Abstract

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Automatic Detection of Landmarks and Abnormalities in Eye Fundus Images

The eye fundus is the only organ of the central nervous system of the human body that can be imaged directly since it can be seen through the pupil. Accordingly, experts have been applying digital image processing techniques to fundus images with the aim of identifying, locating, and analyzing the fundus landmarks such as the optic disc, macula, and blood vessels. Particularly, optic disc segmentation is a key element in automatic screening systems which facilitates the detection of lesions that affect the interior surface of the eye (i.e. fundus), such as glaucoma and diabetic retinopathy. Therefore, this research aimed to provide a fully automated technique for detecting and segmenting the optic disc. This research reviewed, categorized and compared the optic disc detection algorithms and methodologies in the literature, giving a description of each of them, highlighting their key points and performance measures. Having a concrete understanding of those previous studies, the proposed approach for segmenting the optic disc was presented. First, the fundus image was preprocessed in order to estimate the approximate location of the optic disc, excluding the positions that doubtfully contain the optic disc. Consequently, the top candidates for the optic disc were nominated and then ranked based on their strengths. Afterwards, the vessels density within each candidate was calculated and then weighted according to the candidate's strength, in which the top-scoring candidate was chosen to be the segmented optic disc. The proposed algorithm was tested and evaluated over nine diverse datasets containing a total of 1933 images. The segmentation algorithm proved its effectiveness by segmenting the optic disc correctly in 1831 images achieving a total sensitivity of 94.72% which was comparable to the results achieved by the other approaches. But more importantly, the implementation of the segmentation algorithm was fully automated regardless of the extreme heterogeneity of the tested datasets as no image-dependent parameters were adjusted, nor predefined templates were used for the sake of customizing the proposed algorithm over certain datasets.