ENHANCEMENT OF RETINAL BLOOD VESSEL SEGMENTATION AND CLASSIFICATION

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ABSTRACT- Image segmentation is a decomposition of scene into its components. It is a key step in image analysis. Edge, point, line, boundary, texture and region detection are the various forms of image segmentation. In human visual Systems, edges are more sensitive than other picture elements. Edge detection technique when used alone for image segmentation results in small gaps in edge Boundaries to any of the neighbouring pixels. A new supervised method for segmentation of blood vessels in retina photographs is implemented in the project. The purpose of this method is to automate the retinal image analysis. Using the retinal image analysis the retinal abnormality can be detected, to diagnose the retinal blood vessel features which is linked to systemic disease. The morphological segmentation is used the cardiovascular and coronary disease in adult life. The algorithm described here is for integrating edges and regions. Firstly, the edge map of image is obtained by using kirsch edge operator. The algorithm is implemented in MATLAB and the result demonstrates that the algorithm is robust, satisfying and work well for images with non-uniform illumination.

INTRODUCTION

Digital image processing refers to processing of a two-dimensional picture by digital computer. It implies digital processing of two dimensional data. A digital image is an array of real or complex numbers represented by a finite number of bits. Image segmentation is a key step in digital image processing. It was developed in 1960's for image analysis. It is the process of grouping together pixels which are semantically linked. Segmentation divides image into its constituent regions or objects. The level to which segmentation is carried out depends upon the problem being solved i.e. segmentation should stop when the objects of interest in an application have been isolated. Segmentation accuracy determines the eventual success or failure of computerized analysis procedures. For this reason considerable care is taken to improve the probability of rugged segmentation. In some situations such as industrial inspection applications, at least some measure of control over the environment is possible at times. In others, as in remote sensing, user control over image acquisition is limited principally to the choice of image sensors.

Binaries image has only Two levels i.e. black and white and is obtained by thresholding. The next step of image Segmentation is feature extraction. Feature extraction generally refers to the extraction of discontinuities such as point, line and edge, and pixels norming homogeneous regions.

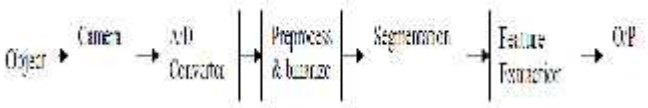


Figure-1.1: Image Analysis

KIRSCHEDGE DETECTION

Kirsch edge detection is introduced by Kirsch (1971). The masks of this Kirsch technique are defined by considering a single mask and rotating it to eight main compass directions: North, Northwest, West, Southwest, South, Southeast, East and Northeast. The masks are distinct as follows

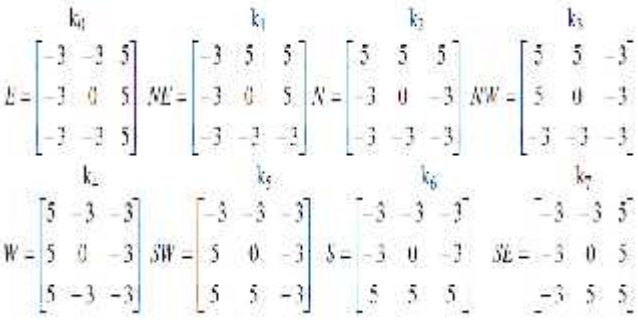


Fig 2.kirsch edge masks

The Kirsch edge-detection algorithm was designed to be implemented simply and efficiently in hardware. It can do significant area optimizations very early in the design cycle by finding efficient ways to calculate the derivative equations. For example, identify algebraic optimizations and common sub expressions in the equations.
Several useful equations to apply in the optimizations are

$$5a-3b = 8a-3(a+b) \quad (1)$$
$$\max(a-c,b-c) = \max(a,b)-c \quad (2)$$
$$\max(a+b,b+c) = b+\max(a,c) \quad (3)$$

The gradient direction is assigned from a template of eight angle directions based on the selected maximum measure and its corresponding sign.

$$\Theta = \text{invtan}[E / H] \quad (4)$$

k is determined as the value which minimizes the magnitude error, which is computed using error analysis

HUMAN EYE AND NERVE DETECTION

A new supervised method for segmentation of blood vessels in retinal photographs. This method uses an ensemble system of bagged and boosted decision trees and utilizes a feature vector based on the orientation analysis of gradient vector field, morphological transformation, line strength measures and Gabor filter responses. The feature vector encodes information to handle the healthy as well as the pathological retinal image.

LIGHT PASSES THROUGH RETINA

As the light travelling in the retina, through the various layers by the horizontal cells and cones and rods. The supervised segmentation methods utilize ground truth data for the classification of vessels based on given features. Niemeijer extracted a feature vector for each pixel that consists of the Gaussian and its derivatives at multiple scales, augmented with the green plane of the image.

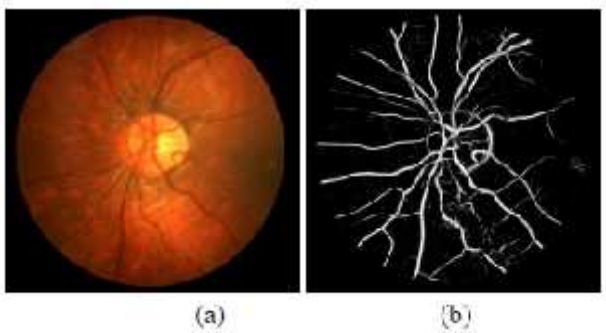


Fig 3 (a) retina (b) nerve image

PRE-PROCESSING ANALYSIS IN IMAGE PROCESSING

Preprocessing of images prior to image classification and change detection is essential. It clearly show the images without any correction Preprocessing commonly comprises a series of sequential operations including normalization, image registration, geometric correction, and masking

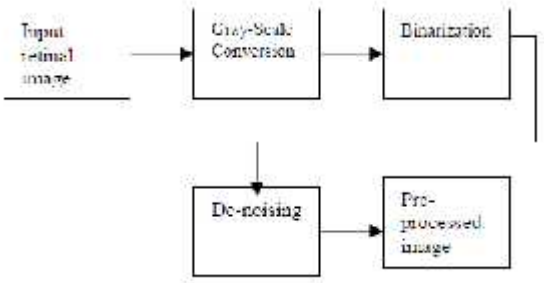


Fig 4 Block diagram of pre –processing

Steps for pre-processing
1.Divide the input retinal image into no overlapping blocks.
2.Extract RGB components from the original color retinal image.
3.After gray-level conversion, use histogram equalization to enhance the contrast and toimprove the quality of retinal image.
4.Use a large median filter to remove the noise from the image.

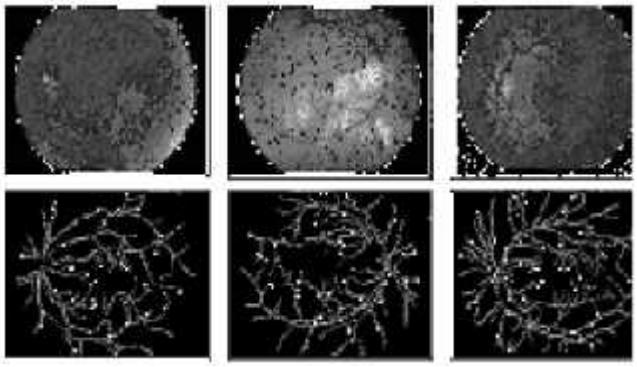


Fig 5 Vascular Segmentation after Pre processing of retinal Nerves

It gives only the frame work for diagnosing human retinal diseases. This can be implemented using matlab. Each module can be tested individually with a test data of size 100. The results can be classified into four phases: true positive, true negative, false positive, false negative. The major goal of the paper is to provide a comprehensive reference source for the researchers involved in automatic diagnosis of retinal images. This framework can be extended to any number of retinal diseases in future

PARTICLE SWARM OPTIMIZATION BASED KIRSCHS DETECTION

Particle Swarm Optimization (PSO) applies to concept of social interaction to problem solving.It was developed in 1995 by James Kennedy and Russ Eberhart It has been applied successfully to a wide variety of search and optimization problems. PSO is an algorithm applied in image processing to detect the nerves In PSO the technique called KIRSCH MODULE is used here to identify the tools.

The Kirsch edge detection algorithm uses a 3×3 table of pixels to store a pixel and its neighbours while calculating the derivatives. The 3×3 table of pixels is called a *convolution table*, because it moves across the image in a convolution-style algorithm. Figure 3 shows the convolution table at three different locations of an image .The purpose of this project is to implement the Kirsch edge detector algorithm in VHDL. The design processincludes exploring a reference model of the algorithm, creating a dataflow diagram, implementing the design in VHDL, optimizing and verifying the design, and finally downloading the optimized design to a Cyclone II 2C35 FPGA on the Altera DE2 Board. The project is to be done in groups of four. North, Northeast, East, Southeast, South, Southwest, West, and NorthWest.fig shows an image sample for each direction. In the image sample, the edge is drawn in white and direction is shown with a black arrow. Notice that the direction is *perpendicular*s the edge. The trick to remember the direction of the edge is that the direction points to the brighter side of the edge.

The Kirsch module detects edges using eight compass filters. All eight filters are applied to the image with the maximum being retained for the final image. The eight filters are a rotation of a basic compass convolution filter. The filters are of the form: and vertical convolution kernels (3x3) are considered Kirsch convolution kernels (3x3) After observing these results for 3x3 kernels which are over segmented for mammographic images so to reduce this over segmentation 3x3 convolution kernels are modified to 5x5 convolution kernels for 0º and 90º Region growing algorithms, including seeded region growing, are a widely employed technique used in image segmentation problems. It is common for region growing techniques to employ queue based techniques that kernels for 0º and 90º Region growing algorithms, including seeded region growing, are a widely employed technique used in image segmentation problems. It is common for region growing techniques to employ queue based techniques that sequentially add pixels to regions. These algorithms are veryflexible, but it is sometimes desirable to be able to apply some constraints to the growing process that reject some higher level knowledge about the problem. Regularized seeded region growing [9] is a technique that constrains (regularizes) the border smoothness of a growing region using a polygonal representation and provides some results illustrating a possible application. The technique can be usefully combined with traditional, un-regularizedtechniquesregularized.

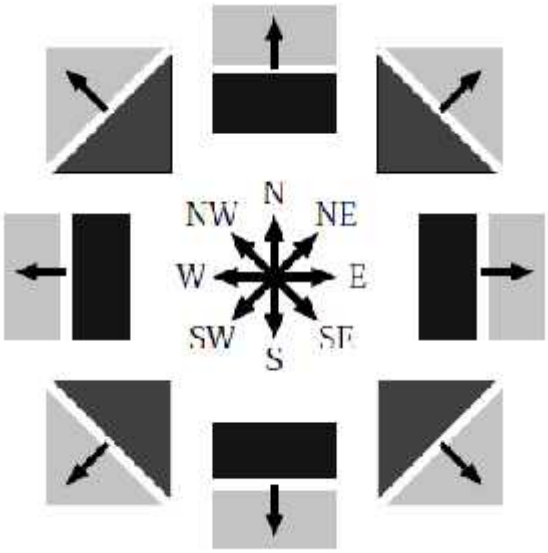


Fig 6 directions

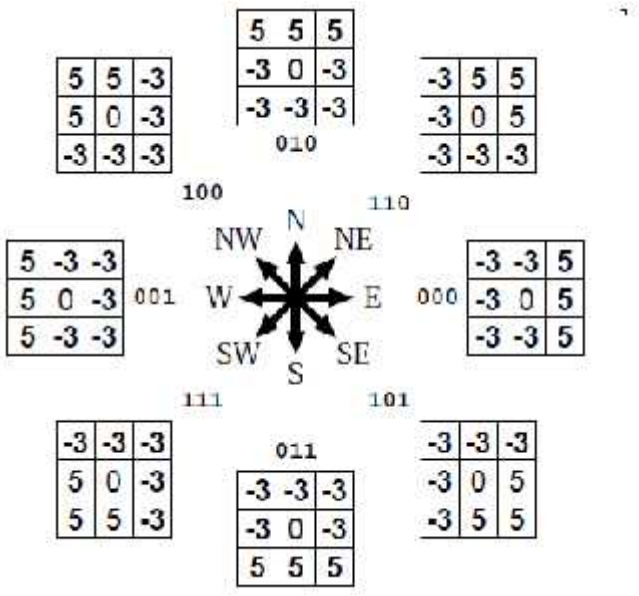
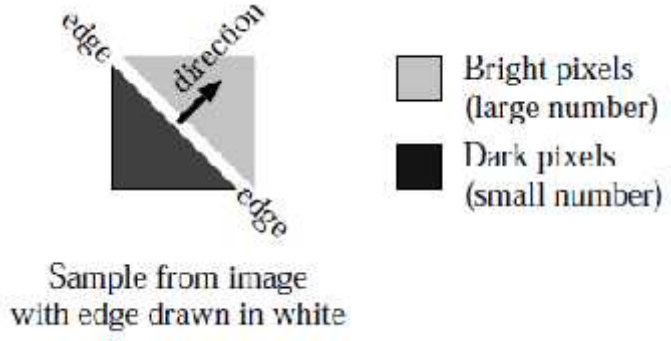


Fig 7masks

The Kirsch module detects edges using eight compass filters. All eight filters are applied to the image

with the maximum being retained for the final image. The eight filters are a rotation of a basic compass convolution filter. The filters are of the matrices form [11][12]. Kirsch edge detector detects edges using eight filters are applied to the image with the maximum being retained for thefinal image. The eight filters are a rotation of a basic compassconvolution filter. For comparison with Sobel and Prewitt operator here only two directions horizontal and verticalconvolution kernel s(3x3) are considered Kirsch convolutionkernels(3x3)After observing these results for 3x3 kernelswhich are oversegmented for mammographic images so to reduce this oversegmentation 3x3 convolution kernels are modified to 5x5convolution kernels for 0º and 90º.



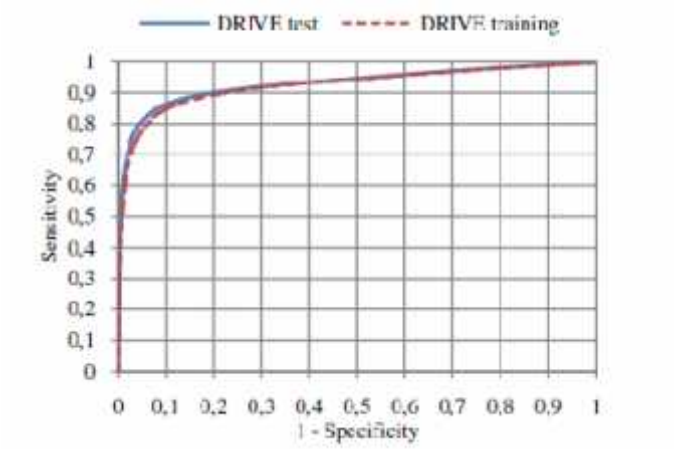


Fig 8The ROC curve of the proposed method on the DRIVE
database.

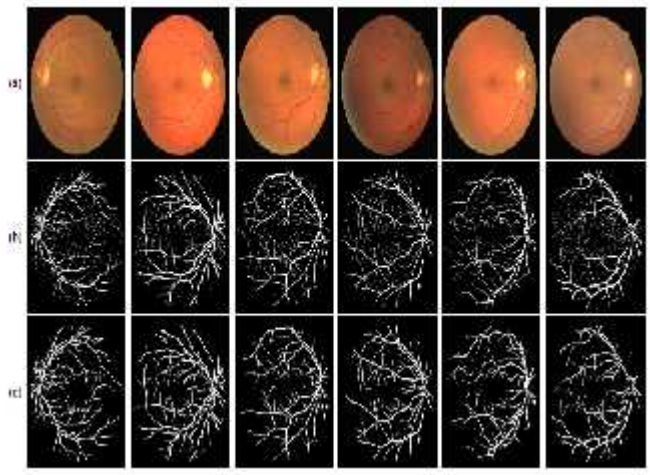


Fig 9 Six images from the DRIVE test set (a) the gold truth segmentation (b), and the results of the proposed method (c) at 96.7% specificity and 76.5% sensitivity.

CONCLUSION

In this project, kirsch edge detector is used which is one of the most powerful edge detector as the edge points determined, give rise to ridges in the gradient magnitude image. The kirsch algorithm then tracks at the top of these ridges and sets to zero all pixels that are not actually on the ridge top so as to give thin line as the output, a process known as non-maximal suppression. Also due to the use of two thresholds, unlike other edge detectors it is able to detect small intensity variations in an image as edges.

Kirsch masks are generally used for detecting the edges in all the four directions, horizontal, vertical, 450 and -450. They are used to find the approximate absolute gradient magnitude with particular direction in input gray scale image. A new approach used is that horizontal and vertical kirsch masks are combined with the 450 and - 450 diagonal masks to obtain the edge region, instead of applying the horizontal, vertical and diagonal masks alone. This method results in thick edge region, which is further used for growing seeds.

In the edge region detected by kirsch operator the two types of region growing seeds (pixels) are grown, which are used to obtain the final segmented image. In the homogeneous region no seeds will be produced and seeds can grow in this region. If an area has both types of seeds then a competition will occur. In this case the kind of seed which is closer to that pixel will win and pixel will be merged into that seed set.

The performance metrics of most of the vessel segmentation algorithms in the literature are calculated on a small number of images of adults with particular

morphological characteristics. The morphological characteristics of retinal images of premature infants and children are very different than those of the adult retina. Choroidal vessels are more visible alongside the retinal vessels in retinal images taken from premature infants .

It offers very precise segmentation in detecting objects of different sizes and also non-rigid targets. This approach is not sensitive to the parameters, such as the sizes of different operators and thresholds in the edge detection and edge region detection. The algorithm is implemented in MATLAB and the result demonstrates that the algorithm is robust, satisfying and work well for images with non-uniform illumination.

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