OPTIMIZATION IN IRIS RECOGNITION

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Abstract

Iris recognition is emerging as one of the important methods of biometrics-based identification systems. Biometric verification systems employing images of the iris are claimed to be extremely accurate, yielding no false accepts at any reasonable false reject rate. This paper demonstrates that a more accurate iris segmentation helps to improve the overall system performance, and that the inaccuracy of iris segmentation and noise detection could be partly compensated for with optimizations in the matching stage.

Keywords: Iris, Segmentation, Optimization, Image Processing

1. 0 Introduction

Biometrics refers to the identification and verification of human identity based on certain physiological traits of a person. The commonly used biometric features include speech, fingerprint, face, handwriting, gait, hand geometry etc. The face and speech techniques have been used for over 25 years, while iris method is a newly emergent technique.

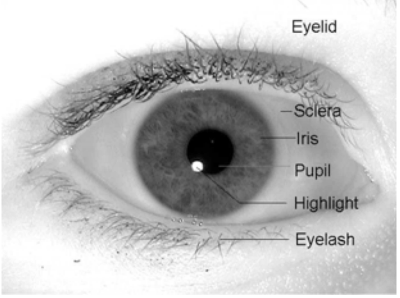

Fig 1: Iris image

The iris is the colored part of the eye behind the eyelids, and in front of the lens[Fig.1]. It is the only internal organ of the body which is normally externally visible. These visible patterns are unique to all individuals and it has been found that the probability of finding two individuals with identical iris patterns is almost zero. Though there lies a problem in capturing the image, the great pattern variability and the stability over time, makes this a reliable security recognition system.

2.0 Background

A complete iris recognition system can be split into four stages: data acquisition, segmentation, encoding and matching. The data acquisition step captures the iris images. Infra-red illumination is used in most iris image acquisition. The iris segmentation step localizes the iris region in the image. For most algorithms, and assuming near frontal presentation of the pupil, the iris boundaries are modeled as two circles, which are not necessarily concentric. The inner circle is the pupillary boundary (between the pupil and the iris). The outer circle is the limbic boundary (between the iris and the sclera). The noise processing is often included in the segmentation stage. Possible sources of segmentation noise are eyelid occlusions, eyelash occlusions, specular highlights, and shadows. Most segmentation algorithms are gradient based; that is, they involve finding the edges between the pupil and iris, and the iris and sclera.

The encoding stage encodes the iris image texture into a bit vector code. In most algorithms[1], filters are utilized to obtain information about the iris texture. Then the outputs of the filters are encoded into a bit vector code. The corresponding matching stage calculates the distance between iris codes, and decides whether it is a match (in the verification context), or recognizes the submitted probe iris from the subjects in the gallery set (in the identification context).

3.0 Image preprocessing

An iris image, as shown in Figure 1, contains not only the region of interest[4] (iris) but also some ‘unuseful’ parts (e.g. eyelid, pupil etc.). In addition, a change in the camera-to-eye distance may result in the possible variation in the size of the same iris. Furthermore, the brightness is not uniformly distributed because of non-uniform illumination. Before extracting features from the original image, the image needs to be preprocessed to localize iris, normalize iris, and reduce the influence[4] of the factors mentioned above. Such preprocessing is described in the following subsections.

4.0 Iris localization

Both the inner boundary and the outer boundary of a typical iris can approximately be taken as circles. [2]However, the two circles are usually not co-centric. The iris is localized in two steps: (1) approximate region of iris in an image can be found by projecting iris image in horizontal and vertical direction. (2) the exact parameters of these two circles are obtained by using edge detection and Hough transform in a certain region determined in the first step.

5.0 Iris Normalization

Irises from different people may be captured in different size, and even for the iris from the same person, the size may change because of the variation[4] of the illumination. and other factors. Such elastic deformations in iris texture affect the results of iris matching. For the purpose of achieving more accurate recognition results, it is necessary to compensate for these deformations. Here, we anticlockwise unwrap the iris ring to a rectangular block of texture of a fixed size (64x512) by piecewise linear mapping. The distortion of the iris caused by pupil dilation can thus be reduced.

6. 0 Existing Algorithms

Daugman's technique and Wildes' system are two of the earliest and best known iris recognition systems[2]. The systems include every stage of iris recognition as described here: image acquisition, segmentation, texture encoding, and matching. There are many other works in the field of iris recognition in recent years. Most of these focus on proposing a new method, or optimizing for a specific one or more stages in iris recognition.

The algorithm of Boles and Boashash extracts a set of one dimensional signals from the iris image using the intensity values on a set of circular contours centered at the pupil center, which is located using edge detection techniques.

7.0 Optimizations in Iris Segmentation

Optimizations in all the stages are very important for recognizing the iris. The following optimization technique yields a marginally superior results during the experimental studies in the segmentation and Eyelid Detection.

Overturn the Iris Boundary Detection Order

The ICE baseline code detects the limbic iris boundary first, then it detects the pupillary iris boundary by looking for peaks in the Hough space that fall. This section is based on the paper Experiments with An Improved Iris Segmentation Algorithm within the detected limbic boundary. However, compared to the limbic boundary, the pupillary boundary is relatively easier to localize for following reasons.

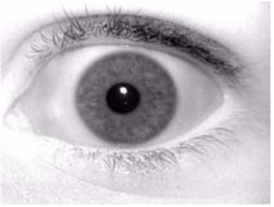

Fig.2(a) Initial Iris Image

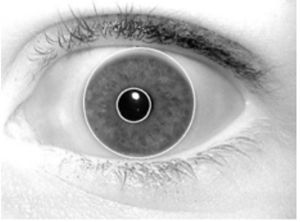

Fig 2(b): Final Iris Image

The contrast between the iris[Fig 2(a) and Fig 2(b)] and the pupil is usually stronger than the contrast between the sclera and the iris. Then, in an iris image captured by the Iris acquisition system, the pupil is always the largest dark area with a specular highlight within it. Also, the pupillary boundary is influenced less by eyelid and eyelash noise. So overturn the order of boundary detection in the Hough space relative to the ICE implementation[3]. By detecting the more reliable boundary first and constraining the search for the second boundary based on the first, performance is improved. After the pupillary boundary is detected, the limbic boundary will be detected in an area centered at the detected pupil.

8.0 Conclusion

The personal identification technique developed by John Daugman was implemented with a few modifications. In this paper, a new and effective algorithm for optimization in iris recognition during the segmentation stage is explored. It increases the efficiency of the recognition of Iris Images.

Reference

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Short Biography

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