Colour Retinal Fundus Image Segmentation Based On Sift Detector

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Abstract: Automatic Segmentation of retinal blood vessels plays an important role in the diagnosis of diagnosing several complicated diseases such as Retinal Tear, Retinal Detachment and Microaneurysm diseases. This work presents a new technique for retinal blood vessel segmentation in color retinal images using the Scale Invariant Feature Transform Detector (SIFT) and predicts the abnormal retinal disease using Artificial Neural Network (ANN). Initially Image pre-processing is done to reduce the presence of unwanted noise in an image. Pre-processing steps make the retinal images more suitable for vessel extraction. Images are then enhanced using Contrast Limited Adaptive Histogram equalization. To estimate the vessel keypoint SIFT is used. Mask based Blood Vessels Extraction with global image threshold is implemented for vessel extraction, the extraction of retinal blood vessels are done using the expectation maximization algorithm. Feature Extraction generally consists of three steps Statistical, Texture and Shape based Feature to evaluate the artificial neural network in predicting Normal and Abnormal Retinal disease. The proposed SIFT based segmentation approach is simulated and performance of the proposed algorithm is evaluated and compared with existing approach.

Index Terms: ANN, CLAHE, Feature Extraction, Microaneurysm, SIFT, Retinal Tear, Retinal Detachment

1 INTRODUCTION
Biomedical Image Processing and computer vision techniques are increasing in all fields of medical sciences. This work aims at developing a computer based diagnosis technique to assist ophthalmologists in retinal screening programs, in order to detect and quantify the early signs associated with retinal disease in fundus photographs.[1] The work described in this paper consists of two parts. The first part addresses the segmentation of blood vessels, which is one of the important diagnostic features and the second part proposes a system to detect abnormalities from retinal images, which helps in the identification of microaneurysms. The automatic blood vessel segmentation technique is used for the analysis of vascular structures of the human retina. Changes in retinal vessel structure are one of the main symptoms of diseases like retinal tear and retinal detachment. Artificial neural network (ANN) is used for classification because it can differentiate large number of fundus images obtained from mass screening and used to classify normal and abnormality of retina.

2 ALGORITHM AND CONCEPTS
The input images are initially collected from database and the contrast of these images are further improved using the image enhancement techniques. To estimate the vessel keypoint SIFT is used. Finally, an optimal set of features are extracted from these images and used as input for the classification techniques to evaluate the normal and abnormal retinal disease.

First step is to acquire an original image from dataset. They are originally RGB in nature and hence it is necessary to convert it into the grey scale image. Pre-processing is a process to eliminate the presence of unwanted features of the image such as noise. The purpose of image pre-processing is to improve the appearance of image since images contain some amount of noise. So a artificial noise like Salt and pepper noise is added to the image just to analysis the process of denoising. Contrast Limited Adaptive Histogram Equalization technique is used for contrast enhancement. This technique enhances the contrast of fundus image by limiting the Expectation and maximization algorithm. SIFT algorithm consist of two important stages: detection of features and descriptor extraction. Mask based Blood Vessels Extraction with global image threshold is performed to improve the image quality. The main purpose of using this technique is that the CLAHE algorithm partitions the images into different regions and then applies the histogram equalization to each region. Global Image Threshold technique is used for segmentation of Blood Vessels and Extraction from fundus Image. Expectation and maximization algorithm is generally used for segmenting abnormality of retina. Feature Extraction generally consist of statistical, texture and shape based feature, this three parameters plays important role in extraction of features. Classification of Normal and Abnormal Fundus Image using Artificial Neural Network.

Figure 2.1. Proposed framework for retinal blood vessel segmentation.
3 SIMULATION RESULTS

3.1 Color retinal fundus image segmentation using SIFT Detector

3.1.1 Preprocessing Result
Retinal blood vessel segmentation is very important element in both ophthalmological and cardiovascular disease such as Retinal Tear, Retinal Detachment and Microaneurysm. Accurate segmentation of the retinal blood vessels has become the basic step for automatic screening of abnormal retinal disease.

Figure 3.1 Preprocessing result on a Fundas image from the HRF dataset. (a) Image with Noise (b) Noise removed

3.1.2 Image Enhancement Using Contrast Limited Adapative Histogram Equalization

Figure 3.2 Image Enhancement using CLAHE

Contrast Limited Adaptive Histogram Equalization technique is generally used for contrast enhancement. This technique enhances the contrast of image. Expectation and maximization algorithm is used for segmentating blood vessels.

3.1.3 Selection of Stable Extremum points using Scale Invariant Feature Transform Detector

Figure 3.3 (a)&(b) Selection of stable extremum points using scale invariant feature transform on a normal image.

The Scale-invariant feature transform (SIFT) algorithm used in identifying and extraction of abnormal features of retina. This method is used to detect keypoints in the original image.

3.1.4 Mask based Blood Vessels Extraction with global image threshold

3.1.5 Segmentation of Affected part using Expectation Maximisation Algorithm

3.1.4 shows mask based blood vessels extraction with global image threshold

This technique adopted for retinal vessel segmentation technique using mask based vessels extraction with global image threshold. This technique is generally used for segmenting the normal and abnormal retinal diseases of retina.

3.1.5 Segmentation of Affected part using Expectation Maximisation Algorithm

The proposed method of blood vessel extraction is experimented on fundus eye images.
Sample images of retinal tear, retinal detachment and microaneurysms blood vessels segmented output

3.1.6 Identification of Normal and Abnormal Retinal Diseases using Artificial Neural Network
Classification of normal and abnormal retinal disease is done by artificial neural network.

The slight improvement in the accuracy is mainly due to the involvement of probability measures which is better than the methodology used in ANN classifier.

| Table 3.4 Comparison Between Different Retinal Vessel Segmentation Methods |
|---|---|---|
| Sensitivity | Specificity | Accuracy |
| Chaudhuri et al. [24] | 0.282 | 0.926 | 0.604 |
| Hanwimaluang et al. [25] | 0.508 | 0.943 | 0.726 |
| Proposed Method (RT, RD, MA) | 0.492 | 0.843 | 0.756 |

In this study, a retinal vessel segmentation algorithm based on SIFT detector method was proposed. Utilising expectation maximisation algorithm, the CLAHE and matched filtering...
techniques, the images were enhanced before the blood vessel segmentation. Finally, the vessels were segmented by a Mask based blood vessels extraction with global image threshold approach. The pro-posed segmentation method was validated on publicly accessible data sets by using common validation metrics in retinal vessel segmentation where the results (Sensitivity = 0.492, Specificity = 0.843, Accuracy=0.756), and compared with other methods in literature. The proposed method can detect abnormalities like retinal tear, retinal detachment and microaneurysms.

CONCLUSION
In this work biomedical retinal image processing system is used to help ophthalmologist in identifying and diagnose of abnormalities. To develop this system, features are extracted from normal and abnormal retinal images by applying new techniques comprising of image processing and machine learning. These extracted features help in detecting abnormalities. The main advantages of this proposed work lies in simple implementation, less cost and segmenting blood vessels from retina. The method used in vessel extraction using SIFT based Vessel Segmentation. Contrast Limited Adaptive Histogram Equalization used in pre-processing and Segmentation operations in post-processing helps in identifying retinal diseases like retinal tear, retinal detachment and microaneurysms. Optic disc removal for individual type of vessels will be done in future.

REFERENCES