

Chapter 12

Using Ocular Data for Unconstrained Biometric Recognition

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ABSTRACT

There are several scenarios where a full facial picture cannot be obtained nor the iris properly imaged. For such cases, a good possibility might be to use the ocular region for recognition, which is a relatively new idea and is regarded as a good trade-off between using the whole face or the iris alone. The area in the vicinity of the eyes is designated as periocular and is particularly useful on less constrained conditions, when image acquisition is unreliable, or to avoid iris pattern spoofing. This chapter provides a comprehensive summary of the most relevant research conducted in the scope of ocular (periocular) recognition methods. The authors compare the main features of the publicly available data sets and summarize the techniques most frequently used in the recognition algorithms in this chapter. In addition, they present the state-of-the-art results in terms of recognition accuracy and discuss the current issues on this topic, together with some directions for further work.

1. INTRODUCTION

The face and the iris are among the most popular traits for biometric recognition, and are – together with the fingerprint – the most frequently reported in the specialized literature (Bowyer, Hollingsworth, & Flynn, 2008; Zhao et al. 2000).

The iris has a predominantly randotypic morphogenesis, unique for each individual, and allows very high recognition accuracy. Also, it is a protected organ visible from the exterior, justifying the efforts on “relaxing” its acquisition setup (Santos & Hoyle, 2012; Shin et al., 2012; Tan, Zhang, Sun, & Zhang, 2012).

The face has been traditionally regarded as the main trait to perform recognition under less controlled conditions. However, several drawbacks significantly decrease the effectiveness of face-based recognition systems: 1) due to its 3D structure, substantial differences in appearance are expected with respect to subjects’ poses; 2) large regions of the face are often occluded, in case of non-orthogonal data acquisition; 3) facial expressions notoriously affect the appearance of the face; 4) disguising is particularly easy.

According to the above, growing attention has been paid to other traits potentially useful for biometric recognition. Among these, the use of information in the vicinity of the eye (the periocular region) has been gaining in popularity. Being particularly useful on less constrained scenarios, when image acquisition is unreliable, or to avoid iris pattern spoofing, the periocular region does not require constrained close capturing or user cooperation, it’s relatively stable, when compared to the whole face, and rarely occluded. Due to the proximity with the iris, both can be easily acquired with a single camera and fused at the score level to compensate for environmental adversities and uncooperative subjects.

The usage of periocular information has even proven itself to be of importance in scenarios where the face has been *reshaped* (e.g. plastic surgery), with interesting results (Jillela & Ross, 2012; Bhatt, Bharadwaj, Singh, & Vatsa, 2013).

The idea of *periocular recognition* came from the ability of humans to recognize someone by his /her eyes, which are known to provide substantial amounts of discriminating information that is relatively stable over lifetime. Hence, the term periocular biometrics refers to the development of recognition methods that analyze not only the iris structure, but also the shape of eyelids, the distribution of eyelashes, the texture of the sclera and of the skin surrounding the eye to perform recognition.

This chapter provides an overview of the most relevant attempts to perform biometric recognition in uncontrolled acquisition environments, using information in the periocular area. We summarize the most relevant methods in the literature and compare the techniques most frequently reported for each of the typical processing phases: segmentation, quality assessment, feature encoding and matching. Next, we describe the data sets that are publicly available and used in the evaluation of algorithms, and report the state-of-the-art recognition rates that act as reference values for further improvements on this technology.

The remainder of this chapter is organized as follows: Section 2 overviews the anatomic and biological features of the periocular region. Section 3 compares the main characteristics of the data sets used in periocular recognition experiments. A comprehensive review of the most relevant papers published in this scope is given in Section 4. Section 5 reports the current state-of-the-art results and Section 6 discusses the issues and challenges that are currently associated to the periocular recognition process. Finally, Section 7 concludes this chapter.

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