International
Journal
Of Advanced Research in Engineering & Management (IJAREM)
ISSN: 2456-2033 || PP. 38-42

EXTRACTION OF RETINAL BLOOD VESSELS USING IMAGE PROCESSING TECHNIQUES

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Abstract: Assessment of blood vessels in human eye allows earlier detection of eye diseases such as glaucoma and diabetic retinopathy. Digital image processing techniques play a vital role in retinal blood vessel detection , Several image processing methods and filters are in practice to detect and extract the attributes of retinal blood vessels such as length ,width, pattern and angles. Automated Digital image processing techniques and methods has to undergo more of improvisation to achieve precise accuracy to study the condition of Retinal Vessels especially in cases of Glaucoma and retinopathy; we have explained various Templates based matched filters, Thresholding Methods, Segmentation methods, and functional approaches to isolate the blood vessels.

Keywords: Glaucoma, Image Processing, Matlab, Retinopathy.

I. INTRODUCTION

This paper describes about the extraction process of the retina blood vessel using the filters i,e gabor filters

II. BACKGROUND

2.1 Introduction

In the past years, many approaches for extracting retinal image vessels have been developed and applied. The matched filter approach is a widely used template-based method usually uses a two-dimensional linear structural element that has a Gaussian cross-profile section, extruded or rotated into three dimensions to identify the cross profile of the blood vessels. The resulted image is finally thresholded to produce a binary segmentation of the vasculature. However, with this method in the detected images, the junction points are not always detected, small vessels are missed and the validity of the detected vessels is not checked. Besides, the threshold selection is also critical. To improve the performance of the conventional matched filter, Rawi in the year 2007 proposed an improved matched filter by using an optimizing procedure to search for the best parameters for the method. Another technique for vessel extraction is the vessel tracking method in which each vessel segment is defined by three attributes: direction, width, and centre point The density distribution of the cross section of a blood vessel is estimated using a Gaussian shaped function. Individual segments are identified using a search procedure, which keeps track of the Centre of the vessel and makes some decisions about the future path of the vessel based on certain vessel properties. However, the vessel-tracking method requires a user intervention and may be confused by vessel crossing and bifurcations. To deal with the problem of the central light reflex area in the tracking method, Others have proposed the use of pixel classification approaches, which involve two steps. Firstly, a low-level algorithm produces a segmentation of spatially connected regions. These candidate regions are then classified as being vessel or non-vessel. A drawback of these methods is that the large-scale properties of vessels cannot be applied to the classification until the low-level segmentation has already been finished classifiers in vessel segmentation through classifying the retinal image pixels as blood vessel or non blood vessel pixels.

2.2 Methodology

There are two sources of blood supply to the retina the central retinal artery and the choroidal blood vessels. The

choroid receives the greatest blood flow and is vital for the maintenance of the outer retina and the remaining 20-30% flows to the retina through the central retinal artery from the optic nerve head to nourish the inner retinal layers. The central retinal artery has 4 main branches in the human retina. The human retina is a delicate organization of neurons, glia and nourishing blood vessels. In some eye diseases, the retina becomes damaged or compromised, and degenerative changes set in that eventually lead to serious damage to the nerve cells that carry the vital messages about the visual image to the brain . Blood vessel segmentation is the basic foundation while developing retinal screening systems, since vessels serve as one of the main retinal landmark features. For every image pixel, a feature vector is computed that utilizes properties of scale and orientation selective Gabor filters. The extracted features are then classified using generative Gaussian mixture model and discriminative support vector machines classifiers. Experimental results demonstrate that the area under the receiver operating characteristic (ROC) curve reached a value 0.984, which is highly comparable and, to some extent, higher than the previously reported ROCs that range from 0.797 to 0.981. Moreover, this method gives a sensitivity of 96.50% with a specificity of 97.10% for identification of blood vessels. The second part of the paper deals with the different techniques used in blood vessel detection.

The various methods discussed in the table are as follows:

A) Morphological Method
B) Template based Matched Filter Methods
C) Vessel Tracking Method (Gaussian Filter Method)
D) Top Hat Filter E) Bottom Hat Filter
F) GABOR Filter And Matched Filter.

A. Morphological Method

Exudates are the primary signs of diabetic retinopathy which are main cause for blindness and could be prevented with an early screening process. Pupil dilation is required in the normal screening process but this affects patient's vision. Automatic methods of exudates detection on low-contrast images taken from non-dilated pupils, has two main segmentation steps which are coarse segmentation using Fuzzy C-Means clustering and fine segmentation using morphological reconstruction. Four features, namely intensity, standard deviation on intensity, hue and adapted edge, were selected for coarse segmentation. Results of Fuzzy C-Means Method and Morphological Methods. The sensitivity and specificity for our exudates detection are 86% and 99% respectively.

B. Template based Matched Filter Methods

Many approaches for extracting retinal image vessels have been developed and applied. The matched filter approach is a widely used template-based method this method usually uses a two-dimensional linear structural element that has a Gaussian cross-profile section, extruded or rotated into three dimensions to identify the cross profile of the blood vessels. The resulted image is finally threshold to produce a binary segmentation of the vasculature. However, with this method in the detected images, the junction points are not always detected, small vessels are missed and the validity of the detected vessels is not checked. Besides, the threshold selection is also critical.

C.Vessel Tracking Method (Gaussian Filter Method):

Another technique for vessel extraction is the vessel tracking method in which each vessel segment is defined by three attributes: direction, width, and centre point. The density distribution of the cross section of a blood vessel is estimated using a Gaussian shaped function. Individual segments are identified using a search procedure, which keeps track of the centre of the vessel and makes some decisions about the future path of the vessel based on certain vessel properties. However, the vessel-tracking method requires a user intervention and may be confused by vessel crossing and bifurcations. To deal with the problem of the central light reflex area in the tracking method, the vessel intensity profiles can be modeled as twin Gaussian functions, and a new method in which the tracking process started from the circumference of the optic disc and applied a Kalman filter as the base to estimate the next search location.

D.Gabor filter:

The retinal images from the DRIVE database and STARE database are used for evaluating the performance of the vessel segmentation method. Bank of twelve Gabor filters oriented in the range of 0 to 170 degrees are used to enhance thematic-oriented vessels. Increasing the number of filter banks did not result in significant improvement of result but increased the convolution operations. Quantitative evaluation of the segmentation algorithm is done by comparing the output image with the corresponding manually segmented image.

III. INDENTATIONS AND EQUATIONS

$$Sensitivity = \frac{T_p}{T_p + F_n}$$

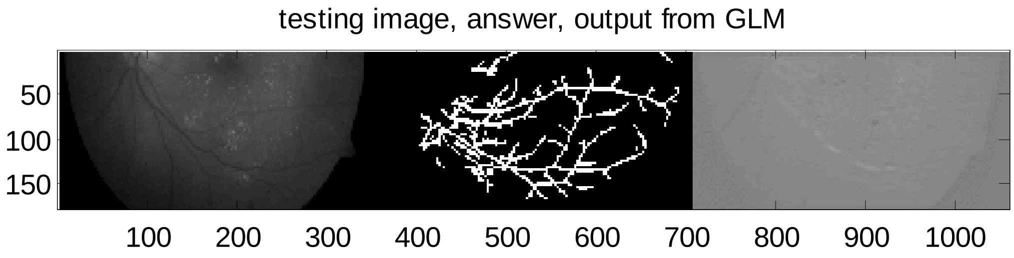
$$Specificity = \frac{T_n}{T_n + F_p}$$

TP=Correctly detected blood vessel
Tn=wrongly detected blood vessel
Fp=correctly detected non blood vessel
Fn=falsely detected non blood vessel

IV. FIGURES AND TABLES (11 BOLD)

For different retinas, the relative abortion is computed and they are presented in the figures.

Input Image



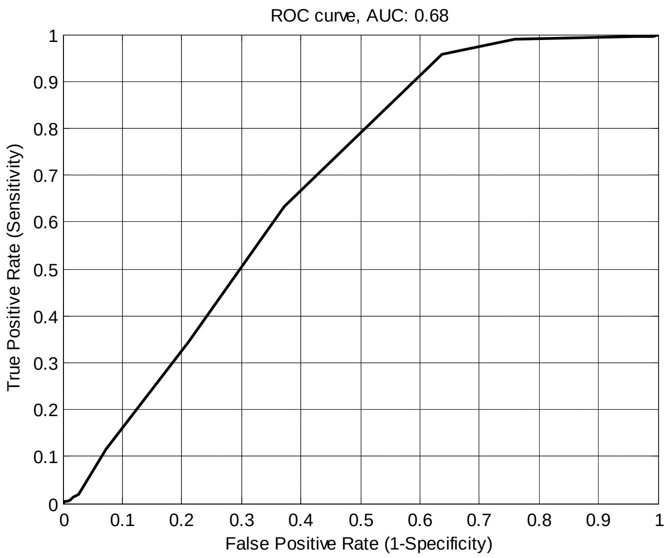


Fig 2. 1)severe postion input image 2)testing output image 3)ROC curve

METHOD	SENSITIVITY (%)	SPECIFICITY (%)
GABOR FILTER BASED (PROPOSED METHOD)	89.4±3.04	97.1±0.04
EXISTING METHOD	86.4±4.0	96±1.01

V. CONCLUSION

Fast and efficient computation of Gabor features from video frames has become the focus of recent studies of the functionalities of the human brain and visual cognitive systems. The resulted enhanced vessels were then subjected to thresholding for vessel pixel classification. Entropic threshold calculation based on gray level co-occurrence matrix as it contained information on the distribution of gray level frequency and edge information have been presented. Two publicly available databases were used to evaluate the performance of the method and also to compare it with the matched filter methods. It was found that for DRIVE database the method provided sensitivity of 89.4±4.0 % and 97±0.0 4specificity. And for the STARE database.

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