Chapter 4
Biometrical Processing of Faces in Security and Forensics

Paweł T. Puślecki
National University of Ireland, Ireland

ABSTRACT

The aim of this chapter is the overall and comprehensive description of the machine face processing issue and presentation of its usefulness in security and forensic applications. The chapter overviews the methods of face processing as the field deriving from various disciplines. After a brief introduction to the field, the conclusions concerning human processing of faces that have been drawn by the psychology researchers and neuroscientists are described. Then the most important tasks related to the computer facial processing are shown: face detection, face recognition and processing of facial features, and the main strategies as well as the methods applied in the related fields are presented. Finally, the applications of digital biometrical processing of human faces are presented.

INTRODUCTION

The recognition of faces is one of the easiest and the most frequently used by adult human method of distinction between known and unknown persons and identification of these familiar. Usually we benefit from it even without the awareness of this process and similarly another people can recognize our identity basing only on the quick observation. Often such recognition is done even without our knowledge or our permission to do it, and moreover, usually we ignore the most of looks given us. It is not meaningless, that recognition of faces, along with the recognition of voice, is the most common in the nature method of identification of individuals for a number of species.

Automatic processing of faces has found a number of applications in several specific fields: in security, forensic and commercial solutions. The neutrality and non-intrusiveness are the main reasons

DOI: 10.4018/978-1-60566-836-9.ch004

why the automatic machine face recognition systems are often treated as the promising tool for security applications. The precision of facial recognition by humans motivates researchers to apply the artificial facial recognition in forensics. Moreover, recognition of faces is very natural to all human beings, and it does not arouse such negative (criminal-like) associations as, for example, gathering fingerprints or samples of the genetic material for DNA tests, thus biometrical processing of faces can be successfully used in commercial applications.

Faces and their recognition always have been of the interest to various researchers. However, the dynamic growth of interest in this field we can observe from early 1990s. There are several reasons that motivate the progress of research in the automatic facial recognition. One of the most important is the development of the hardware, which has allowed the real-time acquiring and processing of vision data. Also the rising both importance and number of observation surveillance systems cause the interest in such biometric technologies. It is not meaningless, that along with developing the knowledge on biometrical recognition of faces to the mature level, it becomes the regular product available on the commercial market.

The automatic face processing is a field, which attract the attention of researchers in various disciplines of engineering, such as signal and image processing, pattern recognition, machine vision, computer graphics. Face perception by humans is also interesting for scientists, mainly for psychologists and neuroscientists. What is important, the results of observations concerning face recognition in humans can pose an inspiration for engineering research on machine methods, and also contrary to that, results of research on automatic face processing may suggest interesting directions of research in humans.

Automatic face processing is a non-trivial task, and the facial researches, independent on the final application of the issue, need to face a series of challenges, mainly derived from the fact, that machine processing of faces from images (or video sequences) concerns the classification of three-dimensional elastic objects, while the data are available merely in a two-dimensional form. When face recognition is evaluated in controlled conditions it shows very good performance, but when it is applied to real-world applications, especially in non-controlled conditions, it still does not achieve such good results as recognition of fingerprint or iris. Nevertheless, these better performing biometrics definitely require to cooperate (thus also the goodwill) from the examined subject, *e.g.* to contact with fingerprint scanner or to present the eye in location proper to iris sensor.

The chapter is organized as follows. In the further part of this chapter presented are the most important issues related to the biometrical processing of faces. To better understand the tasks that engineers are facing, presented are observations concerning perception and recognition of faces by humans – done by psychologists and neuroscientists. Results of these observations may contain information posing hints for engineers, who create machine facial processing systems. Then characterized are the most important tasks of machine processing of faces, and presented are the differences between them. The most significant challenges, which usually are common for the majority of automatic facial processing problems that must be met by researchers, are enumerated. In further sections presented are tasks of detection and recognition of faces, and quoted are several of the most important approaches to these problems. Also other machine facial processing tasks that are generally related to the processing of the information concerning the facial features are presented. The last section sums up the chapter. Further challenges that face processing methods must meet are presented and several of the promising further directions are described. Also in this section, the disputes of controversies concerning the privacy in facial processing methods are quoted.