Segmentation in the Retinal Blood Vessel and Recognition using the Gabor Filter

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Abstract: Computer-aided medical diagnostic system design is an emerging to assists medical practitioners for providing quick and accurate diagnosis and prognosis of pathology In this Database, we study new methods to analyze digital fundus images. In particular, we concentrate on the development of the algorithmic components of an automatic screening system for diabetic retinopathy. The techniques developed can be categorized broadly in quality assessment and improvement, lesion segmentation. firstly, we present a fast algorithm to numerically calculate approximately the quality of a single image by employing vasculature and color-based features, that is we convert given image to respective Red, Green and Blue components (RGB) additionally, we show how it is possible to increase the image quality and remove reflection artifacts by merging information gathered in multiple fundus images (which are captured by changing the stare point of the patient). It is seen in the images that the blood vessels are best visible in Green component of image. Then the green image is converted into grayscale image and enhanced. Using Gabor Filter is used for edge detection as it is seen that the Frequency and orientation representations of Gabor filters are similar to Human Visual system. Under certain conditions the phase of the response of Gabor filters is approximately linear and these properties serves the best use in detection of edges and then we can easily identify the swelling of the macular.

Keywords: Gabor filter, Retinal image, Detection of blood vessels.

Introduction

The Eye and Retina

Analysis of the retinal blood vessels from fundus images has been widely used by the medical community for diagnosing complications due to hypertension, arteriosclerosis, cardiovascular disease, glaucoma, stroke and diabetic retinopathy (DR). According to the American Diabetes Association, DR and glaucoma are the leading causes of acquired blindness among adults aged 20-74 years with estimates of 4.2 million Americans having DR and 2.3 million having glaucoma in 2011. Automated blood vessel segmentation systems can be useful in determining variations in the blood vessels it is based on the vessel branching patterns, vessel width, twisted form and vessel density as the pathology progresses in patients. Such analyses will guide research towards analyzing patients for hypertension, variability in retinal vessel diameters due to a history of cold hands and feet and flicker responses. Existing automated detection systems for non-proliferative DR detection require masking of the vasculature to ensure that the blood vessels are not mistaken for red lesions that are caused by DR. Also, automated detection of proliferative DR requires analysis of the density, vessel width and tortuosity of the blood vessels. A fast and accurate segmentation algorithm for detecting the blood vessels is necessary for such automated detection and screening systems for retinal abnormalities such as DR. Some existing unsupervised vessel segmentation methods have achieved up to 92% segmentation accuracy on normal retinal images by line-detector and template matching methods that are computationally very fast. However, increasing the segmentation accuracy above 92% for abnormal retinal images with bright lesions (exudates and cotton wool spots), or red lesions (hemorrhages and microaneurysms), or variations in retinal illumination and contrast, while maintaining low computational complexity is a challenge. In this chapter we separate the vessel segmentation problem into two parts, such that in the first part, the thick and predominant vessel pixels are extracted as major vessels and in the second part, the fine vessel pixels are classified using neighborhood-based and gradient-based features. Vision is arguably the most used of the five senses in the human body. The considerable portion of the brain is dedicated completely to visual processing. The eye is capture image and convert it into light form information that understandable by the brain and lenses are to focus the incoming light. A captured image create a picture by the use of camera, whereas the eye uses a particular layer of cells, called the retina, to produce an fundus image. We are using some method like matched filtering and vessel tracking. Matched filtering: In this method we are using ant-based clustering. In as much as ant-based algorithms or MF algorithms are proper to extract blood vessels, with the help of hybrid form can get better the accuracy and false/true ratios performance of the ensuing images. The Final result is out with the combination of different threshold applied which is provided by the particular threshold.

Vessel tracking
in this method we can use vessel center lines to obtain vascular structure. Starting from an early set of points placed automatically or by manual, with the help of candidate pixel vessels are traced from those close to that currently under evaluation. Supervised methods are based on pixel categorization. each pixel is classified into vessel and non-vessel, introduced using ridge-based vessel detection and Gabor filters methods .

Ridge-based vessel detection
vessels are extended structures and it was the based upon the supervised method of ridge-based vessel segmentation. Each image assign the pixel then compare the closed pixel then find out the best one and image is segmentation into the patches.

Retina Imaging Technique

Ophthalmologists conventionally imaged the eye using ophthalmoscopes which allowed for the determination of the health of the retina and vitreous humour. There are two types of ophthalmoscopes: direct and indirect. The form is an instrument about the size of a small flashlight with several lenses that can enlarge up to about 15 times, the latter is mounted on a headband and it provide a wider view of the fundus of the eye. Relatively recently, fundus cameras were successfully introduced as an imaging technique. A fundus camera provides an upright, magnified view of the original image of the interior surface of the eye: the retina, optic disc, macula. Camera is views 30 to 50 degrees of retinal area, with a magnification of 2.5x, and allows some modification of this or auxiliary lenses from 15 degrees which provides 5x magnification to 140 degrees with a large angle lens which minimizes the image by half.of the image.

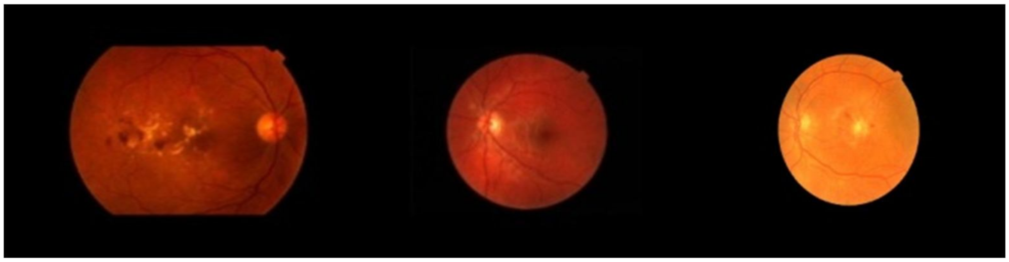

Figure1: Examples of retina fundus images (a) healthy patient; (b) retina showing signs of diabetic retinopathy (c)retina showing signs of age related macular degeneration

Recent paper describes the methods to detect main features of fundus images such as optic disk, fovea, and exudates and blood vessels. To determine the optic Disk and its centre we find the brightest part of the fundus and apply Hough transform. The candidate region of fovea is defined an area circle. gabor filter is basically used for the detection of blood vessels.
The objectives of this paper

- To segment the retina image into Red Green and Blue Components
- To compare the visibility of the components and find the best one
- To match the retina image with stored templates of blood vessels of retina

Quality of Fundus Retina Image
Various systems for automatic or semi-automatic detection of retinopathy with fundus images have been developed. The results obtained are promising but the initial image quality is a limiting factor. This is especially true if the machine operator is not a trained photographer. Algorithms to correct the illumination or increase the vessel contrast exist, however they can not store the image. On the other hand, a fast and accurate quality algorithm is take image automatically and it select the fundus image .The measurement of a precise image quality index is not a straight forward task, mainly because quality is vary the other parameters. In addition, image quality is depend upon the diagnosis. For example, an image with dark regions might be measured of good quality for detecting glaucoma but of bad quality for detecting diabetic retinopathy. Figure 2 shows some examples of macula centred fundus images whose quality is very likely to be judged as poor by many ophthalmologists. The reasons for this vary. They can be related to the camera settings like exposure or focal plane error (Figure2(a,e,f)), the camera condition like a dirty or shuttered lens (Figure2(d,h)), the movements of the patient which might blur the image (Figure2(c)) or if the patient is not in the field of view of the camera (Figure 2(g)). An outlier may be defined as any image that is not a retina image which could be submitted to the screening system by a mistake. Existing algorithms to estimate the image quality are based on the length of visible vessels in the macula region, or mistake.

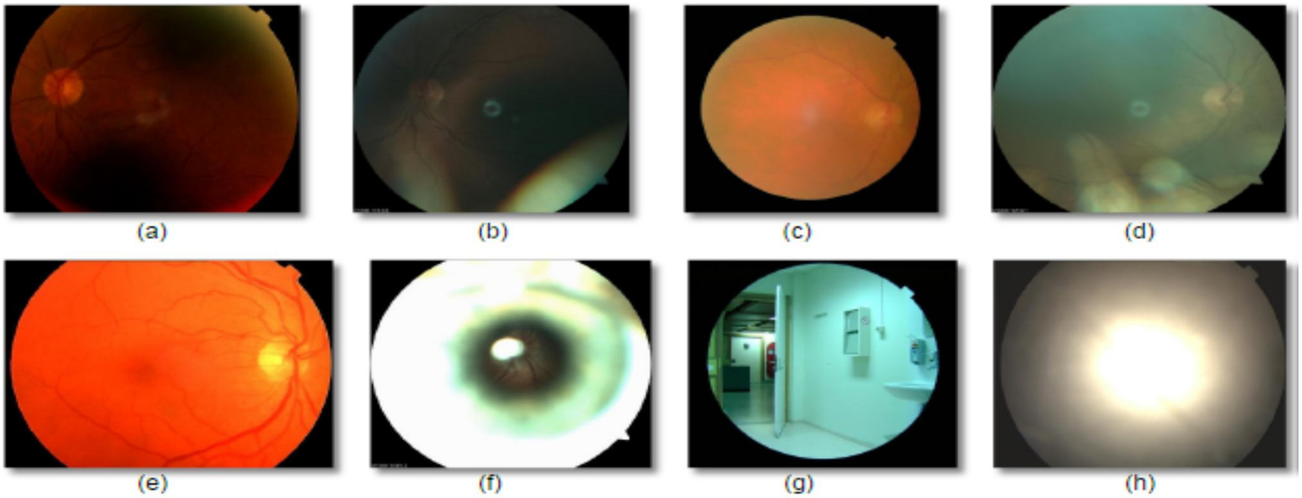

Figure2: Examples of Poor Quality Fundus Images. (a) Underexposed; (b) eyelid Arte facts; (c) blurred; (d) dirty lens; (e) overexposed; (f) out of focal plane; (g) no patient (outlier); (h) camera objective covered (outlier)

Existing algorithms to estimate the image quality are based on the length of visible vessels in the macula region, or edges and luminosity with respect to a reference image. Another method uses an unsupervised classified that employs multi-scale filter banks responses. The shortcomings of these methods are either the fact that they do not take into account the natural difference encountered in retinal images or according to time produce result.. This is not really flexible and is error free .In fact human experts are likely to dissimilar if several categories of image quality are used. Therefore, a quality measure between 0 and 1 seems the indicated the problem. Processing speed is another feature to be taken into consideration. While algorithms to review the disease state of the retina do not require to be generally fast (within reason), the time response of the quality evaluation method is to develop the automatic retinopathy screening system which allows real-time interactions with the photographer. Retina morphology methods employ features that are unique to fundus images to evaluate their quality.Usher et al. (2003) employ a vessel segmentation algorithm to estimate the image blurring. The area of the detected vessels is measured and directly correlated with image quality by the means of a hard threshold. Fleming et al. (2006a) presented a method that separately evaluates image clarity and field definition, which are finally combined to generate a global quality value. The image clarity was assessed taking into consideration the vessel area in the macula region, the field definition the relative position of fovea, ON and the length of the main vessel arcades. In “bag-of-words” the authors borrow a method typically used for document classification. They employ a pattern recognition classifier (such as Support Vector Machine, Naive Bayes, etc.) to classify the occurrence of some common “words”. These words are automatically generated from the raw features in test set with a unsupervised clustering algorithm (such as k-means). During the classification phase, the new raw features are associated to the known words based on their distance. Niemeijer et al.(2006) employed this approach with two sets of unrefined features of image quality: colour and second order image structure invariants (ISI). Colour is considered through the normalized histograms of the RGB planes, with 5 bins per plane. ISI are proposed by ter Haar Romeny (2003) who employed filte rbanks to generate features invariant to rotation, position or scale. Recently, Paulus et al. (2010) employed a different set of features: the pixel grey levels and the Haralick texture metrics .in this paper algorithm is used to detect the blood vessels of retina image.180 gabor filter is used to captured image and edges and used to threshold problem.RGB is input component and I(x,y)is the retinal intensity image.

$$I(x,y) = \frac{R_{\Gamma(x,y)} + G_{\Gamma(x,y)} + B_{\Gamma(x,y)}}{3}$$

Gabor filtering

Its is used for the pixel matching and edge detection and compare the vessel ,green channel compared into the red and blue(RGB).and green channel is processing.

Thresholding

It is used for separate of the image component to the binary and separate white or black pixel to evaluate the intensity value of greater or lesser. sensitivity(SE) and specificity(SP) are statically measures.SE is calculate the positive rate and SP is calculate negative rate. Matlab software is used external interface. It includes facilities for routines calling from MATLAB for calling MATLAB as a computational engine, and for reading and writing MAT-files. The STARE (Structured Analysis of the Retina) Database was conceive and initiated in 1975 by Michael Goldbaum, M.D., at the University of California, San Diego. It was found by the U.S. National Institutes of Health over thirty people contribute to the database, with setting ranging from medicine to science to engineering. Images and medical data were provided _at the University of California. methodology of the detection of retina blood vessel.

- Image capturing
- Enhancement
- segmentation into RGB component
- comparison
- visual green
- converting the image into grey scale image
- edge detection
- comparing the image with storage template matching and detection

Image enhancement is the provide the better input and the automatic image processing.segmentation is the portioning the image.first of all image is capured then the enhancement and segmentation into the RG. Converting the green to grey because easily detect the blood vessel.

Result

Given the fixed threshold check the performance of segmentation of blood vessels. evaluate the accuracy, specificity and sensitivity. Average time to required perform on stare database images is calculated and compared the other method. The result is segmentation is faster than the literature. Proposed method accuracy is 93.66and time 19s. present is 96.66 and time 30s.gabor filter is better than the other sensitive filters, steerable filters.

Figure 3(original image,.red channel)

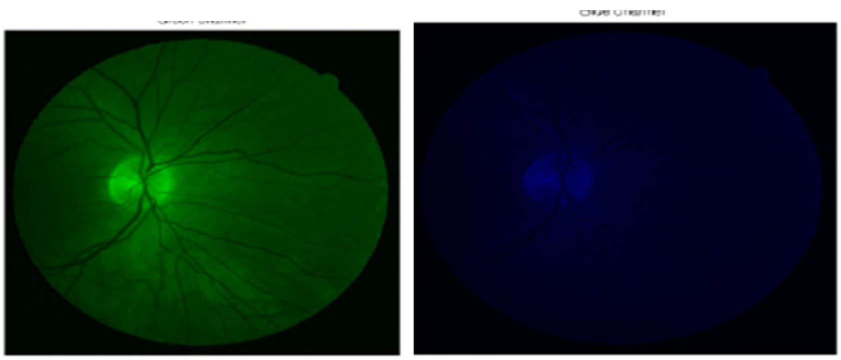

Figure.4(green and blue channel)

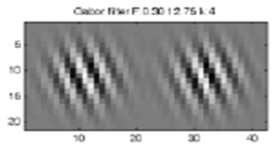

Figure 5(gabor filter)

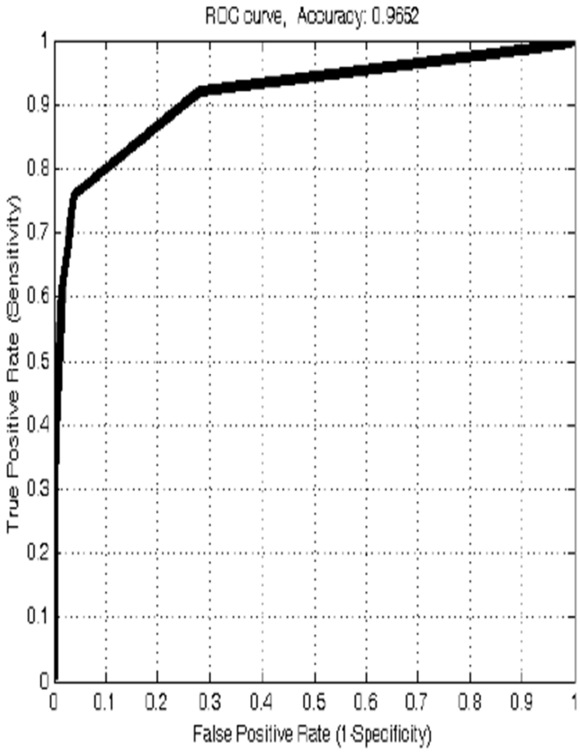

Figure 6(graph)

Conclusion

In this paper 180 gabor filter is used for the blood vessel detection and improve the accuracy and we can conclude our method is better comparable to the other method.

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