AUTOMATIC DETECTION OF OPTIC DISC BASED ON CONNECTED COMPONENT ANALYSIS

T.S.Udhaya suriya[#1], N.Bavya[*2], R.Jansi[*3], J.Jayapriya[*4],M.Ramya[*5]
[#]*Associate Professor, Department of Biomedical Engineering,*
Adhiyamaan College of Engineering, Hosur-635109, Tamilnadu.
[1]tsu.suriya@gmail.com
[*]*Final Year Students, Department of Biomedical Engineering,*
Adhiyamaan College of Engineering, Hosur-635109, Tamilnadu
[2]aaradhyabme@gmail.com

***Abstract*-The algorithm proposed in this paper allows to automatic dectection of optic based on connected component analysis. The goal is to facilitate the early detection of certain pathologies and to fully automate the process so as to avoid specialist intervention. The method proposed for the extraction of the optic disc contour is mainly based on mathematical morphology along with connected component analysis (CCA). The proposed method involves blood vessels detection and removal, image Inpainting and segmentation. The blood vessels are effectively detected using morphological opening and closing operations. The image Inpainting process will be used to fill the empty vessels region and disc is detected using gray level thresholding approach. Optic disc detection and tracking will be performed using connected component analysis. The methodologies used in the project to provide better results in detection rather than prior approaches.**

Key words: Morphological filtering-erosion and dilation, Inpainting technique, Gray level thresholding, connected component analysis.

I.INTRODUCTION

Diabetic retinopathy, hypertension, glaucoma, and macular degeneration are nowadays some of the most common causes of visual impairment and blindness. Early diagnosis and appropriate referral for treatment of these diseases can prevent visual loss. Usually, more than 80% of global visual impairment is avoidable and in the case of diabetes by up to 98%. All of these diseases can be detected through a direct and regular ophthalmologic examination of the risk population. However, population growth, aging, physical inactivity and rising levels of obesity are contributing factors to the increase of them, which causes the number of ophthalmologists needed for evaluation by direct examination is a limiting factor.

So, a system for automatic recognition of the characteristic patterns of these pathological cases would provide a great benefit[5]. Regarding this aspect, optic disc (OD) segmentation is a key process in many algorithms designed for the automatic extraction of anatomical ocular structures, the detection of retinal lesions, and the identification of other fundus features .

II.LITERATURE SURVEY

There are Numerous OD segmentation methods, i.e., OD-boundary detectors, have been reported in the literature. In general, the presented techniques can mainly be grouped into template- based methods, deformable models, and morphological algorithms. Different approaches have been proposed according to template-based methods: edge detection techniques.

The method proposed in this paper is mainly based on mathematical morphology although includes a morphological filtering in the pre-processing stage. The main steps of the method are the following: It is observed that disc appears most contrasted in the green channel compared to red and blue channels in the RGB image. Therefore, only the green channel image is used for calculating the optimal threshold. This stage is very important since it largely determines the final result [4].

III.METHOD

A.Morphological filtering

Morphological operations are used here to detect vessels from enhanced retinal fundus image with more flexible[6]. It processes the image based on shapes and it performs on image using structuring element. The vessel edge will be detected by applying dilation and erosion process with 'disk' shape structuring element to an image after that by thresholding vessels are extracted effectively. Then, the vessels are subtracted from input image with this detected vessels and process inpainting to fill the empty vessels region with the neighbouring pixel values. Finally the Gaussian smoothing filter is applied to suppress the irrelevant details from the retinal fundus.

B.Inpainting

Inpainting algorithms are used in diverse applications, from the restoration of damaged photographs to the removal/replacement of selected objects. These algorithms usually try to fill selected

parts of an image by propagating external information so that structure continuity is preserved.
Let a binary image Ω(x) stand for the region to be inpainted and $\partial\Omega$ for its boundary. For each $\partial\Omega$ pixel x, the inpainted pixel value is computed as

$$P(\mathbf{x}) = \frac{\sum_{k=1}^{n} \frac{P_k(\mathbf{x})}{l_k}}{\sum_{k=1}^{n} \frac{1}{l_k}}$$

Where P_K denotes the pixel values in a neighbourhood of the pixel under consideration n, is the number of neighbouring pixels, and l_K is the distance between the pixel x and each neighbouring pixel. So that, the in painted image Υ(f,Ω) of a gray image f(x) is,

$$\Upsilon(f,\Omega)(\mathbf{x}) = \begin{cases} f(\mathbf{x}), & \text{if } \partial\Omega(\mathbf{x}) \\ P(\mathbf{x}), & \text{if } \partial\Omega(\mathbf{x}) \end{cases}$$

After filling $\partial\Omega$ with the computed values, the - pixels are removing from Ω and $\partial\Omega$ is recalculated. The process is repeated until the mask is empty and all pixels have been filled[3].

C. Morphological Operators:

Mathematical morphology is a nonlinear image processing methodology based on minimum and maximum operations [5] whose aim is to extract relevant structures of an image. Let f be a greyscale image which is defined as f(x):E->T where x is the pixel position. In the case of discrete valued images, $T=\{t_{min}, t_{min}+1.....t_{max}\}$
is an ordered set of gray-levels. Typically, in digital 8-bit images $t_{min}=0$ and $t_{max}= 255$. Furthermore, let B(x) be a subset of Z^2 called structuring element (shape probe) centred at point x, whose shape is usually chosen according to some a priori knowledge about the geometry of the relevant and irrelevant image structures. The two basic morphological operators

$$\text{Dilation}: [\delta_B(f)](\mathbf{x}) = \max_{b\in B(\mathbf{x})} f(\mathbf{x}+\mathbf{b})$$

$$\text{Erosion}: [\varepsilon_B(f)](\mathbf{x}) = \min_{b\in B(\mathbf{x})} f(\mathbf{x}+\mathbf{b}).$$

Their purpose is to expand light or dark regions, respectively, according to the size and shape of the structuring element. Those elementary operations can be combined to obtain a new set of operators or basic filters given by

$$\text{Opening}: \gamma_B(f) = \delta_B(\varepsilon_B(f))$$

$$\text{Closing}: \varphi_B(f) = \varepsilon_B(\delta_B(f)).$$

Light or dark structures are respectively filtered out from the image by these operators regarding the structuring element chosen[7]. Other morphological operators that complement the previous ones are geodesic transformations[2].

D. Image segmentation:

Segmentation refers to the process of partitioning a digital image into multiple regions. Image segmentation is typically used to locate objects and boundaries (lines, curves, etc.) in images. Here, the input image will be segmented with gray level thresholding method[1].

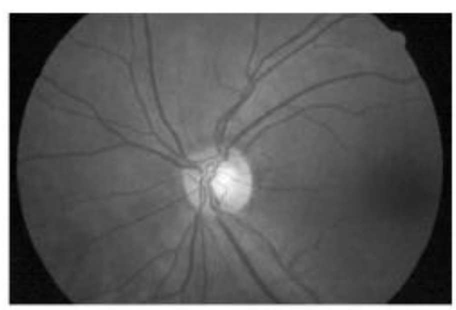
E. Connected component analysis

Connected component analysis is a process to label the segmented image foreground pixels. It will be used to separate the image into n number of local objects. Then the irrelevant background object with maximum area was removed using the morphological process.

IV.RESULT

(a)

Fig.1.RGB fundus image



(b)

Fig.2.Green plane image

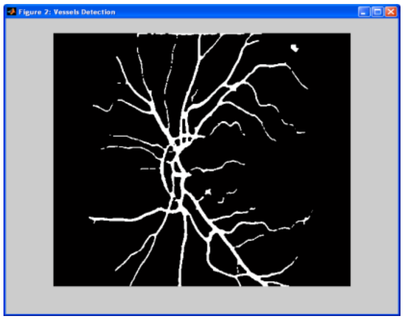


Fig.3.Vessel detection

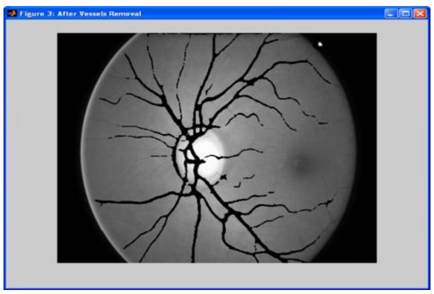


Fig.4.After vessel removal

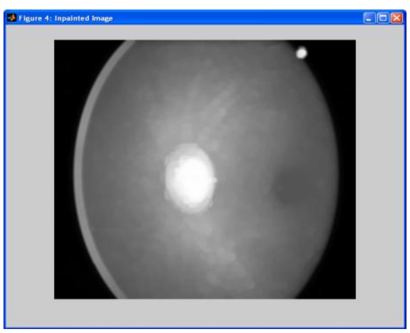


Fig.6.Inpainted image

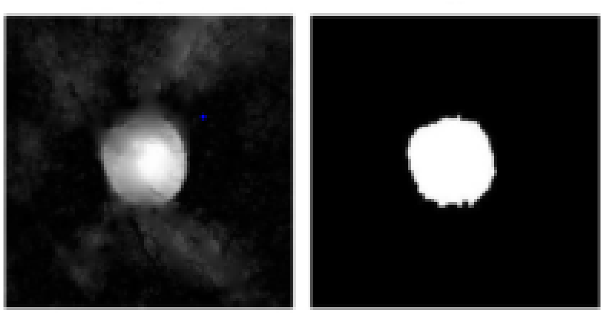


Fig.7.Thresholding optic disc

V.CONCLUSION:

In this paper, a new approach for the automatic detection of the optic disc has been presented. First, it is focused on the use of a new grey image as input obtained which combines the most significant information of the three RGB components. Secondly, several operations based on mathematical morphology are implemented with the aim of locating the OD. For that purpose, both grey level thresholding and connected component analysis have been used. The algorithm has been validated on five different public databases obtaining promising results and improving the results of other methods of the literature. The final goal of the proposed method is to make easier the early detection of diseases related to the fundus. Its main advantage is the full automation of the algorithm since it does not require any intervention by clinicians, which releases necessary resources (specialists) and reduces the consultation time, hence its use in primary care is facilitated. As for future lines, the optic cup will also be detected with the goal of measuring the cup-to-disc (C/D) ratio. A high C/D ratio will indicate that a fundus is suspicious of glaucoma.

VI.REFERENCES

L. D. Hubbard, R. J. Brothers,
W. N. King, L. X. Clegg, R. Klein,
L.S. Cooper, A. Sharrett, M. D. Davis, and J. Cai, "Methods for evaluation of retinal micro vascular abnormalities associated with hypertension/sclerosis in the atherosclerosis risk in communities study," Ophthalmology, Vol. 106, no. 12, pp. 2269–2280, 1999.

2 .M. D. Knudtson, K. E. Lee, L. D. Hubbard, T. Y. Y. Wong, R. Klein,
and B. E. Klein, "Revised formulas for summarizing retinal vessel diameters,"Current Eye Res., vol. 27, no. 3, pp. 143–149, Sep. 2003.

3. J. Liu, D. W. K. Wong, J. H. Lim, H. Li, N. M. Tan, Z. Zhang,
T.Y. Wong, and R. Lavanya, "Argali: An automatic cup-to-disc ratio measurement system for glaucoma analysis using level-set image processing," in 13th International Conference on Biomedical Engineering, Berlin, Germany: Springer, 2009, Vol. 23, pp. 559–562.

4. D. Pascolini and S. P.Mariotti, "Global estimates of visual impairment: 2010,"Br. J.Ophthalmol., pp. 614–621, 2011.

5. World Health Org., Action plan for the prevention of blindness and
Visual impairment 2009–2013 2010.

6. T. Walter, J. C. Klein, P. Massin, and A. Erginay, "A contribution of image processing to the diagnosis of diabetic retinopathy-detection of exudates in color fundus images of the human retina," IEEE Trans. Med. Imag., Vol. 21, no. 10, pp. 1236–1243, Oct. 2002.