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Retinal Vessel Segmentation using Infinite Perimeter Active Contour with Hybrid Information Model

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Abstract--The aim of the segmentation in image processing is to represent images in an easy and meaningful manner by dividing them into a different group. It mainly helps for medical imaging and surveillance. We propose an infinite active contour model that uses hybrid region information of the image which allows for better detection of small branching like structures than the other models. Furthermore, for better general segmentation performance, the proposed model takes the benefit of using different types of region information, such as the combination of intensity information and local phase based enhancement method. The local phase based enhancement method is used for its superiority in conserving vessel edges while the given image intensity information will ensure a correct feature's segmentation. We estimate the performance of the proposed model by applying it to two public retinal vessel image datasets. And also it compares the performance of unsupervised segmentation using three influential filters.

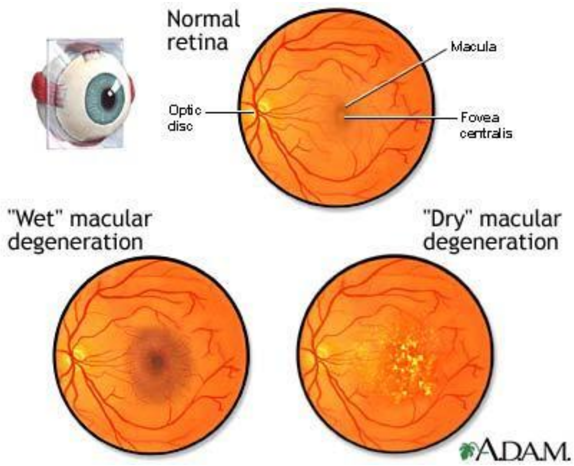
Keywords: *Segmentation, Local Phase, infinite perimeter, active contour.*

1. INTRODUCTION

Variations in blood vessel thickness occur as part of the sovereign control of blood flow in healthy subjects and at different stages in the pulse cycle, while continuous changes may also indicate the presence of some mental disorder. Measurements of vessel size are therefore of

interest both to physiologists looking to better understand the regulation of blood flow and to clinicians interested in the likelihood, diagnosis or advancement of disease. Specific importance is retinal images, as these may be used to directly envisage blood vessels. Conversely, exact quantification of changes in vessel measurement is difficult to preset fully because of large variations in image type, size and quality. In practice, measurements are frequently obtained using semi-automated computer-assisted methods, which can be both strenuous and open to user-bias.

Fully presetting the analysis of vessel measurement in still images depends on firstly upon exactly locating the blood vessels. The application of state-of-the-art image processing techniques to the accurate segmentation of vessels in human fluorescein angiograms and fundus (red-free) images has received significant attention in recent years. In this project, we describe a fast and precise unsupervised algorithm to detect and measure blood vessels in retinal images.



2. LITERATURE SURVEY

Retinal image vessel segmentation algorithms have been deeply researched. There are so many approaches to the segmentation. Among these approaches, two of them were chosen for implementation in that paper. These methods exploit different image processing techniques and each offer different pros and cons in vessel segmentation. These are Gray level and Moment invariant features for inevitably segmenting blood vessels in retinal images.

Two techniques for segmenting retinal blood vessels, based on different image processing techniques, are described and their asset and flaw are compared. This method uses a neural network (NN) scheme for pixel classification and gray-level and moment invariants-based features for pixel representation. The performance of each algorithm was tested on the STARE and DRIVE dataset widely used for this purpose; meanwhile they contain retinal images and the vascular structures.

Performance on both sets of test images is better than other prevailing images. The method proves specifically accurate for vessel detection in STARE images. This effectiveness and heftiness with different image conditions, is used for simplicity and firm implementation. This method used for early detection of Diabetic Retinopathy (DR).

The disadvantage of supervised method that ground truth classes from a training set are needed. A drawback of this method is that because the classification is pixel-by-pixel, the result often has many smaller disconnected segments. Therefore, post-processing methods designed to reduce noise by removing small connected components will also remove these disconnected segments.

3. PROPOSED SYSTEM

Filters which can enhance vessel-like structures (retinal images) have competed an important role in the vessel segmentation problems. Here, we analysis the three most influential filters.

3.1 EIGEN VALUE BASED FILTER

For a given pixel of the input image a Hessian matrix is comprised from the image 2nd order partial derivatives. The partial derivatives are computed as pixel intensity differences in the neighborhood of the pixel. The Hessian matrix describes the 2nd order local image intensity variations around the selected pixel. For the attained Hessian matrix its eigenvalues λi and the eigenvectors are calculated.

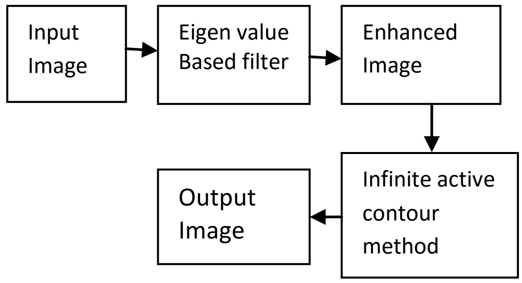


Fig-1: Block diagram of proposed system

3.2 ISOTROPHIC UNDECIMATED WAVELET FILTER

The Isotropic Undecimated Wavelet Transform (IUWT) is a powerful, redundant wavelet transform that has been used in astronomy and biology applications. It provides a chiefly simple implementation that can be promptly appreciated without option to wavelet theory: at every iteration.

The scaling coefficients preserve the mean of the original signal, whereas wavelet coefficients have a zero mean and encode information corresponding to different spatial scales present within the signal.

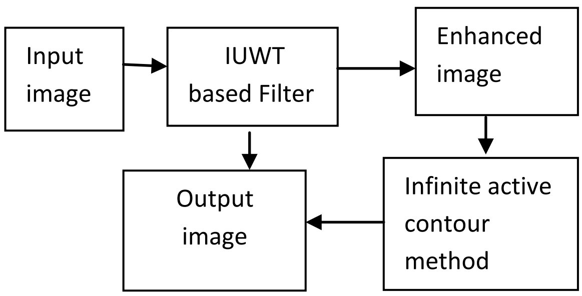


Fig 2 Block diagram of IUWT method

3.3 LOCAL PHASE BASED FILTER

Local phase is an important local feature that can estimate structural information (e.g. lines and edges) of an image. It has recently been shown that this information can be used to enhance vessels in a more accurate way and produce assuring segmentation results. For imaging applications, local phase can be estimated by using quadrature filters under the concept of monogenic signals.

The local energy Anj(x) and local phase φnj(x) at scale *n* and orientation *j* are defined respectively as follows:

$$Anj(x) = \sqrt{enj(x)^2 + onj(x)^2} \quad and$$

$$\varphi nj(x) = arc\tan\left(\frac{onj(x)}{enj(x)}\right).$$

3.4 INFINITE ACTIVE CONTOUR MODEL

Unsupervised segmentation refers to methods that achieve the segmentation of blood vessels without using training data, or obviously using any classification techniques. The lower requirement on the data and focusing makes unsupervised segmentation methods more applicable to an extensive range of imaging modalities.

For unsupervised segmentation, different segmentation models have been proposed ranging from the primitive thresholding technique, morphological path opening followed by thresholding and fusion, to sophisticated approaches such as active contour models. As such we will focus on the development of a new active contour model for improving accuracy in vessel segmentation problems.

The IPAC model was proposed for the segmentation of objects with crooked boundaries.

The energy function is given as:

$$F^{IPAC\ (\Gamma, c1,\ c2)} = L^{2(\gamma-\Gamma)} + \lambda 1 \int |u0(x) - c1|^{2}\, dx + \lambda 2 \int |u0(x) - c2|^{2}\, dx \quad \ldots\ldots\ldots (3.4.1)$$

Where L2 is the 2D Lebesgue measure of the γ neighborhood of the edge set Γ and λ1and λ2 are fitting term parameters.

A new infinite perimeter active contour model has shown considerable performance in the detection of small oscillatory structures. This characteristic of the model implies good performance prospects with vessel segmentation problems.

4. PERFORMANCE METRICS AND DATASETS

4.1 Performance metrics:

Two normally used metrics were engaged to assess the performance of the contending methods in terms of pixels: Sensitivity (Se) = $tp/(tp + fn)$, Accuracy (Acc)=$(tp + tn)/(tp + fp + tn + fn)$ Where tp=true positive (correctly identified vessel pixels), tn=true negative (correctly identified background pixels), fp= false positive (incorrectly identified vessel pixels) and fn=false negative (incorrectly identified background pixels).

4.2 Datasets:

DRIVE (Digital Retinal Images for Vessel Extraction) consists of a total of 40 color retinal images, obtained in the sequence of a diabetic retinopathy screening program in the Netherlands. The set of 40 images was seperated into a test and a training set, each containing 20 images.

STARE (Structured Analysis of the Retina) contains 20 color retinal images, 10 of which show the sign of pathology. The digitized slides were captured by a Top Con TRV-50 fundus camera and the photos were digitized to 605700 pixels.

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5. RESULTS

Several performance measures were calculated in order to assess the performance of each of the developed methods. These measures include accuracy, precision, and sensitivity. Each of the developed algorithms offer trade-offs between these performances metrics.

Stage 1: Image Enhancement

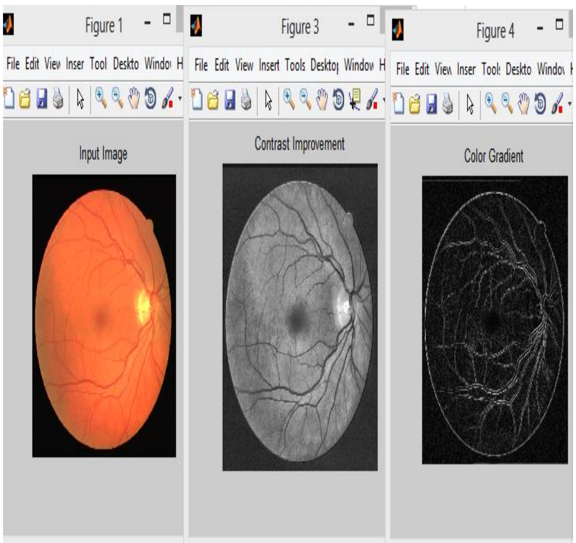

Fig-3: Output diagram of retinal image using enhancement filters

First, we have to take retinal images from any of the two pubic retinal datasets. Then apply three filters (FR, IUWT, LP).After that we have to apply the segmentation model to the enhanced image. More precisely, image segmentation is the process of assigning a label to every pixel in an image such that pixels with the same label share certain characteristics.

TABLE-1: Comparison of segmentation performance of using three different enhancement methods (LP, WL, FR).

DATASET	ENHANCE -MENT METHOD	Se	ACC
DRIVE	EV based method	1.000	0.0196
	WL based method	4.784	0.8516
	LP based method	9.056	0.9652

Stage 2: Image Segmentation

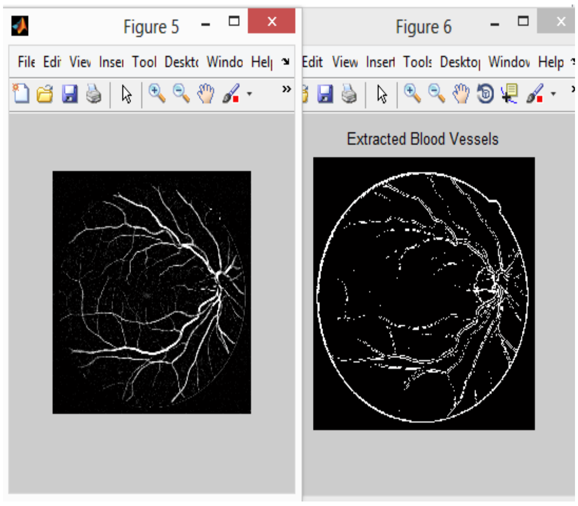

Fig-4: Output diagram of retinal image using IPACHI segmentation model.

5. CONCLUSION

We have proposed a infinite perimeter active contour model with hybrid region terms for the vessel segmentation problem. This model has been applied to two available retinal datasets and the results establish that it smashes most of the existing methods in terms of segmentation accuracy. Later vessel segmentation, it is possible to achieve more progressive analysis, such as measurements of diameters and lengths of the vessels, classification of veins and arteries, calculation of arteries venous ratio, and more prominently study the analytical and predictive values of these features on eye disease and a number of systematic diseases.

REFERENCES

[1] Automated Vessel Segmentation Using Infinite Perimeter Active Contour Model with Hybrid Region Information with Application to Retinal Images Yitian Zhao, Lavdie Rada, Ke Chen, Simon P Harding, Yalin Zheng, Member *IEEE transactions on medical imaging* , vol. 24, no. 10, 2015

[2] Y. Wang, G. Ji, P. Lin, and E. Trucco, "Retinal vessel segmentation using multiwavelet kernels and multiscale hierarchical decomposition," Pattern Recogn., vol. 46, pp. 2117–2133, 2013.

[3] B Al-Diri, A. Hunter, and D. Steel, "An active contour model for segmenting and measuring retinal vessels," IEEE Trans. Med. Image vol. 28, pp. 1488–1497, 2009.

[4] J. Soares and M. Cree, "Retinal vessel segmentation using the 2D Gabor wavelet and supervised classification," IEEE Trans. Med. Image., vol. 25

[5] Vessel Detection Method Based on Eigenvalues of the Hessian Matrix, XI International PhD Workshop OWD 2009, 17–20 October 2009.

[6] A general framework for vessel segmentation in retinal images,Changhua Wu, Gady Agam, Peter Stanchev.

[7] K. Sun and S. Jiang, "Local morphology fitting active contour for automatic vascular segmentation," IEEE Trans. Biomed. Eng., vol. 59, pp. 464–473, 2012.