A New Approach to Detection of Blood Vessels and Optic Disc from Digital Fundus Images

P. P. Muralikrishna[1] , B. Manikanth[2]

[1] *Project student, Department of ECE, Vasireddy Venkatadri Institute of Technology, Nambur, AP, India.*

[2]*Assistant professor, Department of ECE, Vasireddy Venkatadri Institute of Technology, Nambur, AP, India.*

[1] ppm.krishna7@gmail.com

[2] manikanth439@gmail.com

Abstract: **Retinal image analysis is the most important for detecting diagnosis in modern ophthalmology. In this paper, we present a novel method to detect blood vessels and optic disc from fundus retinal images. The early diagnosis of diabetic retinopathy are damages the retina, is crucial to the protection of the vision of diabetes sufferers. This method is useful to detect the diagnosis in the fundus retinal images like diabetic retinopathy, hypertension and glaucoma. In this histogram equalization technique is used for detection of blood vessels from digital fundus retinal images and histogram matching method is used for detecting optic disc.**

Keywords: **Optic disc, blood vessels, fundus and retinal image.**

1.0 INTRODUCTION

Retina is the innermost layer of the eye which can be visualized using adequate apparatus such as fundus camera. The two main structures used in retinal image analysis are blood vessels and optic disc. The morphology of the retinal blood vessel and the optic disc is an important structural indicator for detecting the severity of retinal diseases such as diabetic retinopathy, hypertension, glaucoma, hemorrhages and vein occlusion. The optic disc is the brightest component on the fundus retinal images, so cluster of high intensity pixels will identify the optic disc location. The OD is important for developing automated diagnosis expert systems. Optic disc detection is a key preprocessing component in many algorithms designed to identify other fundus features. However, to assess the diameter and tortuosity of the retinal blood vessel or the shape of the optic disc, manual planimetry has commonly been used by ophthalmologists. Generally this process is time consuming and prone to human error, especially when the vessel structures are very complicated or a large number of images are acquired to be labeled by hand. Therefore, ophthalmologists need a automated method for retinal blood vessel and optic disc detection to identify the diseases.

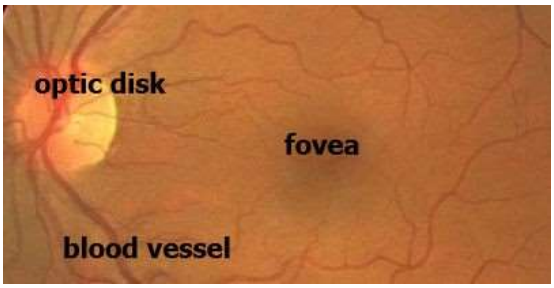

Fig 1: Color fundus image showing main features of retina

Many techniques were proposed for the detection of blood vessels and optic disc of fundus retinal images. In this paper, we proposed histogram equalization method for detection of blood vessels of fundus retinal image.

1.1 RETINAL IMAGING BACKGROUND

Digital images and human retina images are captured by digital video camera with flash. Generally Ophthalmology clinic can access large collections of digital fundus retinal images. Detection of diseases of fundus retinal image is a challenging process for ophthalmologists. Large variability is observed between images from different patients, even if healthy, with the situation worsening when pathologies exist. For the same patient, variability is observed under differing imaging conditions, and during the course of a treatment.

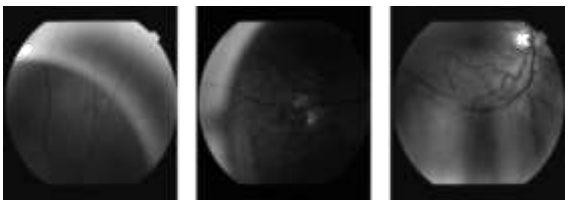

Fig 2: some examples of fundus images with non- uniform illumination.

1.2 MODELS FOR DETECTING RETINAL VASCULATURE IN DIGITAL IMAGERY

In the previous several methods were used to detect the blood vessels and optic disc of fundus retinal images. Thresholding is a process of segmentation of

blood vessels. In this technique segmentation of blood vessels is based on the observation that blood vessel pixels are darker than the background pixels. Thus by identifying all pixels that are darker than some threshold *T*, you can easily identify all vessel pixels.

2.0 PROPOSED METHOD

The histogram equalization is a widely used method for enhancing the contrast of the retinal images. The enhanced images represent the small blood vessels in much better manner. The proposed algorithm is designed for retinal blood vessels segmentation.

2.1 HISTOGRAM EQUALIZATION

Histogram Equalization method is use to segmentation of blood vessels of fundus retinal image. Cumulative density function (CDF) is useful to generate the flat histogram of the retina image. The CDF function is obtained by simply integration of Probability density functions (PDF) and it is given as

$$= \int_0^r P(r)dr; \quad 0 \le r \le 1 \text{ ------ } (2.1)$$

Now differentiating the equation (2) will give;

$$\frac{ds}{dr} \propto P(r) \text{ ---------- } (2.2)$$

This is the CDF will flatten the histogram. But Histogram equalization method is simply change the brightness of an input image and cause problem in some applications where brightness preservation is necessary. The below figure shows the original retina image and histogram equalized image of the retina image.

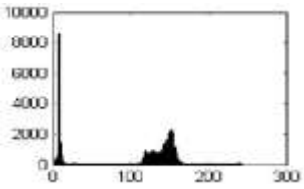

Fig 3: Original histogram

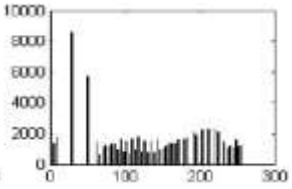

Fig 4: Equalized histogram

2.2 HISTOGRAM MATCHING

Histogram is the main character of each image and histogram based methods are used as the first step of most preprocessing methods to improve the contrast and illumination retina images. Proposed a histogram matching method based on template matching for localizing the center of optic disc. Most of the methods for localizing optic disc fail when pathological regions exist in retina images. Some other algorithms suffer from high computational cost. Here, a new robust method for localizing the center of optic disc in presence of pathological regions is proposed. Since in this method preprocessing algorithms such as segmentation are not used, the computational cost is drastically reduced with respect to some counterparts.

3. RESULTS

a) Proposed algorithm is designed for retinal blood vessels detection. Input to the system is a fundus image of human retina acquired by a fundus camera and the output is a binary image which contains only blood vessels. In this histogram equalization method the color retinal image is converted into binary image after that we did the processes of contract enhancement, background exclusion and thresholding for detecting blood vessels is shown in figure 9.

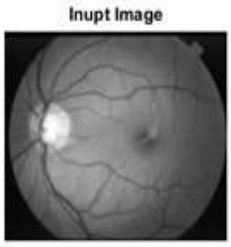

Fig 5: Input image

Fig 6: Histogram of input image

Fig 7: Histogram equalized image

Fig 8: Histogram of equalized image

Fig 9: Detected vessels

b) Detection of optic disc is done by histogram matching method. Input to the system is a color fundus image of human retina, at first the image is converted as binary image and next optic disc is detected from that binary image is shown in figure 12. In this method instead of creating an image as template, we are creating the template of optic disc.

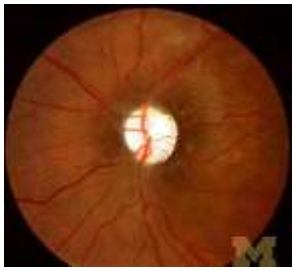

Fig 10: input image

Fig 11: binary image

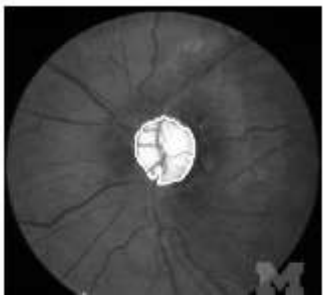

Fig 12: detected optic disc

4. CONCLUSION

In this paper we proposed a simple method for detection of blood vessels and optic disc of retinal fundus images using histogram equalization method and histogram matching method respectively. The proposed method uses simple and computationally less intensive processing steps so it is suitable for fast processing applications also. The proposed histogram matching method for detection of optic disc gives very accurate results with less running time.

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