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Review Article

A Review on the Extraction of Quantitative Retinal Microvascular Image Feature

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Digital image processing is one of the most widely used computer vision technologies in biomedical engineering. In the present modern ophthalmological practice, biomarkers analysis through digital fundus image processing analysis greatly contributes to vision science. This further facilitates developments in medical imaging, enabling this robust technology to attain extensive scopes in biomedical engineering platform. Various diagnostic techniques are used to analyze retinal microvasculature image to enable geometric features measurements such as vessel tortuosity, branching angles, branching coefficient, vessel diameter, and fractal dimension. These extracted markers or characterized fundus digital image features provide insights and relates quantitative retinal vascular topography abnormalities to various pathologies such as diabetic retinopathy, macular degeneration, hypertensive retinopathy, transient ischemic attack, neovascular glaucoma, and cardiovascular diseases. Apart from that, this noninvasive research tool is automated, allowing it to be used in large-scale screening programs, and all are described in this present review paper. This paper will also review recent research on the image processing-based extraction techniques of the quantitative retinal microvascular feature. It mainly focuses on features associated with the early symptom of transient ischemic attack or sharp stroke.

1. Introduction

One of the most important subfields of biomedical engineering is the analysis of fundus retinal images. Analysis of the human fundus eye images has become the key point for diagnosing the various pathologies of retinal vasculature. Furthermore, image analysis provides a simple and noninvasive visualization of the retinal blood vessels in those high risk ophthalmologic medical conditions [1–3].

The fundus retinal images are directly captured from human eye that includes some other landmarks like microcirculation system of the retina, macula, optic disc, fovea, microaneurysm, and exudates [4]. This cost-effective, simple image acquisition system can be used in the large-scale screening programs and retinal image analysis developing mathematical and computational techniques. In addition, physicians can benefit from this technique as to objectively assess abnormal symptoms such as vessel tortuosity, vessel width, bifurcation angles, branching angles, and vessel caliber. All these features are useful for early detection of hypertensive and diabetic retinopathy, macular degeneration, acute stroke, neovascular glaucoma, and some other cardiovascular diseases [1, 3, 5–9].

Some distinct changes in the retinal microvasculature are recognized as the preindicator of subsequent vascular incidents like ischemic stroke or acute stroke [10]. It was