Automatic Detection of Vascular Lesions of the Retina Using a Localized Adaptive Thresholding Approach

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I created a software application that, when integrated with an optical addendum to smartphones, allows for mobile pre-screening for ocular diseases in almost any setting. Early detection of vascular lesions such as exudates, hemorrhages, and tumors in the retina is important for early diagnosis of diabetes, hypertension, and cancer. Diabetic retinopathy (DR) is the leading cause of adult blindness in the United States, and the presence of exudates in fundus imagery (images of the retina) is an early sign of DR. Early detection of DR decreases the risk of severe vision loss by greater than 90%. I present a novel technique developed in MATLAB and adapted from radar imagery analysis to automatically detect lesions in fundus imagery that is robust against spatial and temporal variations of background noise. The detection threshold is adjusted dynamically based on the local noise statistics around the Pixel-Under-Test in order to maintain a pre-determined, constant false alarm rate (CFAR). A pre-processing step accommodates the detection of bright lesions (exudates) as well as dark lesions (hemorrhages and tumors). In this novel application to fundus imagery, the algorithm addresses the challenge of detecting lesions in color and multispectral fundus imagery where the background clutter often exhibits variations in brightness and texture. These variations present challenges to common, global thresholding detection algorithms. Performance of the adaptive-threshold CFAR algorithm is assessed using a publicly available, annotated, DR database. Performance of the CFAR detector is presented and proves to be superior to more common detection techniques such as Otsu thresholding.

Awards Won:

Fourth Award of $500