Chapter 35
Machine-Learning-Based Approach for Face Recognition

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ABSTRACT

Face recognition has been one of the most interesting and important research areas for real time applications. There is a need and necessity to design efficient machine leaning based approach for automatic recognitions and surveillance systems. Face recognition also used the knowledge from other disciplines such as neuroscience, psychology, computer vision, pattern recognition, image processing, and machine learning, etc. This chapter provides a review of machine learning based techniques for the face recognition. First, it presents an overview of face recognition and its challenges then, a literature review of machine learning based approaches for face detection and recognition is presented.

1. INTRODUCTION

In recent years there has been a growing interest in improving all aspects of the interaction between humans and computers with the clear goal of achieving a natural interaction, similar to the way human-human interaction takes place. The most expressive way humans display emotions is through facial expressions. Humans detect and interpret faces and facial expressions in a scene with little or no effort. Still, development of an automated system that accomplishes this task is rather difficult. There are several related problems: detection of an image segment as a face, extraction of the facial expression information, and classification of the expression. A system that performs these operations accurately and in real time would be a major step forward in achieving a human-like interaction between the man and machine. In this chapter, we present several machine learning algorithms applied to face analysis.

Face recognition is one of the most challenging areas in the field of computer vision. Face detection is the first step for face recognition in order to localize and to extract the face region from the background. For face detection, active contour models are used to detect the edges and for locating the face boundary. For face recognition, facial feature extraction algorithm is widely used. The distinguishing features found by the algorithm are used to compare images. There exist several algorithms to extract features

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such as Principal Component Analysis (PCA) (Wold, S. *et. al*. (1987); Jolliffe, I. (2002)), Linear Discriminate Analysis (LDA) (Chien, et al., 2005; Martínez, et al., 2001), Principal Component Analysis (PCA) (Wold, et al., 1987; Jolliffe, 2002; Holand, 2008). This type of feature extraction algorithms needs manual interaction and do not consider prominent local features of a face, i.e., extracts the various facial features globally. Automatic recognition is a vast and modern research area of computer vision, reaching from recognition of faces, facial expressions and gestures over related topics such as automatically detecting, locating and tracking faces, as well as extraction of face orientation and facial features. Facial recognition system is a computer application for automatically identifying or verifying a person from a digital image or a video frame from a video source (see Figure 1).

The development of face recognition over the past years allows an organization into three types of recognition algorithms, namely frontal, profile, and view-tolerant recognition, depending on both the facial views available, and according to the recognition algorithms. While frontal recognition certainly is the classical approach to tackle the problem at hand, view-tolerant algorithms usually treat it in a more sophisticated fashion by taking into consideration some of the underlying physics, geometry, and statistics.

There are several challenges in face detection and recognition these include:

1. **Illumination Challenged:** Although the performance of face recognition systems in indoor platforms has reached a certain level, face recognition in outdoor platforms still remains as a challenging topic the effect of variation in the illumination conditions, which causes dramatic changes in the face appearance, is one of the most challenging problems that a practical face recognition system needs to achieve.
2. **Face Pose:** In an automatic face recognition system, the camera is mostly mounted to a location where the people cannot reach to the camera. Mounting a camera a high location, the faces are

Figure 1. Face recognition system