Biometric based identification using retinal fundus images

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Abstract

We propose a methodology based on a physiological characteristic, the retinal vessel network, obtained with photographs of the fundus of the eye, for identification of individuals. The identification corresponds to determining the identity of an individual, using only the retinal fundus image of his left or right eye, from a dataset of retinal fundus images of known persons. The retinal vasculature is a reliable biometric parameter, since each person's eye is known to have a unique arrangement of blood vessels [1].

The proposed biometric based identification consists in retinal fundus image matching and essentially relies on a two-step image registration of the retinal blood vessel networks [2]: a multiscale affine registration followed by a multiscale elastic registration. The first step corresponds to an affine alignment of the two vessel network images of the two individuals to be compared, correcting the main distortions, as rotation, translation and scale. The solution of this first step is then used as the starting point in the multiscale elastic registration, which corrects the fine and local misalignments generated by non-rigid deformations inherent to the retina tissues and to the imaging process itself. In fact, the first step only accounts for rigid-like misalignments and it is unable to detect elastic deformations that are observed in many retinal images. Finally, we also define an appropriate decision identification measure, or equivalently a similarity measure, to serve as a binary classifier for deciding, after the registration process, whether a pair of retinal fundus images belongs or not to the same individual's eye.

The method is tested on a proprietary data set (provided by the company Retmarker, http://www.retmarker.com/) consisting of 21721 real pairs generated from 946 images of 339 different individuals, and acquired during an ongoing screening program in Portugal. The data set is composed of images of patients followed in the context of different retinal diseases and also healthy patients. The evaluation of the method's performance reveals a very low false rejection rate (FRR) at zero FAR (false acceptance rate), equal to 0.084, as well as a low equal error rate (EER), equal to 0.053. The obtained results also show a better performance of the proposed registration approach (as intuitively expected in particular when the pair of images to be matched exhibit non-rigid deformations), compared to the performance of a single multiscale affine registration. Moreover, and for comparison purposes with other existing approaches, the method is also tested on a second data set built from the publicly available data set VARIA.

The assessment of the performance of the proposed biometric method is very positive and suggests its future use in real-life applications as for instance in the framework of EHR (Electronic Health Records) or security systems.

Keywords: Retina identification, Retinal fundus images, Elastic image registration.

References

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