Chapter 9

A Comparative Study on Diabetic Retinopathy Detection Using Texture-Based Feature Extraction Techniques

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ABSTRACT

Diabetic retinopathy is proved to be one of the most important eye disorders in recent decades that late diagnosis of it may cause low vision or even blindness. Specialists are able to detect retinopathy in retinal images using machine learning as a decision support system which helps accelerate and facilitate the diagnosis. The automated diabetic retinopathy is a difficult computer vision problem—with the goal of detecting features of retinopathy. The present chapter is written with the purpose of analyzing and comparing different feature extraction methods to evaluate the best algorithm for detection retinopathy with least error. Extracted features using these methods are used to classify images into normal and altered groups.

INTRODUCTION

In recent years, machine learning and data mining techniques have been considered as good tools for automated medical diagnosis systems (Kononenko, 2001; Kononenko, Bratko, & Kukar, 1997). Bearing in mind that medical diagnosis is a difficult and visual task, it is often carried out by an expert who commonly takes decisions by evaluating the current test results of a patient or comparing the patient
with other patients of the same condition by referring to the previous decisions (Polat & Güneș, 2006). Therefore, medical diagnosis is considered as an important but complicated process that requires to be executed accurately and effectively. Machine learning can help experts automate diagnosis and accordingly, reduce the possibility of error in experts dramatically. And, as a result, providing them with more detailed medical data inspected in a shorter time.

Detection of different disease using machine learning methods has been considered in various research works. Such attempts include diagnosis of hepatitis (Bascil & Oztekin, 2012), using neural network, Breast Cancer least square support vector machine (Polat & Güneș, 2007), and heart disease using artificial immune recognition system (Polat, Güneş, & Tosun, 2006).

Nowadays, diabetic retinopathy is the leading cause of blindness in adults all around the world. Most people with diabetes will develop some form of eye disease (retinopathy) causing reduced vision or blindness. Consistently high levels of blood glucose, together with high blood pressure and high cholesterol, are the main causes of retinopathy which can be managed through regular eye checks and keeping glucose and lipid levels at or close to normal (“International federation diabetes,” 2014). Therefore, the Importance of early diagnosis of diabetes based on analysis of retinal images is increasing as this disease is affecting more people every day (Klein, Meuer, Moss, & Klein, 1995). As aforementioned, diabetic retinopathy (DR) has a fundamental role in visual impairment, and automated detection of diabetic retinopathy can reduce its lesion.

Regarding the importance of diagnosing the disease, a great deal of attempt has been made to utilize different methods of machine learning to diagnose diabetic retinopathy from retinal images. The process of detection of disease in images using these methods has two steps roughly. First, it should extract some features from images to describe the nature of image. The second step is the classification of these features using a classifier. There are a variety of methods to perform these two steps. Some researchers focus on improving the diagnosis using defining better features, while others outperform different classification methods. (Di Wu, et al, 2006) use Gabor filters to trace and patch the blood vessels together (Wu, Zhang, Liu, & Bauman, 2006). Pinz et al,(Pinz, Bernögger, Datlinger, & Kruger, 1998) use gradient based techniques and hough transforms (Illingworth & Kittler, 1988) to map and localize blood vessels. (Silberman et al, 2010) utilize SIFT feature extractor to describe the images. The second step support machine classifier(SVM) (Conforti & Guido, 2010) is considered to classify the features(Silberman, Ahrlich, Fergus, & Subramanian, 2010). Neovascularization features extracted from retinal images are among other features in this area. (Vatanparast & Harati, 2012) has classified these features using SVM.

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In another work, the optic disc is detected by means of morphological filtering techniques and the watershed transformation (Walter, Klein, Massin, & Erginay, 2002). Also (Hoover & Goldbaum, 2003) used fuzzy convergence to determine the origination of the blood vessel network. Some work is performed on vessel segmentation (Niemeijer, Staal, van Ginneken, Loog, & Abramoff, 2004). Retinal vessel segmentation is important for the detection of numerous eye diseases and plays an important role in automatic retinal disease screening systems. (Niemeijer et al., 2004) compared the performance of