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Segmentation of the Blood Vessels and Optic Disk in Retinal Images using SVM Classifier

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***Abstract*—The retinal image diagnosis is an important methodology for diabetic retinopathy detection and analysis. In this Concept the morphological operations and SVM classifier are used to detect and segment the blood vessels from the retinal image. The proposed system consists of three stages-first is preprocessing of retinal image to separate the green channel and second stage is retinal image enhancement and third stage is blood vessel segmentation using morphological operations and SVM classifier. The performance of the proposed system is analyzed using publicly available dataset.**

INTRODUCTION

Introduction blood vessels in the retina is part of the retina that serves to supply blood and oxygen to the blood vessel of the retina. If the blood and oxygen supplies are not smooth, then this may be a reference to detect whether there are health problems (hypertension, cardiovascular, stroke or diabetes). To detect these problematic veins that can be done with the segmentation of blood vessels in retinal images. There have been many approaches made to handle segmentation of blood vessels (supervised and un-supervised), but still do not meet the problems of state-of-the-art.

(1) The existence of the reflection of light from the center,
(2) Blood vessel,
(3) Branching blood vessels,
(4) merging of adjacent blood vessels,
(5) loss of blood vessles are thin/small and
(6) Error detection of blood vessles in the area.

The retina is a highly organized structure with the ability to start the processing of visual information before the information is transmitted through the optic nerve to the visual cortex. Layered structure that allows the function to search restrictions in optic disk function or functional impairment on a layer or group of cells. However, the perception of color, contrast, depth, and shape take place in the cortex Aliaa Abel-haleim Abdel-Razik yousisf et al Optic Disk is one of the main features of fundus images of the retina is an original image taken from the dataset VDIS. OD is one of the most important from indicator opthamology pathology, There was some research done for the optic disc segmentation but before segmentation must be clearly for detected

Boundary area from centroid for OD previous research can be done with active contour model. There are several steps described in previous studies initially mask binary image produced on the retina, then the illumination equalization to locate the OD is shown in fig.2 the next step adaptive histogram equalization receipts to detect small areas of blood vessles.

Fig I. Original Image retinal fundus image.

Welfer et al [3-4] Segematation is necessary to separate the optic disc area with blood vessels that exist in the area of the optic disc at the time was not considered in the segmentation of blood vessles

OPTIC DISC DETECTION

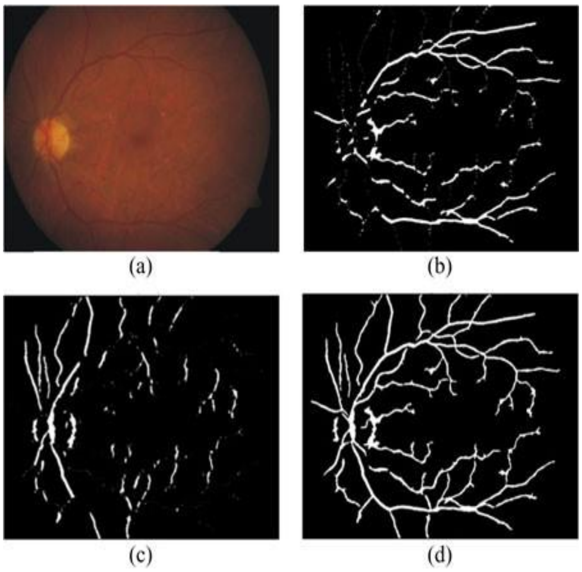
Optic Disc in healthy retina marked by bright circular area on the disk so that when the detection ara is easily detected by using entropy map In that area could also be detected by using curvelet transform In the region of intrest (Roi) can be extaracted using the average pixel and take the picture with the red channel gives the area centroid as the center

Carla Agurto et al using topological active nets, capable of segmentation the image of the optic disc by integrating features of the region segmentation technique and edge area. In the previous picture image reshape Fig.4c is an implementation of the existing k-means clustering method after that is it in the detection of optic disc should then select the area in which one will be detected is an image that will reshape the detection of optic disc area in retinal fundus images, small black circle area of pathological blood vessles is an area that will be in the optic disk detection

VESSEL SEGMENTATION:

Jan, J et all [19] the process of blood vessel segmentation using directional 2D matched filtering and estimation with Neural Fiber layer of high-resolution images taken from the camera. Segmentation of blood vessles in retinal image had been in previous through and succeeded in segmentation using the line detection [5]. Where is detected during the

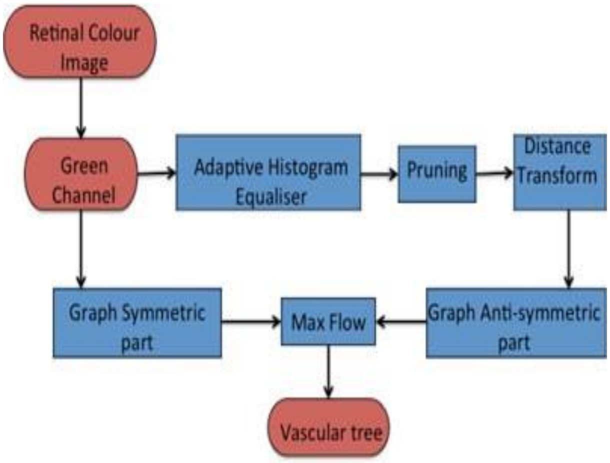
Next step of segmentation optic disc is in the area of adaptive morphology pathological using, Fig.7. is the steps in related work [3]. In the previous steps described there are several stages, the first stage, the RGB image to the image of the fox green channel, then the image in the image of the marker by using the function RMIN operator then for some later step using the operator skeleton image, the last image in the pruning step .



Vessel segmentation using the decomposition of vector v: (a) input retinal image, (b) blood vessel segmentation using horizontal (*X*-axis) decomposition of vector v, (c) blood vessel segmentation using vertical (*Y* -axis) decomposition of vector v, and (d) blood vessel segmentation result using the decomposition of vector v along the *X*- and *Y*-axes.

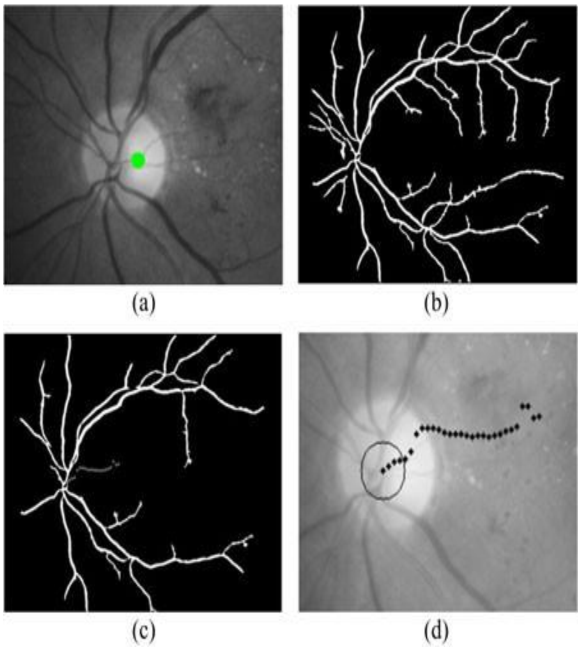
BLOOD VESSEL SEGMENTATION

Blood vessels can be seen as thin elongated structures in the retina, with variation in width and length. In order to segment the blood vessel from the fundus retinal image, we have implemented a preprocessing technique, which consists of an effective adaptive histogram equalization and robust distance transform. This operation improves the robustness and the accuracy of the graph cut algorithm. Fig. 1 shows the illustration of the vessel segmentation algorithm



OPTIC DISK SEGMENTATION WITH MRF IMAGE RECONSTRUCTION

The high contrast of blood vessels inside the optic disk presented the main difficulty for its segmentation as it misguides the segmentation through a short path, breaking the continuity of the optic disk boundary. To address this problem, the MRF-based reconstruction method presented in [25] is adapted in our study. We have selected this approach because of its robustness. The objective of our algorithm is to find a best match for some missing pixels in the image; however, one of the weaknesses of the MRF-based reconstruction is the requirement of intensive computation. To overcome this problem, we have limited the reconstruction to the ROI, and using prior segmented retina vascular tree, the reconstruction was performed in the ROI. An overview diagram of the optic disk segmentation with the MRF image reconstruction



Optic disk detection. (a) Retinal image green channel with 1% of the brightest region selected in green color, (b) binary segmented blood vessel, (c) binary segmented blood vessel after pruning, and (d) sequence of points from the centroid to vessel convergence point (optic disk location).

OPTIC DISK SEGMENTATION:

In contrast to the MRF image reconstruction, we have incorporated the blood vessels into the graph cut formulation by introducing a compensation factor *Vad*. This factor is derived using prior information of the blood vessel.

The energy function of the graph cut algorithm generally comprises boundary and regional terms. The boundary term defined in (6) is used to assign weights on the edges (*n*-links) to measure the similarity between neighboring pixels with respect to the pixel proprieties (intensity, texture, and color). Therefore, pixels with similar intensities have a strong connection. The regional term in (5) is derived to define the likelihood of the pixel belonging the Bg or the Fg by assigning weights on the edges (*t*-link) between the image pixels and the two terminals.

Once the optic disc area in detection by using the proposed method the K-means clustering pseudo code of the proposed methods showing in fig.6. The next step, segmentation of optic disc area using Adaptive morphology that has been in related work [3]. In this concept, after the are detected the optical disk is assumed as centroid then the step is much faster than step on the previous researchers.

PROPOSED THEORY:

The proposed system consists of three stages-first is preprocessing of retinal image to separate the green channel and second stage is retinal image enhancement and third stage is blood vessel segmentation using morphological operations and SVM classifier.

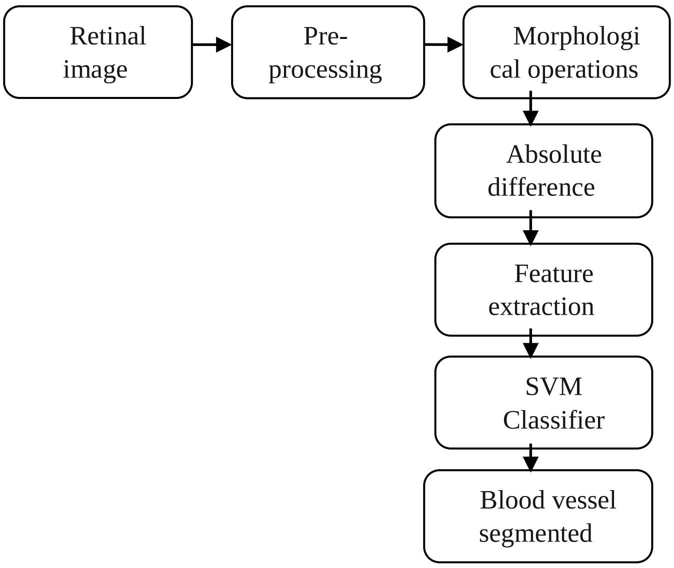


Fig: Block diagram of segmentation of the blood vessels and optic disc in retinal image using SVM classifier

PRE PROCESSING:

Initially the retinal image is enhanced using adaptive histogram equalization technique in order to enhance the blood vessels'. Then, the retinal fundus image is divided in to three primary components such as Red channel (R), Green Channel (G) and Blue channel (B). The green channel is high sensitive to the blood vessels. Hence this channel is considered for the detection and segmentation of retinal blood vessels from the retinal image.

MORPHOLOGICAL OPERATIONS

The morphological operations are applied on the pre processed green channel. Morphological operation processes the preprocessed image with structuring element. The Retinal blood vessles are detected by applying dilation and erosion process to a preprocessed image. The morphological opening and closing operation are applied to an image based on multi structure elements to enhance the vessel edges. Morphological opening and closing is performed by using dilation and erosion. The morphologically processed opened image and morphologically processed closed images are absolutely subtracted to detect the blood vessels from retina funds image. The combination of dilation and erosion operations is performed on image with different structuring element of radius 3 . Then, an absolute difference mapping image is formed by absolute subtraction of retinal image from the morphologically processed sub-band image

FEATURE EXTRACTION AND CLASSIFIER

The Local Binary Pattern (ELBP) features and GLCM features are extracted from the morphologically processed image. It can be computed as in eq.1,

$$\mathrm{LBP} = \sum_{p=1}^{8} 2^p * K(I_N - I_C) \qquad (1)$$

where, IN denotes the neighboring pixel in a square window (3×3), IC is the center pixel in the 3×3 mask, 'p' represents the number of surrounding pixels, 'K' denotes c function and K(IN – IC) is marked as the threshold value and it is estimated as

$$K(I_N - I_C) = \begin{cases} 1, & \text{if } I_N - I_C \geq 0 \\ 0, & \text{if } I_N - I_C < 0 \end{cases} \qquad (2)$$

GLCM FEATURES

The Co-occurrence features can be extracted from each Co-occurrence Matrix. Energy, contrast, correlation and homogeneity are used as GLCM features.

The extracted features are trained The given retinal images are Classifier. The SVM classifies each Pixel in the retinal image as blood Vessel or non blood vessel pixels.

RESULT

CONCLUSION:

We have presented a novel approach for blood vessels and optic disk segmentation in retinal images by integrating the mechanism of flux, MRF image reconstruction, and compensation factor into the graph cut method. The process also involves contrast enhancement, adaptive histogram equalization, binary opening, and distance transform for preprocessing. We have evaluated the performance of vessel segmentation against ten other methods including human manual labeling to the STARE dataset and 15 other methods including human manual labeling on the DRIVE dataset. For the optic disk segmentation, we have evaluated the performance of our method against three methods on the DRIVE and DIARETDBI datasets.

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