RETINAL VESSEL SEGMENTATION USING IMPROVED MATCHED FILTERING : EVALUATION ON A HIGH RESOLUTION FUNDUS IMAGE DATABASE.

INTRODUCTION:

Automatic assessment of retinal vessels plays an important role in the diagnosis of various eye, as well as systemic diseases. A public screening is highly desirable for prompt and effective treatment, since such diseases need to be diagnosed at an early stage. Automated and accurate segmentation of the retinal blood vessel tree is one of the challenging tasks in the computer-aided analysis of fundus images today. We improve the concept of matched filtering, and propose a novel and accurate method for segmenting retinal vessels. Our goal is to be able to segment blood vessels with varying vessel diameters in high-resolution colour fundus images. All recent authors compare their vessel segmentation results to each other using only low-resolution retinal image databases. Consequently, we provide a new publicly available high-resolution fundus image database of healthy and pathological retinas. Our performance evaluation shows that the proposed blood vessel segmentation approach is at least comparable with recent state-of-the-art methods. It outperforms most of them with an accuracy of 95% evaluated on the new database.

**OBJECTIVES OF THE PROJECT:**

Digital imaging using a fundus camera is widely considered an integral part of medical examination in ophthalmology. Standard fundus images contain various regions which can

be useful for diagnosis, such as the macula, which is usually examined in connection with age-related macular degeneration; the optic disc for examination of glaucoma; and vascular structures, which are mostly evaluated in the context of diseases affecting the circulatory

system

Several pathologies affecting the retinal vascular structures due to diabetic retinopathy can be found in fundus images using precisely segmented blood vessels. Moreover, automatic retinal vessel segmentation algorithms can be useful in the evaluation of other diseases, such as arteriolar narrowing and vessel tortuosity due to hypertensive retinopathy or glaucoma.

METHODS

Previously, low resolution fundus images were used for the research analysis. The proposed method uses a publically available high resolution dataset of fundus images for analysis and produces more accurate results. This database contains three sets of fundus images : one of

Healthy retinas , one of glaucomatous and one of DR retinas. The second and third groups , thus , allow evaluation of the segmentation methods in the case of pathological retinas.

The preprocessing step consists of illumination correction and Contrast equalisation of the fundus images in preparation for further analysis. Only the green channel of an RGB image is utilised, since this channel has the highest contrast between blood vessels and other retinal structures. The segmentation of blood vessels in the preprocessed image utilises a MF approach. Five two-dimensional filters were designed according to typical blood vessel cross-sectional intensity profiles, whereas five different blood vessel widths

were considered – from the thinnest to the thickest retinal vessels. The preprocessed image is convolved with each of the five kernels, each of which is rotated into 12 different orientations. The resulting parametric images are then fused so that the locally maximum response is selected for each pixel. The fused parametric image is then thresholded to obtain a binary map of the blood vessel tree. This is thenfurther cleaned using morphological operators to remove small or short artefacts due to noise or other image

structures that do not belong to the vascular tree.

EXPECTED RESULTS

The presented blood vessel segmentation method was primarily evaluated using the new HRF database containing Hand - labelled images.



