Abstract

Biometric systems based on biometric trait such as face, fingerprint, gait, palm print, iris etc. are considered as a secure and reliable for authentication of an individual over the traditional systems based on PIN or password. Unlike traditional system, the characteristics represented by biometric traits are permanent and cannot be lost or forgotten. The application domains of biometric system include border control, access control, computer system security, banking sector, citizen registration health and social services. When high security is concerned, due to the epigenetic nature and unique complex texture pattern of an iris, iris as a biometric trait is found to be more appropriate compared to other biometric traits.

Typically, an iris recognition system has image acquisition, iris segmentation, normalization, feature extraction and iris recognition modules. After acquiring eye images, iris part is localized by demarcating its inner and outer boundaries through different segmentation algorithms. Next, the localized circular iris is isolated and transformed into the rectangular shape of fixed size during the normalization process. The feature extraction module extracts the unique iris feature using appropriate algorithm from the segmented normalized iris. Finally, the extracted features are matched with the stored features to validate the recognition process. The output of one module is used as an input of another module. So, each of the module plays a vital role in the overall performance of the iris recognition system. Various authors have made contributions to the development of algorithms for different modules of iris recognition system for efficient performance. However, the iris recognition system has many challenges such as precise and accurate segmentation of an iris in a reasonable amount of time, extraction of distinct feature vector to represent an iris and the design of appropriate recognition algorithm to achieve the high accuracy iris recognition system.

A detailed investigation has been carried out in the present work on the existing statistical methods, soft computing methods and hybrid techniques with a focus on the

development of hybrid iris segmentation and recognition algorithms. Soft Computing (SC) based techniques *viz*. Quantum-behaved Particle Swarm Optimization (QPSO), Artificial Neural Network (ANN), Modular Neural Network (MNN), Fuzzy Inference System and their hybrid variants are employed in order to achieve the goal of development of hybrid iris recognition algorithms.

In the present work an iris segmentation approach based on Adaptive Histogram Equalization and median filter is proposed. In order to improve the overall performance of the iris recognition system, a hybrid iris segmentation appraoch comprising of Quantum-behaved Particle Swaarm Optimization (QPSO), circle geometry and Circular Hough Transform (CHT) is developed. The recognition accuracy of iris recognition system depends on the recognition algorithm. Therefore, three different hybrid iris recognition approaches have been proposed in this thesis for identification and verification of an input iris image. The first approach adopts hybridization of ensemble of neural network and statistical city block distance, where the task of iris recognition is compartmentalized among the networks to perform the recognition efficiently. However, the perfomance of this method deteriorates when iris information is degraded by noise such as eyelids, eyelashes and reflection. To address this problem and to further enhance the iris recognition performance, in the second approach, a Modular Neural Network (MNN) with score level fusion is proposed. Finally, in order to reduce the FAR and FRR of the recognition system, a hybrid approach based on MNN and Fuzzy Inference System is presented.

The investigation and experimentations carried out in this thesis demonstrate that the proposed hybrid approaches for iris recognition outperform some of the existing approaches in terms of computational time, False Acceptance Rate (FAR), False Rejection Rate (FRR) and accuracy over the considered iris image databases.

Keywords: Biometric System, Iris Recognition System, Soft Computing Techniques, Score Level Fusion