Chapter 24
An Efficient and Automatic Iris Recognition System Using ICM Neural Network

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ABSTRACT

Iris recognition has been shown to be very accurate for human identification. In this chapter, an efficient and automatic iris recognition system using Intersecting Cortical Model (ICM) neural network is presented which includes two parts mainly. The first part is image preprocessing which has three steps. First, iris location is implemented based on local areas. Then the localized iris area is normalized into a rectangular region with a fixed size. At last the iris image enhancement is implemented. In the second part, the ICM neural network is used to generate iris codes and the Hamming Distance between two iris codes is calculated to measure the dissimilarity. In order to evaluate the performance of the proposed algorithm, CASIA v1.0 iris image database is used and the recognition results show that the system has good performance.

INTRODUCTION

Today, biometrics is a common and reliable way to authenticate the identity of a living person based on physiological or behavioral characteristics. A physiological characteristic is relatively stable physical characteristics, such as fingerprint, iris pattern, facial feature, etc. (Jain, Bolle, & Pankanti, 1999; Wayman, 2001). The human iris is an annular part between pupil and sclera and its complex pattern contains many distinctive features such as arching ligaments, furrows, ridges, crypts, and a zigzag collarette. Iris
structure patterns are different for different persons even if they are twins or multiple births. At the same time the iris is protected from the external environment behind the cornea and the eyelid. No subject to deleterious effects of aging, the small-scale radial features of the iris remain stable and fixed from about one year of age throughout one’s life. All these advantages let the iris recognition be a promising topic of biometrics and get more and more attentions (Boles, 1998; Daugman, 1993; Liam, 2002; Lim, 2001; Ma, 2002; Tisse, 2002; Wilds, 1997).

In Daugman’s (1993) system an Integro-differential operator was used to locate the iris. And 2D Gabor filters and phase coding were used to obtain 2048 binary feature code for the iris representation. In order to measure the dissimilarity between two irises, the Hamming Distance is computed between the pair of iris codes.

Different from Daugman, Wildes (1997) exploited the gradient-based Hough transform for localizing the iris area, and made use of Laplacian pyramid constructed with four different resolution levels to generate iris code. The degree of similarity is evaluated with the normalized correlation between the acquired and database representations.

Boles (1998) used the knowledge-based edge detector for iris localization, and implemented the system operating the set of 1-D signals composed of normalized iris signatures at a few intermediate resolution levels and obtaining the iris representation of these signals via the zero-crossing of the dyadic wavelet transform. It made use of two dissimilarity functions to compare a new pattern and the reference patterns.

Lim (2001) exploited 2D Haar wavelet transform to extract high frequency information of iris to form an 87-bit code and implemented the classification using a modified competitive learning neural network. A bank of Gabor filters was used to capture both local and global iris characteristics in Ma’s (2002) algorithm. And the iris matching is based on the weighted Euclidean distance between the two corresponding iris vectors.

Monro (2007) uses the discrete cosine transform for feature extraction. They apply the DCT to overlapping rectangular image patches rotated 45 degree from the radial axis. “The differences between the DCT coefficients of adjacent patch vectors are then calculated and a binary code is generated from their zero crossings.” (Monro, 2007 pp.590).

In our research, a method based on local areas of pupil and iris is used to complete iris location quickly at first. Then the located iris region is normalized into Polar coordinates from Cartesian. In order to extract iris features such as furrows, ridges, crypts, freckles and so on, the Intersecting Cortical Model (ICM) neural network is used. In our system, the normalized iris is put into ICM neural network after enhancement processing. And the output pulse image produced by ICM neural network is chosen as the iris code. At last the Hamming Distance is computed to measure the dissimilarity of two iris images.

IRIS IMAGE PREPROCESSING

The iris image preprocessing part includes three steps: iris location (pupil location and iris outer boundary location), normalization and iris enhancement.