A METHOD FOR NOISY IRIS SEGMENTATION

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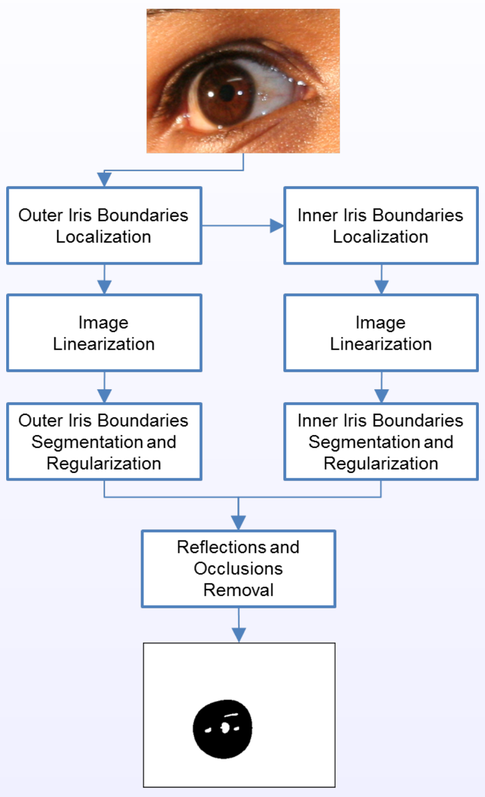
Abstract

We present an innovative algorithm for the segmentation of the iris in noisy images, with boundaries regularization and the removal of the possible existing reflections. The method achieves the iris segmentation by three main steps: estimation of the pupil and iris centers; iris boundaries extraction, linearization, and regularization; detection of reflections and occlusions. The proposed algorithm ranked seventh in the international Noisy Iris Challenge Evaluation (NICE.I) [1].

The proposed approach

The proposed approach can by described by the following schema.



Centers and radii

As a first step, the centers of the inner and outer iris boundary are identified by using a classical method based on a intro-differential technique [2].

References

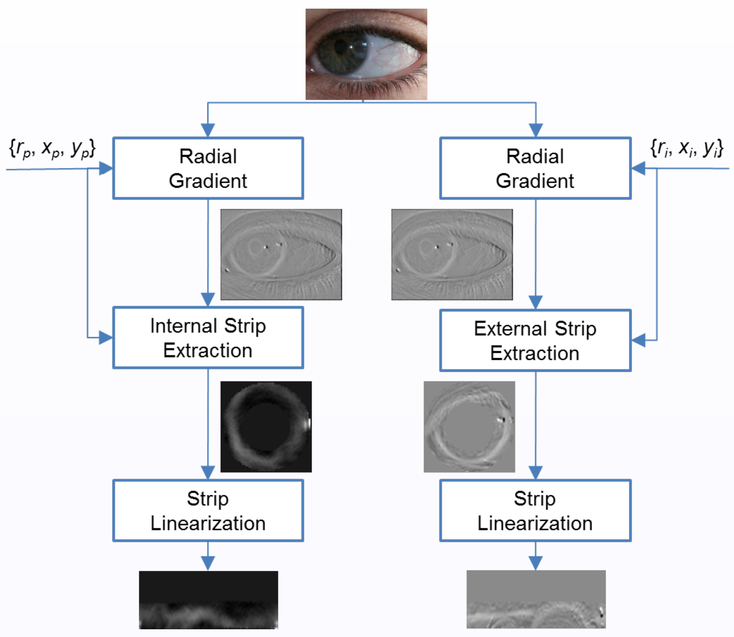
[1] Proença H., Alexandre L.A., The NICE.I: Noisy Iris Challenge Evaluation - Part I, in *IEEE International Conference on Biometrics: Theory, Applications and Systems*, 2007

[2] Daugman J., How iris recognition works, in *IEEE Transactions on Circuits and Systems for Video Technology*, 2004

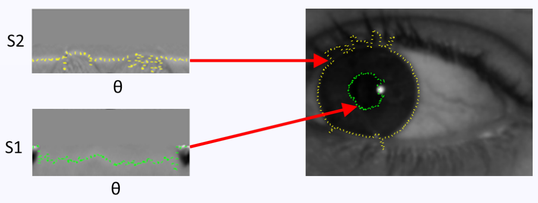
[3] Biometric Ideal Test (BIT), http://www.idealtest.org/

Iris boundaries

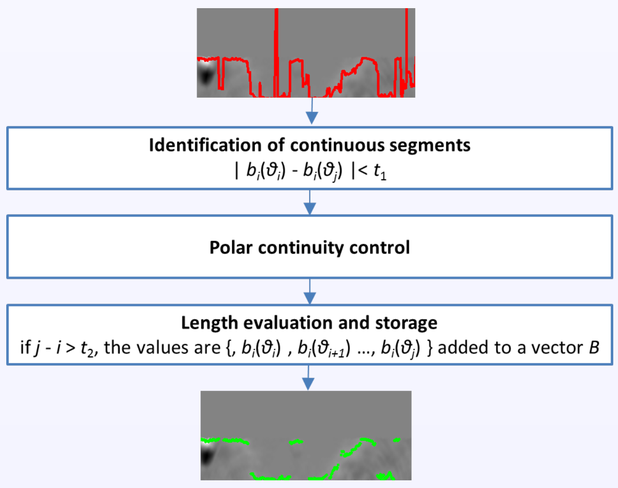
First, two image strips containing the boundary of the inner and outer edge of the iris pattern are computed.



The iris boundaries are extracted by selecting the position of the maximum in each column in the corresponding extracted strips.



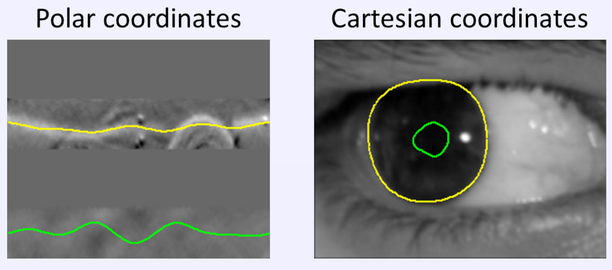
The outliers are then estimated and removed.



Finally, the estimated boundaries are regularized by considering the first M Fourier coefficients

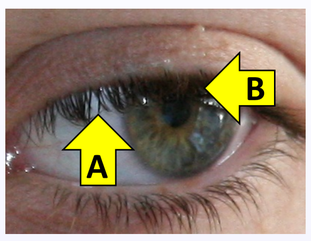
$$\tilde{b}(\theta) = \sum_{i=0}^{M-1} C_k \exp(-j(2\pi N)k\theta), \quad (1)$$

and converted in Cartesian coordinates.



Occlusions and reflections

We adopt different approaches for removing: separable eyelashes (A); not-separable eyelashes(B) and reflections.



The first methods is based on Gabor filters, and the second algorithm searches the areas with the highest local variance and then applies an iterative region growing technique.

Experimental results

Classification error on Validation dataset Nice.I:
- Total Classification error = 3,24%;
- False Positive ratio = 1.9%;
- False Negative ratio = 21.3%.

We tested a complete biometric recognition system based on this method on the CASIA-IrisV3-Interval dataset [3], obtaining satisfactory results.

Conclusions

The described method ranked seventh in the international Noisy Iris Challenge Evaluation (NICE.I) with 97 registered participants among universities and companies of more than 30 countries achieving an overall segmentation error of 3.01%.

Experiments enlightened that the performance of the method is mainly related to the correctness of the initial estimation of the centers of the inner and outer boundary of the iris.