Blood Vessel Segmentation of Retinal Images Using Tyler Coye Algorithm

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Abstract: The detailed study of blood vessels structure in the fundus images of retina of eye is an indicator of many diseases like glaucoma, cataract and blindness etc. The accuracy of the image obtained by retinal blood vessel segmentation determines the efficiency of the retinal image analysis which is used in the diagnosis methods in the ophthalmology. Enhancing the contrast of an image is one of the vital steps in any of retinal blood vessel segmentation approaches that we are using. The dependency of the segmented image depends on the exactness of the contrast over the entire image. The proposed paper gives an assessment of the compatibility of a newly invented spatial adaptive contrast enhancement technique for enhancing fundus images of retina for the blood vessel segmentation. The proposed enhancement technique was combined with a special algorithm called Coye algorithm, which uses blood vessel reconstruction method based on improved hough line transformation. The obtained results conveys that the employed enhancement technique is amply suitable for the specified application in the medical field.

Keywords: ophthalmology, segmentation

1. Introduction:

Diagnosis at early stage is very important in many sight-threatening ailments like glaucoma, hypertension and diabetic retinopathy which cause blindness among working age people. So retinal image analysis has become one major diagnosis method in modern ophthalmology. Image analysis of retina primarily involves in segmentation of blood vessel, segmentation of optical disc and fovea segmentation for recognizing and examining any abnormalities in the eye. The contrast enhancement is one of the compulsory steps in any of the employable image analysis methods. The most frequently encountered challenge of any contrast enhancement algorithm is finding a way to regulate the amplification in accordance with the illumination variations over the entire image. An usual solution is applying a homomorphic filter to normalize the illumination of the image. However, some contrast enhancement techniques like contrast limited adaptive histogram equalization (CLAHE) and local method of normalization (LN) have the capability of analyzing the local illumination and regulate the amplification to bring the final output up to an acceptable level of quality. CLAHE is able to handle the illumination variation by performing local histogram equalization and also able to regulate the amplification of the details. But, it also introduces a box-shaped artifact which may cause to suppress some details and also it amplifies some undesirable details.

Glaucoma is a thief of eye sight. It causes pressure on optic disk of the eye. On the longer run the ability of the eye to see the objects gets worse and even causes the vision loss. Hence retinopathy should be done at the early stages. In this

we will propose an advanced method for prediction the glaucoma at the early stages. That is Tyler coyce algorithm. Which also reduces the complexity of analysis and speeds up the segmentation process as it works on Gray level images.

![Fig 1: comparison of normal eye and eye with Glaucoma](image)

2. Literature review:

Meindert et al. (2007) has designed a supervised algorithm for the purpose of differentiating many retinal diseases. Our proposed work mostly relies on the technique called pixel classification, which had tested on a huge dataset showing the robustness of this approach. Raghu al. (2007) performed the disease detection based on the morphology. Microaneurysm detection in retinal images is used in the Contrast normalization method which is done by Alan et al. (2006). To determine the changes in retinal images for detecting Glaucoma a model has been developed by Koen et al. (2005). The results thus obtained are analyzed using the performance metrics namely sensitivity and specificity

3. Contrast Limited Adaptive Histogram Equalisation Method

The important feature in the color retinal image enhancement is the contrast of blood vessel. The image contrast is combination of the entire range of intensity values and the difference of the maximum and minimum pixel values in the image. The main aim of image enhancement using the histogram manipulation is to obtain the uniform distribution of the overall intensity of pixel. The image having the low contrast signifies narrow range of effective intensity. Histogram equalization process spreads the intensity distribution and the intensity of the original image is adjusted accordingly. This is done normally by using the Contrast limited adaptive histogram equalisation method. The existing method removes the noise over amplification.
3.1 Drawbacks of CLAHE method:
   a. Three channels are used and hence more memory is required.
   b. Performs operations on small parts called tiles and finally integration of those tiles is done finally, which uses recursive functions, so more time consuming process.

To overcome these shortcomings we use the advanced segmentation algorithm namely Tyler coye algorithm, which we will discuss in detail in this paper. The comparison of proposed algorithm with the CLAHE method is presented in this paper. Conversion into grayscale image is an added advantage of this method. Which removes a lot of unnecessary information and hence improves the efficiency of the segmentation.

4. Tyler coye Algorithm:

   Fig. 3 shows the flow chart of the Tyler Coye algorithm for blood vessel segmentation in retinal images. The principle component analysis (PCA) of weighted Lab color model is used for converting the image into grayscale. The contrast enhancement is performed by the adaptive histogram equalization method. Followed by the contrast enhancement, it excludes the background by subtracting the average filtered image. Finally, the smaller components are removed by considering the size of each connected components. Then we will get the enhanced image. This is the required network of blood vessels. These blood vessels are further analyzed by the ophthalmologist and the diseased eye is found out. Which is useful in early treatment and further loss can be prevented. This Tyler coye algorithm can also reduce the power required for processing the image as it works on grayscale image not on the RGB image. So all the useless information is completely removed before going to the further processing. It also improves the accuracy of the processed image. This method integrates the previous methods for a better result.

5. Results And Discussion

   Fig. 2, 5, 8, 11 shows the output of a sample image which has been enhanced by contrast enhancement method. Fig. 3, 6, 9, 12 shows the output of a sample image which has been enhanced by Tyler Coye Algorithm. We can clearly see the enhanced output by the coye Algorithm. As a future work we will perform calculation of various parameters like true positive rate, false positive rate, accuracy which can quantitatively show the superiority of the Tyler coye algorithm over all the existing image enhancement techniques.
Fig. B,E, H, K are the outputs by CLAHE

Fig. C,F,J,L are the outputs by Tyler coye algorithm

**Conclusion And Future Work:**

By observing the output images of the fundus images which are taken from the fundus camera, we can clearly see that the output of the tyler coye algorithm performed better result. It clearly enhanced the output of the contrast limited adaptive histogram equalization method of segmenting the fundus images. Future work is to provide quantitative method of analysing the various parameters like true positive rate, false positive rate, and accuracy.

**References:**


