

BLOOD VESSEL SEGMENTATION IN RETINAL IMAGES USING MATLAB

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Abstract - In Our Project, Feature vectors are composed of the pixel's intensity and continuous two-dimensional stationary wavelet transform responses taken at multiple scales. The Stationary wavelet is capable of turning to specific frequencies, thus allowing noise filtering and vessel enhancement in a single step. We use a neural network on training with class-conditional probability density functions (likelihoods) described as Gaussian mixtures, yielding a fast classification, while being able to model complex decision surfaces and compare its performance with the linear minimum squared error classifier. To implement an effective algorithm based on Morphological process and Segmentation Techniques to detect the Retina vessels and Exudates from an eye fundus image. The combination of multi structure morphological process and Segmentation technique is used effectively for retinal vessel and exudates detection here. The modules made here are 1. Retina Blood Vessels Detection in which Plane separation, Contrast Enhancement, Morphological Process are done under this module. Exudates Detection in which Segmentation Technique is used.

Key Words: Machine Learning, Blood Vessel, Diabetic, Risk of vision loss

1. INTRODUCTION

In an automated retinal image analysis system, exact detection of optic disc in colour retinal images is a significant task. Detection of the same is the prerequisite for the segmentation of other normal and pathological features in the retina. It is seen that optic nerves and blood vessels emerge into the retina through optic disc. Therefore, it is also called the blind spot. From patient to patient the size of optic disc varies, but its diameter always lies between 80 and 100 pixels in a standard fundus images. Analysis in medical images is a multi-disciplinary research area, in which image processing, machine learning pattern recognition and computer visualization are covered. Ophthalmologists interprets and analyses the retinal images visually to diagnose various.

1.1 MOTIVATION:

Pathologies in the retina like Diabetic Retinopathy (DR). In order to make their work more easier retinal image analysis system can be developed to make the diagnosis more efficiently. DR is the most common eye

complication in diabetes is Diabetic Retinopathy. DR is globally the primary cause of visual impairment and causing blindness in diabetic patients. Diabetic patients have to be screened for early detection and timely treatment of diabetic eye diseases which can significantly reduce the risk of vision loss. Reviewing vast number of images by the physicians is time consuming and costly. Several retinal abnormalities including micro aneurysms, haemorrhages, hard exudates and cotton wool spots are caused due to DR. Hard exudates are yellowish intra retinal deposits, made up of serum lipoproteins. Exudates are formed when lipid or fat leaks from abnormal blood vessels. Vision loss can occur if the exudates extend into the macular area. This paper investigates the application of Morphological approaches for detection of exudates in retinal images and compared with the normal retinal images mainly for the detection of exudates

Manual segmentation of the retinal blood vessels is arduous and time-consuming, and making a detailed segmentation can be challenging if the complexity of the vascular network is too high. Thus, automated segmentation is valuable, as it decreases the time and effort required, and in the best-case scenario, an automated algorithm can provide as good or better segmentation results as an expert by manual labeling. For practical applications, it would be better to have algorithms that do not critically depend on configuring many parameters so that also non-experts may utilize this technology with ease. Automated blood vessel segmentation has faced challenges related to low contrast in images, wide range of vessel widths and variety of different structures in retinal images such as retinal image boundaries, optic disc and retinal lesions caused by diseases. Even though, different methods are available for retinal segmentation, there is still space for improvement.

1.2 OBJECTIVE:

Main objective is

- To implement an effective algorithm based on Morphological process and Segmentation

Techniques to detect the Retina vessels and Exudates from an eye fundus image.

- To help ophthalmologists in better and faster analysis and hence early treatment to the patients.

2 LITERATURE SURVEY

[1] Raziieh Akhavan, Karim Faez, etc..." A Novel Retinal Blood Vessel Segmentation Algorithm using Fuzzy segmentation" Assessment of blood vessels in retinal images is an important factor for many medical disorders. The changes in the retinal vessels due to the pathologies can be easily identified by segmenting the retinal vessels. Segmentation of retinal vessels is done to identify the early diagnosis of the disease like glaucoma, diabetic retinopathy, macular degeneration, hypertensive retinopathy and arteriosclerosis. In this paper, we propose an automatic blood vessel segmentation method. The proposed algorithm starts with the extraction of blood vessel centerline pixels. The final segmentation is obtained using an iterative region growing method that merges the binary images resulting from centerline detection part with the image resulting from fuzzy vessel segmentation part. In this proposed algorithm, the blood vessel is enhanced using modified morphological operations and the salt and pepper noises are removed from retinal images using Adaptive Fuzzy Switching Median filter. This method is applied on two publicly available databases, the DRIVE and the STARE and the experimental results obtained by using green channel images have been presented and compared with recently published methods. The results demonstrate that our algorithm is very effective method to detect retinal blood vessels.

[2] Anil Maharjan, et al., "Blood Vessel Segmentation from Retinal Images" Automatic retinal blood vessel segmentation algorithms are important procedures in the computer aided diagnosis in the field of ophthalmology. They help to produce useful information for the diagnosis and monitoring of eye diseases such as diabetic retinopathy, hypertension and glaucoma. In this work, different state-of-art methods for retinal blood vessel segmentation were implemented and analysed. Firstly, a supervised method based on gray level and moment invariant features with neural network was explored. The other algorithms taken into consideration were an unsupervised method based on gray-level cooccurrence matrix with local entropy and a matched filtering method based on first order derivative of

Gaussian. During the work, two publicly available image databases DRIVE and STARE were utilized for evaluating the performance of the algorithms which includes sensitivity, specificity, accuracy, positive predictive value and negative predictive value. The accuracies of the algorithms based on supervised and unsupervised methods were 0.935 and 0.950 compared to corresponding values from literature, which are 0.948 and 0.975, respectively. The matched filtering-based method produced same accuracy as in the literature, i.e., 0.941. Although the accuracies of all implemented blood vessel segmentation methods were close to the corresponding values given in the literature the sensitivities were lower for all the algorithms which lead to smaller number of correctly classified vessels from retinal images. Based on the results achieved, the algorithms have potential to be accepted for practical use, after modest improvements are done in order to get better segmentation of retinal blood vessels as well as the background.

[3] R Geetharamani And Lakshmi Balasubramanian, et al., "Automatic segmentation of blood vessels from retinal fundus images through image processing and data mining techniques" Machine Learning techniques have been useful in almost every field of concern. Data Mining, a branch of Machine Learning is one of the most extensively used techniques. The ever-increasing demands in the field of medicine are being addressed by computational approaches in which Big Data analysis, image processing and data mining are on top priority. These techniques have been exploited in the domain of ophthalmology for better retinal fundus image analysis. Blood vessels, one of the most significant retinal anatomical structures are analysed for diagnosis of many diseases like retinopathy, occlusion and many other vision threatening diseases. Vessel segmentation can also be a pre-processing step for segmentation of other retinal structures like optic disc, fovea, microneurysms, etc. In this paper, blood vessel segmentation is attempted through image processing and data mining techniques.

[4] A. M. R. R. Bandara, et al., "A Retinal Image Enhancement Technique for Blood Vessel Segmentation Algorithm" The morphology of blood vessels in retinal fundus images is an important indicator of diseases like glaucoma, hypertension and diabetic retinopathy. The accuracy of retinal blood vessels segmentation affects the quality of retinal image analysis which is used in diagnosis methods in modern ophthalmology. Contrast enhancement is one

of the crucial steps in any of retinal blood vessel segmentation approaches. The reliability of the segmentation depends on the consistency of the contrast over the image. This paper presents an assessment of the suitability of a recently invented spatially adaptive contrast enhancement technique for enhancing retinal fundus images for blood vessel segmentation. The enhancement technique was integrated with a variant of Tyler Coye algorithm, which has been improved with Hough line transformation-based vessel reconstruction method. The proposed approach was evaluated on two public datasets STARE and DRIVE. The assessment was done by comparing the segmentation performance with five widely used contrast enhancement techniques based on wavelet transform, contrast limited histogram equalization, local normalization, linear un-sharp masking and contourlet transform. The results revealed that the assessed enhancement technique is well suited for the application and also outperforms all compared techniques.

[5] Nilam M. Gawade, S.R.Patil, et al., "Segmentation of Blood Vessels in Retinal Images" Retinal image analysis is a noninvasive diagnosis method in modern ophthalmology. In this paper, a method to segment blood vessels in the fundus retinal images is presented. The morphology of the blood vessels is an important indicator for diseases like diabetic retinopathy, glaucoma, and hypertension etc. The segmentation of the retinal images allows ophthalmologist to perform mass vision screening exams for early detection of retinal diseases and treatment. The images from the public dataset DRIVE are used.

[6] R Geetharamani And Lakshmi Balasubramanian, et al., "Automatic segmentation of blood vessels from retinal fundus images through image processing and data mining techniques" Machine Learning techniques have been useful in almost every field of concern. Data Mining, a branch of Machine Learning is one of the most extensively used techniques. The ever-increasing demands in the field of medicine are being addressed by computational approaches in which Big Data analysis, image processing and data mining are on top priority. These techniques have been exploited in the domain of ophthalmology for better retinal fundus image analysis. Blood vessels, one of the most significant retinal anatomical structures are analysed for diagnosis of many diseases like retinopathy, occlusion and many other vision threatening diseases. Vessel segmentation can also be a pre-processing step

for segmentation of other retinal structures like optic disc, fovea, microneurysms, etc

[7] Dr. N. Jayalakshmi, K. Priya, et al., "A Proposed Segmentation and Classification Algorithm of Diabetic Retinopathy Images for Exudates Disease" The retinal image diagnosis is a significant methodology for diabetic retinopathy analysis. The diabetic retinopathy is a one of the major problematic diseases that provides changes in the blood vessels of the retinal that may issue blindness if it is not properly prevented and should be treated at the early stage. The Principle Component Analysis (PCA) algorithm is proposed to improve the contrast and brightness of the image. This paper presents the novel algorithm for blood vessel segmentation using unsupervised algorithm. The normalized graph cut segmentation with Curvelet transform is applied to segment the blood vessel to determine the thickness of the blood vessel and it is considered as one of the key feature to classify the diabetic retinopathy. The multi-resolution curvelet transform is used to improve the blood vessel segmentation. The PCA algorithm is used to provide the gradient of the image for accurate segmentation of blood vessel. Optic disc is an important key feature of retinal image that is first process for analysis behavior of disease identification. The optic disc is removed by applying morphological erosion and dilation operation.

[8] Hadi Hamadb, Domenico Tegolo and Cesare Valenti, et al., "Automatic Detection and Classification of Retinal Vascular Landmarks" The main contribution of this paper is introducing a method to distinguish between different landmarks of the retina: bifurcations and crossings. The methodology may help in differentiating between arteries and veins and is useful in identifying diseases and other special pathologies, too. The method does not need any special skills, thus it can be assimilated to an automatic way for pinpointing landmarks; moreover, it gives good responses for very small vessels. A skeletonized representation, taken out from the segmented binary image (obtained through a preprocessing step), is used to identify pixels with three or more neighbors. Then, the junction points are classified into bifurcations or crossovers depending on their geometrical and topological properties such as width, direction and connectivity of the surrounding segments. The proposed approach is applied to the public-domain DRIVE and STARE datasets and compared with the state-of-the-art methods using proper validation parameters.

[9] Xiayu Xu, et al., "Automated Delineation and Quantitative Analysis of Blood Vessels in Retinal Fundus Image" Automated fundus image analysis plays an important role in the computer aided diagnosis of ophthalmologic disorders. A lot of eye disorders, as well as cardiovascular disorders, are known to be related with retinal vasculature changes. Many studies has been done to explore these relationships. However, most of the studies are based on limited data obtained using manual or semi-automated methods due to the lack of automated techniques in the measurement and analysis of retinal vasculature.

[10] Andrey V. Nasonov, Andrey S. Krylov, et al., "Fast super-resolution using weighted median filtering" A non-iterative method of image super-resolution based on weighted median filtering with Gaussian weights is proposed. Visual tests and basic edges metrics were used to examine the method. It was shown that the weighted median filtering reduces the errors caused by inaccurate motion vectors.

CONCLUSION

The Retinal image analysis through efficient detection of vessels and exudates for retinal vasculature disorder analysis. It plays important roles in detection of some diseases in early stages, such as diabetes, which can be performed by comparison of the states of retinal blood vessels. Intrinsic characteristics of retinal images make the blood vessel detection process difficult. Here, we proposed a new algorithm to detect the retinal blood vessels effectively. Experimental result proves that the blood vessels and exudates can be effectively detected by applying this method on the retinal image with proposed sensitivity, accuracy, selectivity and ROC curve.

FUTURE SCOPE

Features may be evaluated using various other feature extraction techniques to further improve the classification accuracy. Various Neural Network models may be incorporated to select the best Neural Network. Combined classifier scheme may be implemented for identifying DR. As a future work, with more database images Proliferative DR can be further classified. The classification of PDR is in future enhancement we can implement:

REFERENCES

- [1] Razieh Akhavan, Karim Faez, etc.." A Novel Retinal Blood Vessel Segmentation Algorithm using Fuzzy segmentation" International Journal of Electrical and Computer Engineering (IJECE) Vol. 4, No. 4, August 2014, pp. 561~572 ISSN: 2088-8708
- [2] Anil Maharjan, et al., "Blood Vessel Segmentation from Retinal Images" University of Eastern Finland, Faculty of Science and Forestry, Joensuu School of Computing Computer Science, June 2016
- [3] R Geetharamani And Lakshmi Balasubramanian, et, al., "Automatic segmentation of blood vessels from retinal fundus images through image processing and data mining techniques" Sadhan - a Vol. 40, Part 6, September 2015, pp. 1715-1736. c Indian Academy of Sciences
- [4] A. M. R. R. Bandara, et al., "A Retinal Image Enhancement Technique for Blood Vessel Segmentation Algorithm" 978-1-5386-1676-5/17/\$31.00 ©2017 IEEE
- [5] Nilam M. Gawade, S.R.Patil,et al., "Segmentation of Blood Vessels in Retinal Images" IJEEDC, ISSN (P): 2320-2084, (O) 2321-2950, COE, Bharti Vidyapeeth, Deemed University, Pune, Special Issue-1 April-2015
- [6] R Geetharamani And Lakshmi Balasubramanian, et al., "Automatic segmentation of blood vessels from retinal fundus images through image processing and data mining techniques" MS received 16 June 2014; revised 24 March 2015; accepted 24 April 2015
- [7] Dr. N. Jayalakshmi, K. Priya, et al., "A Proposed Segmentation and Classification Algorithm of Diabetic Retinopathy Images for Exudates Disease" International Journal of Engineering & Technology, 7 (3.20) (2018) 724-731
- [8] Hadi Hamadb, Domenico Tegoloand Cesare Valenti, et al., "Automatic Detection and Classification of Retinal Vascular Landmarks" December 13, 2013; revised April 9, 2014; accepted May 7, 2014.
- [9] Xiayu Xu, et al., "Automated Delineation and Quantitative Analysis of Blood Vessels in Retinal Fundus Image" May 2012
- [10] Andrey V. Nasonov, Andrey S. Krylov, et al., "Fast super-resolution using weighted median filtering" Laboratory of Mathematical Methods of Image Processing Faculty of Computational Mathematics and Cybernetics Lomonosov Moscow State University, 2012