Preface

Face recognition is still a vividly researched area in computer science. First attempts were made in early 1970-ies, but a real boom happened around 1988, parallel with a large increase in computational power. The first widely accepted algorithm of that time was the PCA or eigenfaces method, which even today is used not only as a benchmark method to compare new methods to, but as a base for many methods derived from the original idea.

Today, more than 20 years after, many scientists agree that the simple two frontal images in controlled conditions comparison is practically a solved problem. With minimal variation in such images apart from facial expression, the problem becomes trivial by today's standards with the recognition accuracy above 90% reported across many papers. This is arguably even better than human performance in the same conditions (especially if the humans are tested on the images of the unknown persons). However, when variations in images caused by pose, aging or extreme illumination conditions are introduced, humans' ability to recognize faces is still remarkable compared to computers', and we can safely say that the computers are currently not even close.

The main idea and the driver of further research in this area are security applications and human-computer interaction. Face recognition represents an intuitive and non-intrusive method of recognizing people and this is why it became one of three identification methods used in e-passports and a biometric of choice for many other security applications. However, until the above mentioned problems (illumination, pose, aging) are solved, it is unrealistic to expect that the full deployment potential of face recognition systems will be realized. There are many technological issues to be solved as well, some of which have been addressed in recent ANSI and ISO standards.

This goal of this book is to provide the reader with the most up to date research performed in automatic face recognition. The chapters presented here use innovative approaches to deal with a wide variety of unsolved issues.

Chapter 1 is a literature survey of the usage of compression in face recognition. This area of research is still quite new and there are only a handful of papers that deal with it, but since the adoption of face recognition as part of the e-passports more attention should be given to this problem. In chapter 2 the authors propose a new parallel model utilizing information from frequency and spatial domain, and using it as an input to different

variants of LDA. The overall performance of the proposed system outperforms most of the conventional methods. In chapter 3 the authors give an idea on how to implement a simple yet efficient facial image acquisition for acquiring multi-views face database. The authors have further incorporated the acquired images into a novel majority-voting based recognition system using five views of each face. Chapter 4 gives an insightful mathematical introduction to tensor analysis and then uses the discriminative rank-one tensor projections with global-local tensor representation for face recognition. At the end of the chapter authors perform extensive experiments which demonstrate that their method outperforms previous discriminative embedding methods. Chapter 5 presents a review of related works in what the authors refer to as intelligent face recognition, emphasizing the connection to artificial intelligence. The artificial intelligent system described is implemented using supervised neural networks whose task were to simulate the function and the structure of human brain that receives visual information.

Chapter 6 proposes a new method to improve the recognition rate by selecting and generating optimal face image from a series of face images. The experiments at the end of the chapter show that the new method is on par with existing methods dealing with pose, with an additional benefit of having the potential to extend to other factors such as illumination and low resolution images. Chapter 7 gives and overview of multiresolution methods in face recognition. The authors start by outlining the limitations of the most popular multiresolution method - wavelet analysis - and continue by showing how some new techniques (like curvelets) can overcome them. The chapter also shows how these new tools fit into the larger picture of signal processing, namely, the Comprehensive Sampling of Compressed Sensing (CS). Chapter 8 addresses one of the most difficult problems in face recognition - the varying illumination. The approach described synthesizes an illumination normalized image using Quotient Image-based techniques which extract illumination invariant representation of a face from a facial image taken in uncontrolled illumination conditions. In chapter 9 the authors present their approach to anti-spoofing based on a liveness detection. The algorithm, based on eye blink detection, proved its efficiency in an experiment performed under uncontrolled indoor lighting conditions.

Chapter 10 gives an overview of the state-of-the-art in 2D and 3D face recognition and presents a novel 2D-3D mixed face recognition scheme. Chapter 11 explained an important aspect of any face recognition application in security - disguise - and investigates how it could affect face recognition accuracy in a series of experiments. Experimental results suggest that the problem of disguise, although rarely addressed in literature, is potentially more challenging than illumination, pose or aging. In chapter 12 the authors attempt to analyze the uncertainty (overlapping) problem under expression changes by using kernel-based subspace analysis and ANN-based classifiers. Chapter 13 gives a comprehensive study on the blood perfusion models based on infrared thermograms. The authors argue that the blood perfusion models are a better feature to represent human faces than traditional thermal data, and they support their argument by reporting the results of extensive experiments. The last two chapters of the book address the use of color information in face recognition. Chapter 14 integrates color image representation and recognition into one discriminant analysis model and chapter 15

presents a novel approach to using color information based on multi layer neural networks.

October 2008

Editors

Kresimir Delac,
Mislav Grgic
University of Zagreb
Faculty of Electrical Engineering and Computing
Department of Wireless Communications
Unska 3/XII, HR-10000 Zagreb
Croatia

Marian Stewart Bartlett
Institute for Neural Computation
University of California, San Diego, 0523
9500 Gilman Drive
La Jolla, CA 92093-0523
United States of America