

Preface

Reliable personal biometric recognition is of paramount importance to modern societies, essentially due to increased use of e-commerce on one hand and rise in illegal and terrorist acts on the other hand. In this context, among other biometric traits, the iris is commonly accepted as one of the most unique and stable biometric traits and it has been successfully applied at airports and at advanced ATMs. Iris is the annular part of an eye surrounded by other unwanted parts. Therefore, fast and accurate iris segmentation and unique feature extraction are the most essential aspects of iris recognition system to achieve error-free recognition in real-time. At the same time, iris recognition system is required to be robust against counterfeit attacks.

In this book, we addressed these issues in two iris segmentation methods, one is fast and customized iris segmentation method and the other is focused on accurate methods based on pupil dynamics. Dual Tree Complex Wavelet Transform (DT-CWT) and Rotated Complex Wavelet Filters (RCWF) have been described to extract the randomly oriented multidirectional features.

Existing iris segmentation methods are either time-consuming or inaccurate and are tested on the manually edited nonrealistic CASIA database. These methods fail in segmentation of realistic images of UBIRIS database, which has been addressed in the first method using Canny operator and tangents without employing Hough transform for computational efficiency.

Most of the iris segmentation methods assume boundaries of iris as circle or ellipse, which is seldom true but exact iris is of slightly irregular shape. In the second method, we have segmented an iris of exact shape without any loss of iris data accurately by exploring the pupil dynamics of human eye. The pupil dynamics is a property of the real eye and it is also used for fake iris detection. This method has not only provided extremely high segmentation accuracy but also the excellent recognition rate, due to the loss-free, accurately segmented iris images. This novel method of iris segmentation is also inherently capable of fake iris detection.

In this book, the theories of wavelet transform and complex wavelet transform have been covered in brief. Designs of Wavelet filters, Dual Tree Complex Wavelet Transform filters, and Rotated Wavelet Filters have also been presented. These filters are used to extract randomly oriented, multidirectional texture features of an iris. We used DT-CWT and RCWF jointly to extract unique features of iris in 12 different

orientations. This method successfully addressed the issue of higher computational cost of Gabor filter on one hand and inferior recognition performance of standard DWT, due to its limited directionality, on the other hand.

Thus, in this research work we designed accurate and time-efficient algorithms for all subsystems of robust iris recognition system, i.e., fake iris detection, iris segmentation, feature extraction, and matching which have been presented in five chapters. A comprehensive literature survey of existing iris recognition techniques is presented in [Chap. 2](#). Iris segmentation methods are proposed in [Chap. 3](#). Fast iris segmentation method customized for UBIRIS database and accurate iris segmentation algorithm using pupil dynamics are presented in this chapter. The strengths and weaknesses of our method compared to existing methods are also brought out. The inherent anti-spoofing mechanism of pupil dynamics-based iris segmentation method is outlined in this chapter. The analysis of iris texture brings out the challenges in feature extraction for iris recognition. The essence of wavelets, complex wavelets, and rotated wavelets have been explained in [Chap. 4](#). The design of filters for complex wavelet transform and design of rotated complex wavelet filter for feature extraction are presented in this chapter. Finally, the conclusion and directions for future work are outlined in [Chap. 5](#).

We hope this book will prove to be useful for all readers and will give future direction for postgraduate students and researchers in the area of Image Processing and Pattern Recognition. In spite of our great care, it is likely that some errors might have crept into the text. We appreciate any corrections and suggestions, which will help in the improvement of the book.

Happy reading and warm regards!!!

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