

## Chapter 57

# Face Recognition with Active Appearance Model (AAM)

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### ABSTRACT

*Recognition of human faces has been a fascinating subject in research field for many years. It is considered a multidisciplinary field because it includes understanding different domains such as psychology, neuroscience, computer vision, artificial intelligence, mathematics, and many others. Human face perception is intriguing and draws our attention because we accomplish the task so well that we hope to one day witness a machine performing the same task in a similar or better way. This chapter aims to provide a systematic and practical approach regarding to one of the most current techniques applied on face recognition, known as AAM (Active Appearance Model). AAM method is addressed considering 2D face processing only. This chapter doesn't cover the entire theme, but offers to the reader the necessary tools to construct a consistent and productive pathway toward this involving subject.*

### INTRODUCTION

Computer Vision is a relatively new research field since it was not before the late 70's that it was widely recognized by the scientific community. This was due mainly to the lack of proper computational resources to process images and data on an acceptable rate. Most of these limitations have been overcome and now it is possible to take

advantage of complex algorithms running on fast microprocessors in order to make machines “see” what it was only seen by humans.

Actually, nowadays there are machines able to see beyond of what humans are capable of. The hardware used for image acquisition has taken a real technological and innovative leap for the past 20 years. As a result of this, we can easily add smart cameras, depth cameras, IR (infrared) cameras and many other types of input devices and modern sensors in our projects. The new chal-

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lenge, however, is to make the machines not only see, but also understand and interpret the scene.

New methods for image processing and object recognition are emerging every year. One of the most prominent areas of research in object recognition and pattern recognition is, undoubtedly, face processing. According to Zhao and Chellappa (2003, 2006) this is due to the high demand for commercial and law-enforcement application associated, of course, with the current status of our technological resources to attend such requests. One can say that several years of improvements in hardware and software have contributed positively for the growth in this research field. In addition to that is essential to acknowledge all the effort and endeavor of many researchers working in the areas of psychology, neuroscience, computer vision, artificial intelligence, mathematics and many others.

Another aspect which contributed for the high interest in face recognition is mentioned by Zhao and Chellappa (2003) and is related to the nature of method itself. Face recognition is different from other human identification methods such as biometrics because it doesn't need the cooperation of the person being detected or identified. Therefore, you can think of face recognition process as a passive method which relies only on the camera acquisition and the processing mechanism in order to generate results. This is also a controversial theme since people may start questioning about privacy policy. Does the Government and the so-called Special Agencies have the right on spying on you?

To answer this and other questions related to face recognition there are many conferences and workshops around the world. It is worth to mention the followings: IEEE Conference on Face and Gesture Recognition, International Conference on Pattern Recognition (ICPR), Structural and Syntactic Pattern Recognition (SSPR), International Conference on Image Analysis and Recognition (ICIAR) and International Conference on Machine Learning and Data Mining.

As you may notice recognizing a human face is not a trivial task and demands plenty of work

from several experts. Nowadays, for instance, computer vision, artificial intelligence and pattern recognition practitioners work side by side to create models and improve techniques for the purpose of recognizing human faces in many situations. Researchers from physics have been collaborated in full extension with technological breakthrough in the production of sensors, cameras and different types of vision systems for robotics.

Besides, since the recent spate of terrorist attacks such as September 11 in 2001 and London bombings in 2005, face recognition and facial reconstruction have won a spot on the list of priority systems necessary to promote social well-fare. Despite of security systems and surveillance, a typical list of applications for face recognition are: games, human-robot interaction, photo management, smart cards and psychological studies of human behavior (expressions, mood and appearance).

The next sections explore the field of face recognition by focusing on the AAM technique. First we present the workflow of face recognition by considering it as a problem in the pattern recognition domain. Subsequently, AAM method is described in detail including key points regarding to its implementation in Matlab. Then, a small guide toward open field subjects, usage of tools and frameworks are provided in order to capture the interest of future researchers. Finally, we conclude the work by presenting our opinion and summarizing the topics discussed along this chapter.

## **UNDERSTANDING FACE RECOGNITION PROCESS**

### **Face Processing as a Pattern Recognition Problem**

The first step on face recognition is to understand the problem statement so that goals and problem boundaries are well identified. With this in mind, it is important to realize that face recognition belongs to a class of problems in the pattern recognition

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