Identification of Microaneurysms by Using Spatial Shade Correction and Wavelet Transform

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Abstract

Diabetic Retinopathy (DR) is a serious complication of diabetes. It causes to a loss of vision in diabetic patients. The earlier stage of DR is diagnosed, the more successful the patients will be cured. This paper proposes a method to identify microaneurysms (MAs) in fundus image by using spatial shade correction and removal of vessels in wavelet domain. The spatial background is estimated and removed from the original image. Vessels are defined as the connected edges in directional wavelet subbands. The inversed transform image without vessel coefficients is then finally correlated to the shade corrected image. The output image show prominent microaneurysms.

Keywords: shade correction, wavelet transform, vessel removal, identification of microaneurysms

1. Introduction

Nowadays the number of diabetic patients is increasing as WHO estimates the number of them will reach 366 million in 2030 [1]. The diabetic patients are probably at risk of having diabetic retinopathy (DR) which causes blindness. DR becomes a serious problem in public health because the patients do not realize until they lose their vision. By the way, a research shows that at least 90% of new DR patients could reduce their risk if they are given a proper and vigilant treatment to monitor their eyes [2]. This kind of treatment needs ophthalmologist which is limited in number and not enough for the patients. So it is necessary to have an automatic system to prevent and monitor to diabetic patient.

Microaneurysm, the first state symptoms of DR, is an extremely small aneurysm. Characters of microaneurysm in fundus image are circular shape with diameter less than 125 µm, appear as a dark and small pattern in green channel in RGB color model.

The difficulty in Automatic MAs detection in fundus image is luminosity and low contrast. Thus, reducing luminosity and enhancing contrast are proposed to be the solution of the difficulty. Shade correct was introduced to reduce the luminosity in 1996 [3] by estimating background and subtracting it by image. Background estimation is done by using large of mean filter, median filter [4],[5],[6], Gaussian filter and low pass filter then remove dark lesson such as vessel by using morphological closing in spatial domain. By the way, morphological closing reaches to error matching because the result from morphological closing contains not only MAs, but also parts of vessel caused by non-complete removed vessels. The residual of non-complete removed vessels sometimes have patterns like MAs, so it may be treated like MAs. Moreover, some MAs are removed from image by morphological closing because they appear nearby the vessel.

This paper focuses on identification of candidate region that contains microneurysm (MAs) by using shade correction and vessel removal in spatial domain based on the information from wavelet domain.

2. Microaneurysms in fundus images

Microaneurysms (MAs) are one of the first lesions visible in diabetic retinopathy. It occurs by swelling in the wall of a blood vessel. In fundus image, MAs appear as a dark lesion and seen clearly in green channel in RGB color model. They have small circular shape located near capillary blood vessels. As capillary blood vessels are not visible in fundus image, they appear as an isolated pattern.