Image Mining in IRIS: Integrated Retinal Information System

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Abstract

There is an increasing demand for systems that can automatically analyze images and extract semantically meaningful information. IRIS, an Integrated Retinal Information system, has been developed to provide medical professionals easy and unified access to the screening, trend and progression of diabetic-related eye diseases in a diabetic patient database. This paper shows how mining techniques can be used to accurately extract features in the retinal images. In particular, we apply a classification approach to determine the conditions for tortuousity in retinal blood vessels.

1. Introduction

Retinopathy is a common cause of blindness among the diabetic patients. Regular diabetic retinal eye screenings are needed to detect early signs of retinopathy so that appropriate treatments can be rendered to prevent blindness. With the large number of patients undergoing screenings, a tremendous amount of time and effort is required for the medical professionals to analyze and diagnose the fundus photographs.

In this paper, we will demonstrate how IRIS, an Integrated Retinal Information System, applies state-of-the-art data mining and image processing techniques on the retinal images to aid in the screening process.

2. Image Classification

An abnormal retinal image has one or more of the following signs of retinopathy (Figure 1):

1. Optic disc is not visible or not circular. The optic cup is disproportionately larger than the optic disc.
2. Blood vessels become tortuous, i.e. dilated and wavy.
3. Lesions of varying size and shape in the intervascular region.

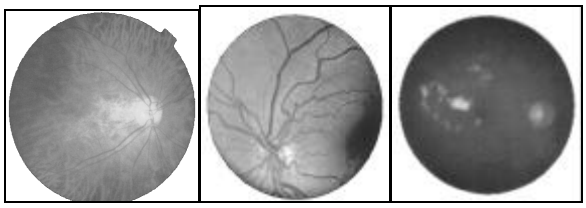

Figure 1. Abnormal retinal images.

3. Tortuous Vessels

An early sign of diabetic retinopathy is the appearance of tortuous blood vessels. To determine whether the vessels are tortuous, we traverse the center (skeleton) lines of the extracted vessels and tabulate the curvatures of the outlines (using 12 attributes based on 4 curvature definitions). We extracted a total of 990 main vessel segments out of the 300 retinal images. Our initial study shows that no one single definition is able to give a reliable and consistent indication of the overall measure of tortuosity of the vessel segment under consideration. In IRIS, we combine all the 12 attributes extracted and feed them into an association based data mining classification tool, CBA [1]. The output of CBA consists of a set of classification rules that can accurately classify the input vessel segments as *Normal* or *Abnormal*. Figure 2 shows an example of the detected tortuous vessel by the system.

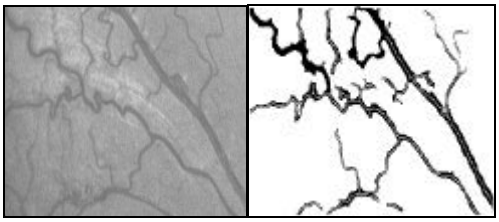

Figure 2. Detection of tortuous vessels (thicken portions).

Reference

[1] Liu B, Hsu W, Ma Y, 'Integrating Classification and Association Rule Mining.' *Proc. 4th Int. Conf. KD. and DM. (KDD-98, Plenary Presentation)*, New York, USA, 1998.

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