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Application to Retinal Images Using Automated Vessel Segmentation

Janani.L[1], Dr.T.Muthumanickam[2], Dr.T.Sheela[3]

II Year M.E Student (Applied Electronics), Dept. of ECE, V.M.K.V. Engineering College, Salem, India[1]

Professor & Head, Dept. of ECE, V.M.K.V. Engineering College, Salem, India [2]

Associate Professor, Dept of ECE, V.M.K.V. Engineering College, Salem, India [3]

ABSTRACT: Automated detection of blood vessel structures is becoming of crucial interest for better management of vascular disease. In this paper, we propose a new infinite active contour model that uses hybrid region information of the image to approach this problem. More specifically, an infinite perimeter regularize, provided by using L2 Lebesgue measure of the neighbourhood of boundaries, allows for better detection of small oscillatory (branching) structures than the traditional models based on the length of a feature's boundaries (i.e. H1 Hausdorff measure). Moreover, for better general segmentation performance, the proposed model takes the advantage of using different types of region information, such as the combination of intensity information and local phase based enhancement map. The local phase based enhancement map is used for its superiority in preserving vessel edges while the given image intensity information will guarantee a correct feature's segmentation.

KEYWORDS: Blood vessels, contour model, L2 Lebesgue, IPACHI Cauchy filter

I. INTRODUCTION

Segmentation of blood vessels in retinal images plays a vital role in medical sciences. In order to increase the efficiency of existing methods and to get the result economically our project is designed using exclusively software than hardware. Our method uses cauchy filter which is ultimately designed for noise elimination in hands with other segmentation methods. This method can find its future existence in three dimensions where the input image has to be obtained in different angles based on the required output.

II. RELATED WORK

This method produces segmentations by classifying each image pixel as vessel or non vessel, based on the pixel's feature vector. Feature vectors are composed of the pixel's intensity and two-dimensional Gabor wavelet transform responses taken at multiple scales. The probability distributions are estimated based on a training set of labelled pixels obtained from manual segmentations. There are few disadvantages such as, it only takes into account information local to each pixel through image filters, ignoring useful information from shapes and structures present in the image. This method did not perform well for very large variations in lighting throughout an image, but this occurred for only one image out of the 40 tested from both databases. It is possible to use only the skeleton of the segmentations for the extraction of shape.

III. LITERATURE SURVEY

Luo Gang et.al [1] suggested that the fitness of estimating vessel profiles with Gaussian function is evaluated and an amplitude-modified second-order Gaussian filter is proposed for the detection and measurement of vessels. Mathematical analysis is given and supported by a simulation and experiments to demonstrate that the vessel width can be measured in linear relationship with the "spreading factor" of the matched filter when the magnitude coefficient of the filter is suitably assigned. The absolute value of vessel diameter can be determined simply by using a pre-calibrated

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line, which is typically required since images are always system dependent. The experiment shows that the inclusion of the width measurement in the detection process can improve the performance of matched filter and result in a significant increase in success rate of detection.

HariharNarasimhaIyer et.al [2] stated a robust framework for detecting vasculature in noisy retinal fundus images. We improved the handling of the "central reflex" phenomenon in which a vessel has a "hollow" appearance. This is particularly pronounced in dual-wavelength images acquired at 570 and 600 nm for retinal oximetry. It is prominent in the 600 nm images that are sensitive to the blood oxygen content. Improved segmentation of these vessels is needed to improve oximetry. We show that the use of a generalized dual-Gaussian model for the vessel intensity profile instead of the Gaussian yields a significant improvement. Our method can account for variations in the strength of the central reflex, the relative contrast, width, orientation, scale, and imaging noise. It also enables the classification of regular and central reflex vessels. The proposed method yielded a sensitivity of 72% compared to 38% by the algorithm of Can et al., and 60% by the robust detection based on a single-Gaussian model. The specificity for the methods were 95%, 97%, and 98%, respectively.

Miguel A. Palomera-P´erez et.al [3] presented a parallel implementation based on insight segmentation and registration toolkit for a multiscale feature extraction and region growing algorithm, applied to retinal blood vessels segmentation. This implementation is capable of achieving an accuracy (Ac) comparable to its serial counterpart (about 92%), but 8 to 10 times faster. In this paper, the Ac of this parallel implementation is evaluated by comparison with expert manual segmentation (obtained from public databases). On the other hand, its performance is compared with previous published serial implementations. Both these characteristics make this parallel implementation feasible for the analysis of a larger amount of high-resolution retinal images, achieving a faster and high-quality segmentation of retinal blood vessels.

João V. B. Soares et.al [4] proposed a method for automated segmentation of the vasculature in retinal images. The method produces segmentations by classifying each image pixel as vessel or non-vessel, based on the pixel's feature vector. Feature vectors are composed of the pixel's intensity and two-dimensional Gabor wavelet transform responses taken at multiple scales. The Gabor wavelet is capable of tuning to specific frequencies, thus allowing noise filtering and vessel enhancement in a single step. We use a Bayesian classifier with class-conditional probability density functions (likelihoods) described as Gaussian mixtures, yielding a fast classification, while being able to model complex decision surfaces. The probability distributions are estimated based on a training set of labelled pixels obtained from manual segmentations. The method's performance is evaluated on publicly available DRIVE (Staal et al., 2004) and STARE (Hoover et al., 2000) databases of manually labelled images. On the DRIVE database, it achieves an area under the receiver operating characteristic curve of 0.9614, being slightly superior than that presented by state-of-the-art approaches. We are making our implementation available as open source MATLAB scripts for researchers interested in implementation details, evaluation, or development of methods.

Bashir Al-Diri et.al [5] proposed an algorithm for segmenting and measuring retinal vessels, by growing a "Ribbon of Twins" active contour model, which uses two pairs of contours to capture each vessel edge, while maintaining width consistency. The algorithm is initialized using a generalized morphological order filter to identify approximate vessels centrelines. Once the vessel segments are identified the network topology is determined using an implicit neural cost function to resolve junction configurations. The algorithm is robust, and can accurately locate vessel edges under difficult conditions, including noisy blurred edges, closely parallel vessels, light reflex phenomena, and very fine vessels. It yields precise vessel width measurements; with sub pixel average width errors. We compare the algorithm with several benchmarks from the literature, demonstrating higher segmentation sensitivity and more accurate width measurement.

IV. PROPOSED ALGORITHM

We propose a new infinite active contour model that uses hybrid region information of the image to approach this problem. More specifically, an infinite perimeter regularize, provided by using L2 Lebesgue measure of the - neighborhood of boundaries, allows for better detection of small oscillatory (branching) structures than the traditional models based on the length of a feature's boundaries (i.e. H1 Hausdorff measure). Moreover, for better general segmentation performance, the proposed model takes the advantage of using different types of region information, such as the combination of intensity information and local phase based enhancement map. There are also many advantages when compared such as, Different types of region information, such as the combination of intensity information and

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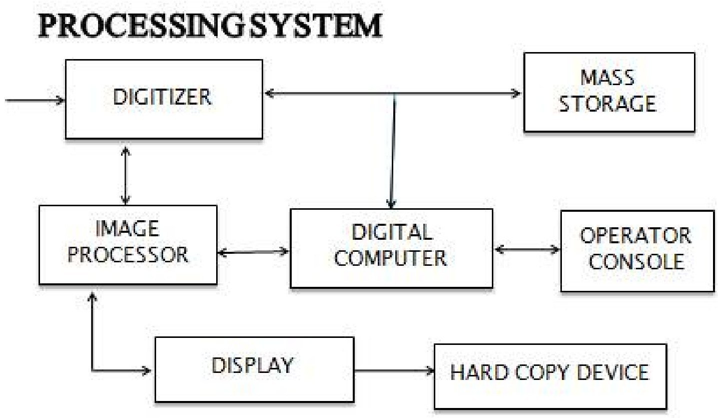
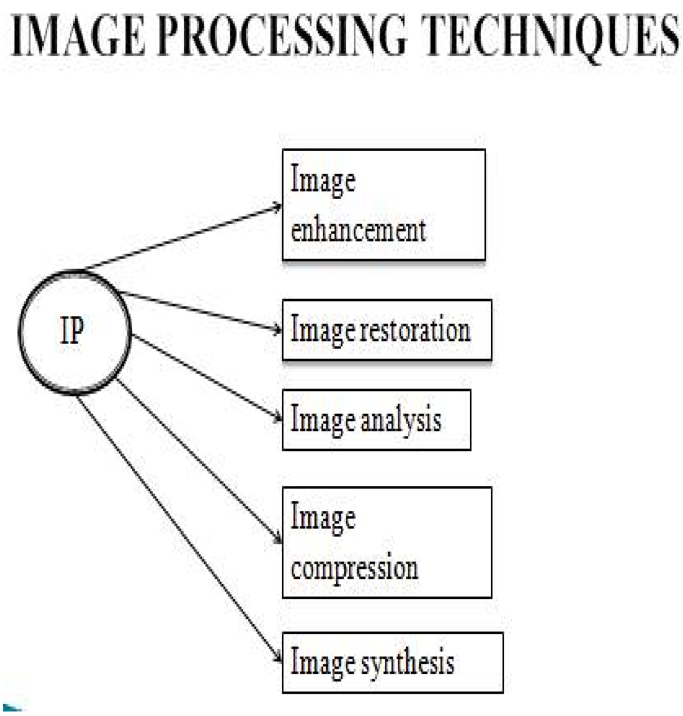
local phase based enhancement map. Automated segmentation methods would have improvements in efficiency and accuracy, Fast, readily available, highest spatial resolution.

PROPOSED BLOCK DIAGRAM:





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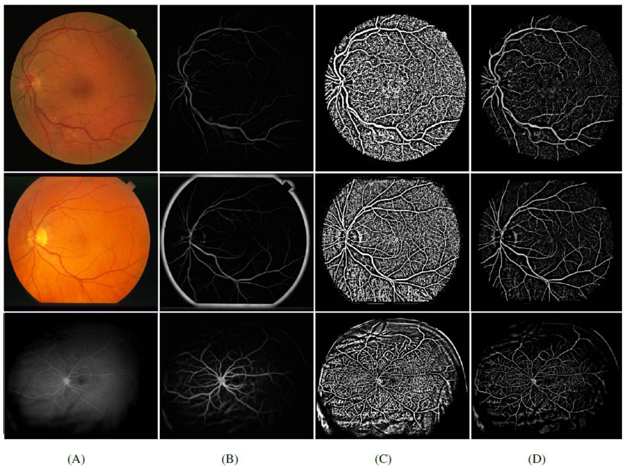
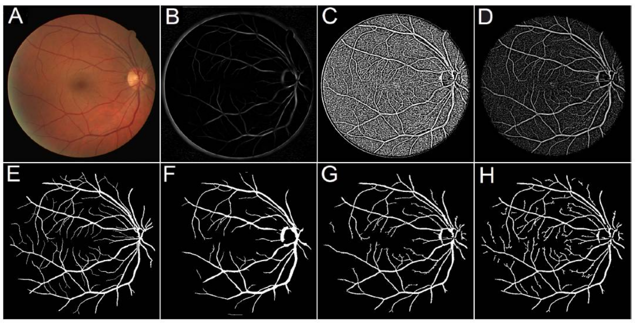
V. SIMULATION RESULTS

Figure 1: Enhancement results produced by the eigen value-based method [2], wavelet-based method [6] and local phase method.



Three images were randomly chosen from three datasets (one image per dataset). From top to bottom: DRIVE, STARE, and VAMPIRE. (B) Eigenvalue-based enhancement results. (C) Wavelet-based enhancement results. (D) Local phase based enhancement results.

Figure 2: Illustrative enhancement results using different enhancement methods and their subsequent IPACHI-based segmentation results



(A) A randomly chosen image from the DRIVE dataset. (B)-(D) Enhancement results on (A) by using the eigenvalue-based (FR), wavelet-based (IUWT), and local phase-based (LP) filters respectively. (E) Expert's annotation. (F)-(H) IPACHI-based segmentation results on (B)-(D).

VI. CONCLUSION AND FUTURE WORK

In this paper, it is shown that the Gaussian curve is suitable for modelling the intensity profile of the cross section of retinal vessels in color fundus images. Based on this elaboration, the amplitude-modified second-order Gaussian filter for retinal vessel detection is proposed and its performance is demonstrated. The mathematical analysis, vessel-detection simulation and its assessment on various fundus images show that the Gaussian filter with modified amplitude can be effectively used to detect and measure the retinal vessels. The vessel width measurement not only provides the size of blood vessel but it is also useful for optimizing the matched filter to improve the successful rate of detection.

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BIOGRAPHY

L.Janani is a post graduation student in Applied Electronics in the department of ECE, VMKVEC, salem. She completed her under graduation in Biomedical Instrumentation Engineering in Avinashilingam university, Coimbatore. She is interested in the area of Digital Image Processing, Microprocessor and Microcontrollers

Dr.T.Muthumanickam is working as Professor and Head in the department of ECE, VMKVEC, salem. He received his Master degree in Sastra university, India, and completed his doctorate in Vinayaka Missions University. He is interested in VLSI design, Medical Electronics and Digital Signal Processing.

Dr.T.Sheela is working as associate professor in the department of ECE, VMKVEC, salem. She received her doctorate in Vinayaka Missions University. She is interested in Digital Signal Processing, Embedded System and VLSI design.