، متعدد القياسات الحيوية، الدمج.

Abstract

The increasing need for information security has led to more attention being given to biometrics-based, automated personal identification. Among existing biometric approaches, the human iris is the most promising technique. This work is proposed the Iris recognition method using local binary pattern(LBP) and component analysis(PCA) with measure distance. In addition, we have introduced the multi biometrics system particularly multimodal system to improve the performance of the identification system. For the validation of this work, we use database CASIA V1. Experimental results show that the multimodal fusion scenario (Iris + Face) with the application of LBP and LDA on the iris and face respectively gives the best recognition rate of 98.33% using mean rule of fusion.

Keywords : Iris recognition, face, Biometrics, PCA, LBP, LDA, Multibiometrics, fusion.

Résumé

Le croissant besoin pour la sécurité de l'information a possédé un intérêt dans la biométrie basée sur l'identification automatique des personnes. Parmi les approches biométriques existe, l'iris humain utilisé le modèle locale binaire (LBP) et analyse de composantes principales (ACP) avec les mesures de distance. Ce travail propose la méthode de reconnaissance d'iris en utilisant trois méthodes différentes : le modèle binaire locale (LBP) et analyse de composantes principales (ACP) avec différentes mesure de distance. En plus, nous nous sommes introduire un système multi-biométriques et plus précisément aux multimodal pour d'améliorer la performance du système de reconnaissance d'iris. pour la validation de ce travaille, on a utilisé la base de données CASIA v1. Les résultats expérimentaux montrent que le scénario de fusion multimodale (Iris + Visage) avec l'application de LBP et LDA sur l'iris et le visage respectivement a permet de donner un taux de reconnaissance de 98,33% en utilisant la règle de fusion moyenne.

Mots clés: reconnaissance d'iris, face, biométrie, PCA, LBP, LDA, multi biométrie, fusion.