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Retinal blood vessel extraction

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Abstract: Image segmentation is the process of partitioning a digital image into multiple segments (sets of pixels). Segmentation refers to the operation of partitioning an image into component parts, or into separate objects. Segmentation subdivides an image into its constituent regions or objects. The level to which the subdivision is carried depends on the problem being solved. The goal of segmentation is to simplify or change the representation of an image into something that is more meaningful and easier to analyze. The objective of Segmentation is to partition an image into regions. This paper proposes a novel method for retinal blood vessel segmentation. In this paper an automated method for blood vessel segmentation is used. Simple morphological parameters are used for retinal blood vessel segmentation. Retinal image segmentation helps to analysis retinal blood vessel damages due to various causes. Hence the extraction of retinal blood vessel is an important task. Segmentation can be effectively implemented using morphological operators. This paper emphasis on vessel extraction using morphological approaches. Vessel extraction is the first procedure in detection of damaged vessels. This approach is implemented using MATLAB.

Keywords: Image segmentation, Morphological processing, Retinal imaging, blood vessel segmentation.

I. INTRODUCTION

Eye is nearly a sphere with an average diameter of approximately 22 mm. three membranes enclose the eye: the cornea and sclera is the outer layer, the choroid, and the retina. innermost layer is the retina. retina lies inside of the wall's posterior portion. when eye is properly focused, the light from the object outside enters into the eye. pattern vision is afforded by the light receptors over surface of retina. retina has two blood vessels. they are cone and rod cells. retina allow conscious light perception and vision including color differentiation and the perception of depth with the help of rods and cone cells. Retina has numerous blood vessels. Retinal blood vessel may get damaged due to various diseases. Diabetic retinopathy is one of the major diseases that affect retina. Diabetics, hypertension, atherosclerosis are the major condition where blood vessel diagnosis is important. This may lead to poor vision. This finally leads to blindness. In this paper the retinal blood vessel segmentation [10] is done. Morphological approaches [4][5] are used for segmentation. Many morphological methods have been used earlier [4]. This project is done using simple morphological approach.

First we have to produce an input digital image from a paper envelope. This can be done by using either a CCD camera, or a scanner. Preprocessing is done for input image. After preprocessing we get enhanced image which will be more suitable for further processing. An image may be referred to as a two dimensional image f(x, y) where x and y are spatial co-ordinates. Amplitude off at any pair of co-ordinates is called intensity or gray level of the image at any point. When x, y and amplitude off are all discrete, finite quantities we call it as discrete image. Morphological operations are the tool for extracting image components that are useful in representation and description of region and shapes, such as boundaries, skeletons etc. the language of mathematical morphology [7] is a set theory. A set in mathematical morphology denotes objects in an image.

Edge detection is the most common approach for detecting discontinuities in an image. It is considered as the boundary between two regions having distinct intensity levels or having distinct gray level. Edge is a set of connected pixels that lie on the boundary between two regions. Edge detection locates sharp changes in the intensity function. Edges are pixels where brightness changes abruptly. There are many edge detectors such as Robert, Priwitt, Sobel, Canny etc. in this paper edge detection is done using morphological approach. Simple morphological operators are used for segmentation.

During segmentation optic disc removal has to be done. This is an important criterion.

II. PREVIOUS WORKS

Several methods [2] [12][13]have been put forward for retinal blood vessel extraction. Some of them are using Sobel edge detector [4], Kirsch edge detector [6], Hough transform [5], histogram equalization and dynamic contour etc

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A. Using Sobel edge detector

One mask identifies the horizontal edges and the other mask identifies the vertical edges. The direction of the edge is perpendicular to the direction of the gradient vector. If the gradient points in the horizontal direction the edge is oriented in the vertical direction. From Gx and Gy, the strength and direction of an edge at a particular location can be identified. Sobel edge operator gives an averaging effect over the image. Sobel operator mask is designed to achieve image differencing along with smoothing. So, the effect due to noise is less severe with Sobel operator. Followed by segmentation of blood vessels

Using Kirsch edge detector

This is done using Kirsch kernels [6]. Using this method the edge detection is done in all direction. Kirsch edge detector uses a mask which rotates in all four directions. That is, it moves in north, south, east and west direction. It moves across the image in convolution style algorithm. It uses a 3*3 table of pixels to store the pixel values. It calculates the derivatives. 3*3 table of pixel is called convolution table. This is computationally complex.

Using Hough transform

In order to establish a boundary between the regions, it might be necessary to fit a line to those points. This can be a time consuming and computationally in efficient process, especially if there are many such edge points. One way of finding such boundary lines is by use of the "Hough transform".

The Hough transform is designed to find lines in images, but it can be easily varied to find other shapes. The idea is simple. Each point in the image is mapped onto a line in the transform. The points in the transform corresponding to the greatest number of intersections correspond to the strongest line in the image. There is a problem with this implementation of the Hough transform, and that is that it can't find vertical lines: we can't express a vertical line in the form y=mx+c, as m represent the gradient, and a vertical line has infinite gradient. We need another parameterization of lines.

The previous works [3] uses a powerful edge detector. Some paper mainly focuses on edge detectors. This is because edge detection is a major criterion for blood vessel segmentation. In this work we mainly focus on morphological operators [8]. In morphological image processing the edge detection is done automatically during morphological processing.

III. PROPOSED WORK

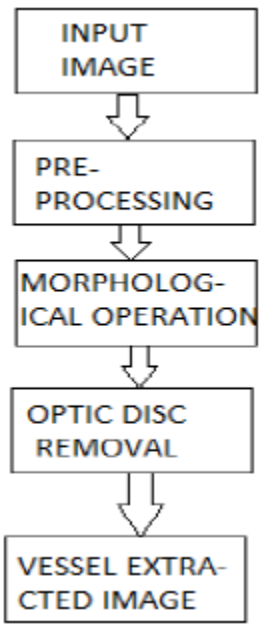

Fig1: Block Diagram for Proposed Method

This paper proposes a new advanced method for blood vessel segmentation. Block diagram for the proposed method is given below.

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Input image [1] is taken. This image is taken for pre-processing. Pre-processing is done to achieve enhanced image. This is the step taken before the "major" image processing task. The problem here is to implement some basic tasks in order to render the resulting image more suitable for the job to follow. In this case it may contain enhancing the contrast, removing noise, and identifying regions likely to contain the postcode. There are various steps for preprocessing. Pre-processing is an essential step which must be employed before image segmentation.

A. Steps for pre-processing:

1. Extract the green channel from the input image
2. Image after green channel extraction is used for histogram equalization. Instead of normal histogram equalization we use adaptive histogram equalization.
3. Then wavelet denoising is used to remove the noise.

Fundus image is colored image with red, green and blue component. Red channel contain noise and blue channel contain less information. So the green channel is extracted from the image. Adaptive histogram equalization is used for image enhancement. Adaptive histogram equalization gives better result than histogram equalization. This gives a better image. Histogram equalization automatically determines a transformation function that seeks to produce an output image that has a uniform histogram. When automatic enhancement is desired, this is good approach because the result from this technique is predictable and the method is simple to implement. Histogram equalization is an adaptive enhancement tool. Next step is noise removal. Median filter is used for de-noising. After pre-processing we can achieve the pre-processed image. This image will be highly enhanced denoised image.

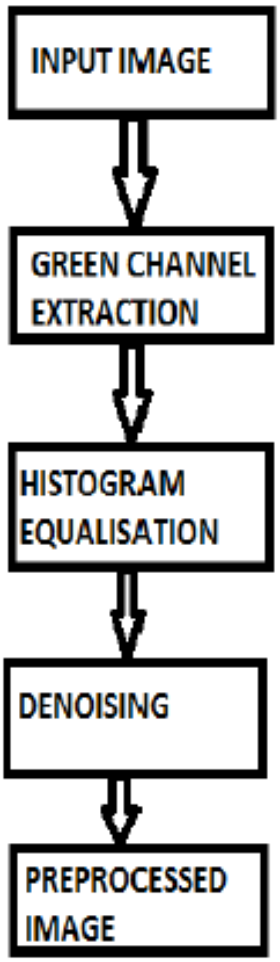

Fig2: Block diagram for pre-processing

Pre-processing improves image quality and after preprocessing we go for image segmentation. Image segmentation is a critical task through which we get the result. Segmentation operation should be better so that we get better result.

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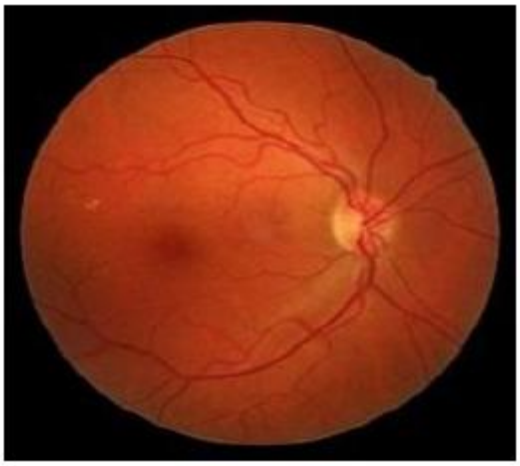

Fig 3: input image

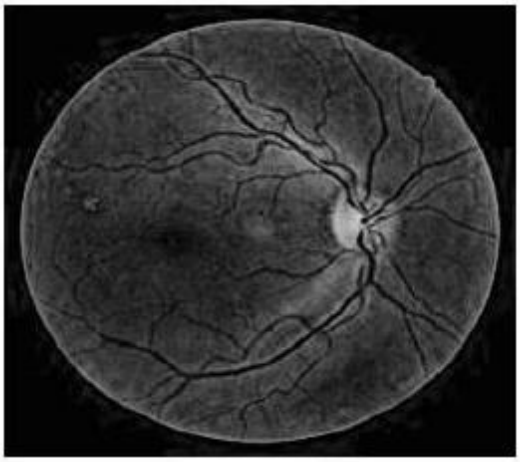

Fig4: pre-processed image

B. IMAGE SEGMENTATION

Image segmentation [3] is the process of partitioning a digital image into multiple number of segments or sets of pixels. Here is where we actually get the postcode. In other words we extract from the image that part of it which contains just the postcode. Segmentation subdivides an image into its various regions or objects. Image segmentation is done using various morphological operators [11]. Image after pre-processing is use for segmentation.

Morphological operations

Principle logic operation used in image processing are AND, OR and NOT. NOT is the complimentary operation. Logic operations such as AND, OR are performed on a pixel by pixel basis between corresponding pixels of two or more images. NOR operation is performed on the pixel of single image. Complimentary operation converts the black pixel into white and the white pixel into black. First the complimentary image of the pre –processed image is taken.

Then it is taken for dilation, erosion operation. Dilation and erosion are fundamental morphological operators. One of the simplest applications of dilation is bridging gaps. During dilation the pixels are added to the region and during erosion the pixels are removed from boundary. Dilation expands an image and erosion shrinks it. In this method we use opening operator. Opening is erosion followed by dilation. Closing is dilation followed by erosion. Opening generally smoothens the contours of an image. Opening and closing operations may be considered as “second level” operations; in that they build on the basic operations of dilation and erosion. In opening operation, each case the image has been separated into distinct components, and the lower part has been removed completely. With closing, the image will be fully joined up. We thus obtain a joining-up effect with the text image, using a diagonal structuring element. Here we use opening operation.

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OPTIC DISC REMOVAL

Optic disc removal is a major task during retinal blood vessel segmentation. Several methods have been put forward for optic disc localization [9]. This is mandatory because the optic disc may be confused during segmentation. For optic disc removal we subtract the image after opening from adaptive histogram equalization.

Fig5: optic disc removed image

After optic disc removal the image is adjusted to increase its contrast. After adjusting operation the blood vessel will be brighter than the previous image.

BINARISATION

This image is then binarised. Binary image will have only two values: 0 and 1. Banalization is one of the most important approaches to image segmentation. If background and object pixels have gray levels grouped into 2 dominant modes, they can be separated with a threshold. After banalization the image will be converted to black and white. Only black and white pixel will be present. The gray scale image is converted into black and white image after banalization. Lighter region is converted to white and the darker area will be transformed to black pixel. In the final step we get the image with extracted blood vessels. We get the clear blood vessel after extraction. From a binary image all connected components (objects) are removed. Connected components that have fewer than P pixels which produce another binary image, BW2. This operation is known as an area opening operation. This operation is used to attain the final image

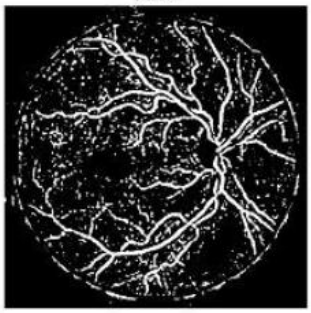

Fig5: Binarised image

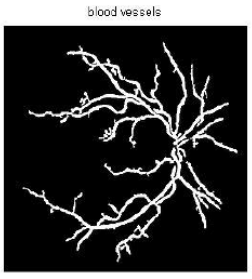

Fig5: Extracted blood vessels

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Using this method we extract blood vessel with much accuracy. Various images can be tested using this method. After segmentation the image can be classified using a classifier. Thus we can obtain the efficiency to which the segmentation is done. This method is a simplest method and less complexity. The segmentation is done more accurately. Here the edge detection is not done using the edge detectors. Morphological operators are used for edge detection which can be done more accurately.

IV. CONCLUSION

This paper uses morphological approaches for retinal blood vessel extraction. Powerful edge detectors such as sobel, prewitt, canny etc are used for vessel extraction. Here morphological operators are used for edge detection. Morphological image processing is a simple operation. That can be done more accurately and efficiently. This is less complex. Thus time consumption is less. Using this method we get result in simpler manner with less time. The segmented image is more accurate. Optic disc has to be removed during segmentation. This is an important task because the optic disk may be misleader as the blood vessel during segmentation. Optic disk may be segmented as blood vessel during the segmentation process. Thus optic disk removal is an important task. Finding image compliment, dilation and erosion, banalization, etc are the simple morphological operators used in this project. Pre-processing is an important criterion that is used before segmentation. Adaptive histogram equalization is used in this project which gives better result than normal histogram equalization. Denoising is done with median filtering. This removes noise effectively. Segmentation refers to extracting the particular features which allow us to recognize between objects. Here we will be looking for curves, holes and corners which allow us to distinguish the different types of digits which constitute a postcode. This means assigning labels to objects based on their descriptors from the previous step, and assigning meanings to those labels. So we identify particular digits, and we interpret a string of four digits at the end of the address as the postcode. This paper mainly focuses on retinal blood vessel extraction which is the first step before detection of damaged blood vessel. This is an automated method which can be implemented using MATLAB commands. This gives better result.

REFERENCES

[1]. www.retinal.med
[2]. M. M. Fraz, et al., "Blood Vessel Segmentation Methodologies of Retinal Images - A Survey," Computer methods and programs in biomedicine, vol. In Press, 2012.
[3]. R. M. Haralick and L. G. Shapiro, “Image segmentation techniques”, CVGIP, 29, pp. 100–132, 1985.
[4]. Shilpa Joshi, Dr P.T. Karule “Retinal Blood Vessel Segmentation”, International Journal of Engineering and Innovative Technology (IJEIT) Volume 1, Issue 3, March 2012
[5]. Nitasha, Shammi sharma, Reecha sharma “Comparision Between Circular Hough Transform And Modified Canny Edge Detection Algorithm For Circle Detection” International Journal of Engineering Research & Technology, vol. 1, pp 1
[6]. R.V.Prasanna, “enhancement of retinal blood vessel segmentation and classification ”
[7]. F. Zana and J. C. Klein, "Segmentation of vessel-like patterns using mathematical morphology and curvature evaluation," IEEE Transactions on, vol. 10, pp. 1010-1019, 2001.
[8]. A. M. Mendonca and A. Campilho, "Segmentation of retinal blood vessels by combining the detection of centerlines and morphological reconstruction," Medical Imaging, IEEE Transactions on, vol. 25, pp. 12001213, 2006.
[9]. Deepali A. Godse, Dr. Dattatraya S. Bormane “Automated Localization of Optic Disc in Retinal Images”, (IJACSA) International Journal of Advanced Computer Science and Applications, Vol. 4, No. 2, 2013
[10]. Axel Pinz,* Stefan Bern¨ogger, Peter Datlinger, and Andreas Kruger” Mapping the Human Retina”, IEEE transactions on medical imaging, vol. 17, no. 4, august 1998
[11]. A. Kuupp, A. Dolemeyer, R. Wilzeck, R. Schlosser, S.Wolf* and D. Meyer-Ebrecht “measuring morphologic properties of the human processing approach”
[12]. Haralick RM (1979) “Textural Featurec for Image Classification”. IEEE Transactions on System, Man and Cybernetics, vol. 3: 610-621
[13]. Adam Hoover, Ph.D.+, Valentina Kouznetsova, Ph.D.+, Michael Goldbaum, M.D.∇, “Locating Blood Vessels in Retinal Images by Piece-wise Threshold Probing of a Matched Filter Response”