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Efficient Detection of Retina Blood Vessels Using Proficient Morphological Algorithms

Sirpa.M.R[1], Vyshnavi.G.K.P[2], Chandramoorthy.M [3], Padmapriya.B[4]

[1234]*M.E/Dept. of CSE*

Abstract-Image processing play a vital role in blood vessel extraction from the fundus image. Retinal vessel segmentation is important for the detection of eye diseases and plays an important role in automatic retinal disease screening systems. Automatic detection and analysis of the vasculature can assist in the implementation of screening programs for vessel diameter measurement in relation with diagnosis of hypertension, and computer-assisted laser surgery. Segmentation retinal anatomical structures are the first step in any automatic retina analysis system. Detection of large vessels is relatively easy due to their strong contrast against background in the images but detection of small vessels is much more difficult due to their low contrast in the images. The proposed method uses a new filter to extract the thin vessels. Also the proposed method has been tested with various set of retinal images. The images used for retinal analysis were collected from DRIVE database.

Key Terms*: Retina, Hypertension, Segmentation, Blood Vessel, Detection.*

1. INTRODUCTION

Image processing play a vital role in blood vessel extraction from the fundus image. In an automated retinal image analysis system, exact detection of optic disc in colour retinal images is a significant task. The information obtained from the examination of retinal blood vessels offers many useful parameters for the diagnosis or evaluation of ocular or systemic diseases. For example, the retinal blood vessel has shown some morphological changes such as diameter, length, branching angles or tortuosity for vascular or nonvascular pathology, such as hypertension, diabetes, cardiovascular diseases. In colour fundus image shown in Figure 1, optic disc appears as a bright spot of circular or elliptical shape, interrupted by the outgoing vessels. It is seen that optic nerves and blood vessels emerge into the retina through optic disc. Therefore it is also called the blind spot. Detection of the same is the prerequisite for the segmentation of other normal and pathological features in the retina. The location of optic disc is used as a reference length for measuring distances in these images, especially for locating the macula.

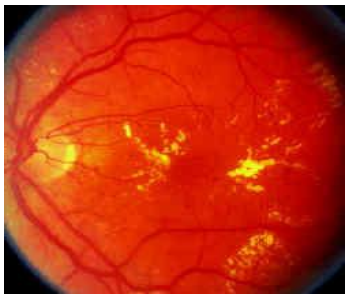

Figure 1: Digital Color Retinal Image

Ophthalmologists interpret and analyses the retinal images visually to diagnose various pathologies in the retina like Diabetic Retinopathy (DR). DR is the most common eye complication in diabetes is Diabetic Retinopathy. Diabetic patients have to be screened for early detection and timely treatment of diabetic eye diseases which can significantly reduce the risk of vision loss. Detection of large vessels is relatively easy due to their strong contrast against background in the images but detection of small vessels is much more difficult due to their low contrast in the images. The proposed method uses a new filter to extract the thin vessels. So detection of block present in the retina blood vessels are easily due to detecting both large and thin vessels. Early detection and timely treatment can be given for patients who are affected in corresponding eye diseases.

2. IMAGE PROCESSING

2.1. Background Study

Image processing is a method to perform some operations on an image, in order to get an enhanced image or to extract some useful information from it. It is a type of signal processing in which input is an image and output may be image or characteristics/features associated with that image. Nowadays, image processing is among rapidly growing technologies. It forms core research area within engineering and computer science disciplines too.

Image processing basically includes the following three steps:

- Importing the image via image acquisition tools;
- Analysing and manipulating the image;
- Output in which result can be altered image or report that is based on image analysis.

There are two types of methods used for image processing namely, analogue and digital image processing. Analogue image processing can be used for the hard copies like printouts and photographs. Image analysts use various fundamentals of interpretation while using these visual techniques. Digital image processing techniques help in manipulation of the digital images by using computers. The three general phases that all types of data have to undergo while using digital technique are pre-processing, enhancement, and display, information extraction.

2.2. Purpose of Image Processing

The purpose of image processing is divided into 5 groups. They are:

1. Visualization - Observe the objects that are not visible.
2. Image sharpening and restoration - To create a better image.
3. Image retrieval - Seek for the image of interest.
4. Measurement of pattern – Measures various objects in an image.
5. Image Recognition – Distinguish the objects in an image.

2.3. Image Processing Applications

Image processing has an enormous range of applications; almost every area of science and technology can make use of image processing methods. Here is a short list just to give some indication of the range of image processing applications.

Medicine

- Inspection and interpretation of images obtained from X-rays, MRI or CAT scans,
- Analysis of cell images, of chromosome karyotypes.

Agriculture

- Satellite/aerial views of land, for example to determine how much land is being used for different purposes, or to investigate the suitability of different regions for different crops,
- Inspection of fruit and vegetables distinguishing good and fresh produce from old.

Industry

- Automatic inspection of items on a production line,
- Inspection of paper samples.

Law enforcement

- Fingerprint analysis,
- Sharpening or de-blurring of speed-camera images.

Physiology of a retina

To study the effects of retinopathies and other systemic diseases on the retina and its vasculature, one needs to understand the detailed architecture of retina and ocular structures. The schematic different ocular structures and retina which is positioned on the back side of the eye, covering it from inside. Retinal membrane consists of nerve cells which are sensitive to light and are classified into two types, viz., rods and cones. The nerve cells are the mediators between optical signals received at the retina, and part of the central nervous system dealing with the visual senses. Rod cells are responsible for black and white vision, the peripheral vision and the vision in dim lighting conditions, whereas the cone cells deal with both black/white and the color vision. Cones are present in the ocular structure known as fovea, which develops the high visual acuity in the central vision the retinal vasculature and the neuronal network organized on the retina are responsible for blood circulation in the inner retina and nervous system signal transmission, respectively. Development of a vasculature on the retina is dependent upon the growth of ocular structures and nervous system during the embryonic stage, along with the oxygen requirements and presence of vasoactive growth factors. Metabolic behaviors which get an acted through diseases such as diabetes, hypertension, cardiovascular diseases, cancers and blood infections, produce detrimental effects on the entire system including the retina and its circulation.

3. EXISTING SYSTEM

In existing system proposes a method for the Retinal image analysis through efficient detection of exudates and recognizes the retina to be normal or abnormal. The contrast image is enhanced by curvelet transform. Hence, morphology operators are applied to the enhanced image in order to find the retinal image ridges. A simple thresholding method along with opening and closing operation indicates the remained ridges belonging to vessels. The clustering method is used for effective detection of exudates of eye. Experimental result proves that the blood vessels and exudates can be effectively detected by applying this method on the retinal images. Fundus images of the retina were collected from a reputed eye clinic and 110 images were trained and tested in order to extract the exudates and blood vessels. In this system we use the Probabilistic Neural Network (PNN) for training and testing the pre-processed images. The results showed the retina is normal or abnormal thereby analysing the retinal image efficiently. There is 98% accuracy in the detection of the exudates in the retina.

Disadvantage

- Low accuracy
- Extraction of Retina thin blood vessels are not possible.

4. PROPOSED SYSTEM

In an automated retinal image analysis system, exact detection of optic disc in colour retinal images is a

significant task. Detection of the same is the prerequisite for the segmentation of other normal and pathological features in the retina. The location of optic disc is used as a reference length for measuring distances in these images, especially for locating the macula. Optic disc appears as a bright spot of circular or elliptical shape, interrupted by the outgoing vessels. It is seen that optic nerves and blood vessels emerge into the retina through optic disc. Therefore it is also called the blind spot. Ophthalmologists interprets and analyses the retinal images visually to diagnose various pathologies in the retina like Diabetic Retinopathy (DR). In order to make their work more easier retinal image analysis system can be developed to make the diagnosis more efficiently. DR is the most common eye complication in diabetes is Diabetic Retinopathy. Diabetic patients have to be screened for early detection and timely treatment of diabetic eye diseases which can significantly reduce the risk of vision loss. In order to make their work more easier retinal image analysis system can be developed to make the diagnosis more efficiently. The proposed method uses a new filter to extract the thin vessels. Segmentation retinal anatomical structures are the first step in any automatic retina analysis system. Detection of large vessels is relatively easy due to their strong contrast against background in the images but detection of small vessels is much more difficult due to their low contrast in the images. The proposed method uses a new filter to extract the thin vessels.

Advantage

- Extract the thin vessels
- Better contrast enhancement
- Accurate retina vessel and easily find out the detection. It is useful in Diabetic diagnosis.

5. SYSTEM OVERVIEW ARCHITECTURE DESIGN

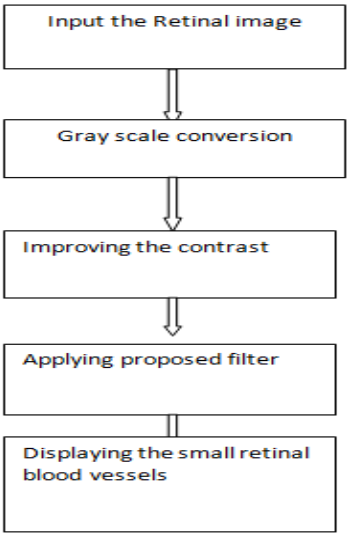

Figure 3. System Overview Architecture Design

6. MODULE DESCRIPTION

6.1. Input the retinal image

The first module is input or read the RGB image.

6.2. Gray Scale Conversion

In the second module RGB image is converted in to gray scale image.

Grayscale is a range of monochromatic shades from black to white. Therefore, a grayscale image contains only shades of gray and no color. While digital images can be saved as grayscale (or black and white) images, even color images contain grayscale information. This is because each pixel has a luminance value, regardless of its color. Luminance can also be described as brightness or intensity, which can be measured on a scale from black (zero intensity) to white (full intensity). Most image file formats support a minimum of 8-bit grayscale, which provides 2^8 or 256 levels of luminance per pixel. Some formats support 16-bit grayscale, which provides 2^16 or 65,536 levels of luminance. 33

Many image editing programs allow you to convert a color image to black and white, or grayscale. This process removes all color information, leaving only the luminance of each pixel. Since digital images are displayed using a combination of red, green, and blue (RGB) colors, each pixel has three separate luminance values. Therefore, these three values must be combined into a single value when removing color from an image. There are several ways to do this. One option is to average all luminance values for each pixel. Another method involves keeping only the luminance values from the red, green, or blue channel. Some programs provide other custom grayscale conversion algorithms that allow you to generate a black and white image with the appearance you prefer. The figures shows the conversions of retinal images by using MATLAB.

Figure 5.3. Conversions into Grayscale Image

6.3. Improving the Contrast

Contrast is defined as the separation between the darkest and brightest areas of the image. Increase contrast and you increase the separation between dark and bright, making shadows darker and highlights brighter. Decrease contrast and you bring the shadows up and the highlights down to make them closer to one another. Adding contrast usually adds "pop" and makes an image look more vibrant while decreasing contrast can make an image look duller.

6.4 Filter Algorithm

Proposed Filter Algorithm consist of combination of 4 filter characteristics,

1. Sobel Filter
2. Wiener Filter
3. Median Filter
4. Gabor Filter

These combinations will give the following new filter. These filters are properly extracted thin vessels.

Apply segmentation and sharpening technique after applying these filters.

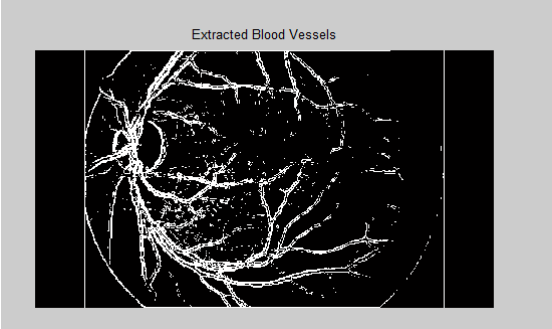

Figure 4. Extraction of retina Blood Vessels

7. CONCLUSION

A new algorithm for vessel extraction in retinal color fundus images was presented in this work. This approach is effective in medical and biomedical applications as automated retinal image analyses system. The proposed method is applied for a database of 40 images and an accuracy of 0.9480 with 0.7840 and 0.9826 sensitivity and specificity, respectively on the DRIVE database obtained. The results of proposed method were compared to those obtained from existing methods and better performance has been achieved used. This method provides clear blood vessels of retinal images, suitable for detection retinal pathologies.

Future Enhancement

For further study an efficient classification process can be considered for every image point in order to minimize or even eliminated some of misdetections of retina blood vessels.

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BIOGRAPHIES

Sirpa.MR[1] received the B.E. degree at the stream of Computer Science and Engineering from the Excel Engineering College, Sankagiri, Anna University, India, in 2013. Currently doing M.E. at the stream of Computer Science and Engineering in Institute of Road and Transport Technology, Erode, Anna University, Chennai, India. Her research interest includes in "Efficient Detection of Retina Blood Vessels Using Proficient Morphological Algorithms".

Vyshnavi.GKP[2] received the B.E. degree at the stream of Computer Science and Engineering from the Vivekanandha Institute of Engineering and Technology for Women, Tiruchengode, Anna University, Chennai, India, in 2014. Currently doing M.E. at the stream of Computer Science and Engineering in Institute of Road and Transport Technology, Erode, Anna University, Chennai, India. Her research interest includes in "Efficient Detection of Retina Blood Vessels Using Proficient Morphological Algorithms".

Chandramoorthy.M[3] received the B.E. degree at the stream of Electronics and Communication Engineering from the Thangavelu Engineering College, Chennai, Anna University, India, in 2012. Currently doing M.E. at the stream of Computer Science and Engineering in Institute of Road and Transport Technology, Erode, Anna University, Chennai, India. His research interest includes in "Efficient Detection of Retina Blood Vessels Using Proficient Morphological Algorithms".

Padmapriya.B[4] received the B.E. degree at the stream of Computer Science and Engineering from the SNS College of Technology, Coimbatore, Anna University, Chennai, India, in 2014. Currently doing M.E. at the stream of Computer Science and Engineering in Institute of Road and Transport Technology, Erode, Anna University, Chennai, India. Her research interest includes in "Efficient Detection of Retina Blood Vessels Using Proficient Morphological Algorithms"