Exudates segmentation using inverse surface adaptive thresholding

Haniza Yazid a,*, Hamzah Arof b, Hazlita Mohd Isa c

a School of Mechatronic Engineering, Universiti Malaysia Perlis (UniMAP), Kampus Ulu Pauh, 02600 Arau, Perlis, Malaysia
b Electrical Engineering Department, Faculty of Engineering, University of Malaya, 50603 Kuala Lumpur, Malaysia
c Department of Ophthalmology, Faculty of Medicine, Universiti Kebangsaan Malaysia, Kuala Lumpur, Malaysia

ABSTRACT

This paper presents a new approach to detect exudates and optic disc from color fundus images based on inverse surface thresholding. The strategy involves the applications of fuzzy c-means clustering, edge detection, otsu thresholding and inverse surface thresholding. The main advantage of the proposed approach is that it does not depend on manually selected parameters that are normally chosen to suit the tested databases. When applied to two sets of databases the proposed method outperforms methods based on watershed segmentation and morphological reconstruction. The proposed method obtained 98.2 and 90.4 in terms of sensitivity for Standard Diabetic Retinopathy Database – Calibration Level 1 (DIARETDB1) and a local dataset provided by National University Hospital of Malaysia (NUHM), respectively.

1. Introduction

Patients with diabetes need annual screening to circumvent vision loss which may lead to blindness. Diabetic Retinopathy (DR) is a diabetic complication that causes changes in the retina. NPDR is a common, usually mild form of retinopathy that generally does not interfere with vision. However, the diabetic retinopathy can progress from non-proliferative (NPDR) to proliferative retinopathy (PDR) if left untreated. In order to prevent patients from partial vision loss or even blindness, early detection of the disease is crucial. However, screening each patient manually is time consuming and it relies on the availability of experts. Medical imaging can alleviate the burden on ophthalmologists by assisting them in detecting lesions that appear in the retinal images. With the advent of medical image analysis, many researchers advocate the use of medical imaging in the detection process. The automated screening tool can highlight any forms of lesions caused by diabetic retinopathy instantly and thus reduce the processing time considerably. The images deemed suspect to showing signs of severe diabetic retinopathy will be further examined by the ophthalmologist.

NPDR is an early stage of DR. There are several lesions that may be present in NPDR namely microaneurysms, hemorrhages, exudates and cotton wool spots. Microaneurysms are small aneurysms of the blood vessels. They appear on the retina as very small dots and have the same color as the blood vessel. The diameter of microaneurysms is around 1–3 pixels [1]. Hemorrhages may appear in blot, dot or flame shape. Microaneurysms and hemorrhages appear in the same color as the blood vessel. The diameter of microaneurysms is around 1–3 pixels [1]. Hemorrhages may appear in blot, dot or flame shape. Microaneurysms and hemorrhages appear in the same color as the blood vessel. They can be distinguished from the color and sharpness of the boundary. Besides those, an optic disc also appears as bright yellowish spot and it has a slightly oval or circular shape.