Chapter 2

Face Searching in Large Databases

Maria De Marsico
Università di Roma “La Sapienza”, Italy

Michele Nappi
Università di Salerno, Italy

Daniel Riccio
Università di Salerno, Italy

Sergio Vitulano
Università di Cagliari, Italy

ABSTRACT

Both government agencies and private companies are investing significant resources to improve local/remote access security. Badge or password-based procedures have proven to be too vulnerable, while biometric research has significantly grown, mostly due to technological progresses that allow using increasingly efficient techniques, yet at decreasing costs. Suitable devices capture images of user’s face, iris, etc., or other biometric elements such as fingerprints or voice. Each biometry calls for specific procedures. Measures from user’s data make up the so called biometric key, which is stored in a database (enrolment) or used for recognition (testing). During recognition, a subject’s key is matched against those in the database, producing a similarity score for each match. However, some drawbacks exist. For example, iris scanning is very reliable but presently too intrusive, while fingerprints are more socially accepted but not applicable to non-consentient people. On the other hand, face recognition represents a good solution even under less controlled conditions. In the last decade, many algorithms based on linear/non-linear methods, neural networks, wavelets, etc. have been proposed. Nevertheless, during Face Recognition Vendor Test 2002 most of them encountered problems outdoors. This lowers their reliability compared to other biometries, and underlines the need for more research. This chapter provides a survey of recent outcomes on the topic, addressing both 2D imagery and 3D models, to provide a starting reference to potential investigators. Tables containing different collections of parameters (such as input size, recognition rate, number of addressed problems) simplify comparisons. Some future directions are finally proposed.

DOI: 10.4018/978-1-61520-991-0.ch002
INTRODUCTION

Secure access to restricted areas or services, has long since been a major issue. Many agencies are increasingly motivated to improve authentication through bodily or behavioural characteristics, referred to as biometries (Perronnin, 2003). Biometric systems process raw data to extract and store a biometric template. They may implement verification or identification. Verification is a 1:1 match that compares a probe biometric template against a stored one, whose identity is being claimed. Identification implies a 1:N comparison of a query biometric template against all stored templates, to determine its identity. Face recognition is less reliable than, say, fingerprints or iris, yet it seems a good compromise: it requires lighter computation, and produces less psychological discomfort, since people is quite accustomed to be photographed, even if a privacy violation is sometimes asserted (Johnson, 2004). It also has the great advantage of being applicable in places with large concourse of possibly unaware visitors. More recent works exploit 3D face models. Progress of technology also influences related algorithms. The first ones directly worked on clouds of points (after a suitable triangulation), while more recent ones work on a mesh, sometimes considering information from both the 3D shape and the texture.

Despite advances in research, real-world scenarios remain a challenge, because five key factors can significantly affect recognition performances: illumination, pose, expression, time delay, occlusions. This also motivated the generation of several 2D face images databases providing as many variations as possible on their images, to validate the performances of the proposed methods. FERET (Phillips, 2000), CMU-PIE (Sim, 2003), AR Faces (Martinez, 2002), Face Recognition Grand Challenge (FRGC) ver2.0 (Phillips, 2005) represent some of the most popular ones. On the other hand, there are few 3D face models databases, with very little amount of data. The 3D_RMA is an example whose models are represented by clouds of points. It has long been the only publicly available database, and its quality is rather low. 3D meshes are available today from newer technologies, but in most cases they make up proprietary databases. Table 1 and Table 2 report the most popular 2D and 3D face databases. Their main characteristics are summarized, in particular available distortions: illumination(i), pose(p), expression(e), occlusions(o), time delay(t), indoor/outdoor(i/o).

Neither a common benchmark database is presently used to test existing face recognition algorithms, nor a unique standard evaluation protocol. Performance is typically characterized by Recognition Rate (RR), False Acceptance Rate (FAR) or False Rejection Rate (FRR) under closed-world assumptions. However Sherrah (Sherrah, 2004) recently underlined the importance of minimizing the false alarm rate, which is a more difficult criterion.

In the following, Section II describes recent 2D face recognition research trends, while highlighting achieved results; Section III analyzes what currently prevents a wider commercial adoption of face biometry. It also provides a more general way to evaluate performances for existing face recognition algorithms. A discussion about 3D-based face recognition is presented in Section IV. Finally, Section V closes the chapter with some considerations on state of the art and possible future trends, suggesting multimodality as a good solution to address reliability.

LITERATURE ABOUT AUTOMATIC FACE RECOGNITION

Face Recognition can be considered as a special example of pattern recognition, in particular as a template matching problem. Such problem is hard, as it is intrinsically non linear and must be addressed within a high-dimensional space. The following subsections will summarize the most widely investigated approaches for 2D face recognition. The aim is to present general issues,
Related Content

The MobiFall Dataset: Fall Detection and Classification with a Smartphone
[www.igi-global.com/article/the-mobifall-dataset/116732?camid=4v1a](www.igi-global.com/article/the-mobifall-dataset/116732?camid=4v1a)

Towards Continuous Authentication Based on Gait Using Wearable Motion Recording Sensors
[www.igi-global.com/chapter/towards-continuous-authentication-based-gait/59671?camid=4v1a](www.igi-global.com/chapter/towards-continuous-authentication-based-gait/59671?camid=4v1a)

Despeckle Filtering Toolbox for Medical Ultrasound Video
[www.igi-global.com/article/despeckle-filtering-toolbox-for-medical-ultrasound-video/101966?camid=4v1a](www.igi-global.com/article/despeckle-filtering-toolbox-for-medical-ultrasound-video/101966?camid=4v1a)

Backpropagation Neural Network for Interval Prediction of Three-Phase Ampacity Level in Power Systems