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An efficient technique for retinal vessel segmentation and denoising using modified isodata and CLAHE (Article)

Khan, K.B.[a], Khaliq, A.A.[a], Shahid, M.[b], Khan, S.[c]

[a]Department of Electronic Engineering, International Islamic University, Chairman Office, Sector H-10, Islamabad, Pakistan
[b]Department of Electrical Engineering, Capital University of Science and Technology, Kahuta Road, Zone-V, Islamabad, Pakistan
[c]Department of Electrical and Computer Engineering, Faculty of Engineering, International Islamic University Malaysia, Jalan Gombak, Kuala Lumpur, Malaysia

Abstract

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Retinal damage caused due to complications of diabetes is known as a Diabetic Retinopathy (DR). In this case, the vision is obscured due to damage of tiny retinal blood vessels. These tiny blood vessels may cause leakage that affect the vision and can lead to complete blindness. Identification of these new retinal vessels and their structure is an essential for analysis of DR. Automatic blood vessel segmentation plays a significant role to assist subsequent automatic methodologies that aid to such analysis. In literature, most authors have used computationally-hungry strong preprocessing steps followed by a simple thresholding and postprocessing steps. This paper proposed an arrangement of simple preprocessing steps that consist of Contrast Limited Adaptive Histogram Equalization (CLAHE) for contrast enhancement and a difference image of green channel from its Gaussian blur filtered image to remove local noise or geometrical objects. The proposed Modified Iterative Self Organizing Data Analysis Technique (MISODATA) has been used for segmentation of vessel and non-vessel pixels based on global and local thresholding. Finally, postprocessing steps have been applied using region properties (area, eccentricity) to eliminate the unwanted regions/segments, nonvessel pixels, and noise. A novel postprocessing steps are used to reject misclassified foreground pixels. The strategy has been tested on the openly accessible DRIVE (Digital Retinal Images for Vessel Extraction) and STARE (STructured Analysis of the REtina) databases. The average accuracy rates of 0.952 and 0.957 with average sensitivity rates 0.780 and 0.745 along with average specificity rates of 0.972 and 0.974 were obtained on DRIVE and STARE datasets, respectively. The performance of the proposed technique has been assessed comprehensively. The acquired accuracy, robustness, low complexity, and high efficiency make the method an efficient tool for an automatic retinal image analysis. The proposed technique perform well as compared to the existing strategies on the online available databases in term of accuracy, sensitivity, specificity, false positive rate, true positive rate, and area under receiver operating characteristic (ROC) curve.

Author keywords

Denoising Diabetic retinopathy Drive Fundus imaging Stare Vessel segmentation

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Khan, K.B.; Department of Electronic Engineering, International Islamic University, Chairman Office, Sector H-10, Islamabad, Pakistan; email:kb.khattak@gmail.com