Unconstrained Iris Recognition: Summary of Segmentation Techniques

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***Abstract*—The development of biometric recognition solutions able to work in visual surveillance conditions, i.e., in unconstrained data acquisition conditions and under covert protocols has been motivating growing efforts from the research community. In this scope, one of the most difficult phases is undoubtedly the segmentation process, where the degradation factors resulting from the unconstrained acquisition conditions should be handled first. This report summarizes some relevant iris segmentation techniques published over the last years.**

***Index Terms*—Biometric recognition, iris recognition, iris segmentation, image segmentation.**

I. Introduction

The human iris supports contactless data acquisition and can be imaged covertly. Thus, at least theoretically, the subsequent biometric recognition procedure can be per- formed without subjects knowledge. The feasibility of this type of recognition has received increasing attention and is of particular interest for forensic and security purposes, such as the pursuit of criminals and terrorists and the search for missing children.

II. Iris Segmentation Methods

Despite the fact that many of the iris recognition approaches obtain minimal error rates, they do so under particularly favourable conditions, having as a prerequisite the existence of good quality images. These conditions are not easy to obtain and usually require the active cooperation of subjects. In this section we analyze and compare several iris segmentation proposals, especially focusing on those that may be more robust against degraded data.

It should be noted that the availability of iris databases with images acquired in visible light and unconstrained data acquisition conditions (e.g., [8] and [13] made easier the development of research works on this topic. Also, several challenges and contests were organised, where participants from different countries had the opportunities to submit their proposals (e.g., [12])

The significant majority of the listed methods operate on NIR images that typically offer high contrast between the pupil and the iris regions, which justifies the order in which the borders are segmented. Also, various innovations have recently been proposed, such as the use of active contour models, either geodesic [17], based on Fourier series [4], or based on the snakes model [1]. All these techniques require previous detection of the iris to properly initialize contours, and are associated with heavy computational requirements. Modifications to known form fitting methods have also been proposed, essentially to handle off- angle images (e.g., [19] and [18]) and to improve performance (e.g., [5] and [3]]). Finally, the detection of non-iris data that occludes portions of the iris ring has motivated the use of parabolic, elliptical, and circular models (e.g., [2] and [3]) and the modal analysis of histograms [4]. Even so, in noisy conditions, several authors have suggested that the success of their methods is limited to cases of image orthogonality, to the nonexistence of significant iris occlusions, or to the appearance of corneal reflections in specific image regions. In [6] and later [7] authors propose a method divided into two blocks: the initial phase is subdivided into two processes: detecting the sclera and detecting the iris. The key insight is that the sclera is the most easily distinguish- able region in non-ideal images. Next, we exploit the mandatory adjacency of the sclera and the iris to detect noise-free iris regions.

More recently, [15] and [16] proposed to perform recognition in visible light data without even segmenting the iris region, or assuming that data has large segmentation errors, which can be an interesting direction for further work.

III. Conclusions

The development of biometric recognition solutions able to work in visual surveillance conditions, i.e., in unconstrained data acquisition conditions and under covert protocols has been motivating growing efforts from the research community. In this scope, one of the most difficult phases is undoubtedly the segmentation process, where the degradation factors resulting from the unconstrained acquisition conditions should be handled first. This report summarizes some relevant iris segmentation techniques published over the last years.

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