



OPTIC DISC DETECTION - A SURVEY PAPER

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Abstract: Retinal Imaging' is a very important feature for detecting diseases like diabetic retinopathy and glaucoma. This is diagnosed by an Ophthalmologist using a 'Digital Retinal Image - a high resolution photographic system to establish critical retinal developments. Timely diagnosis of these diseases can prevent people from severe vision loss. Therefore, necessity of automatic retinal image analysis system is required for reliable and efficient automatic detection of optic disc, blood vessels and fovea in the retinal image.

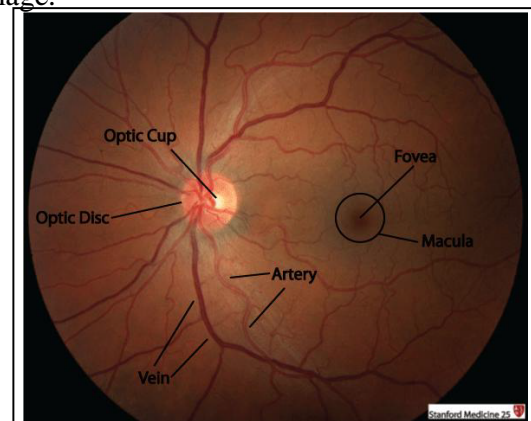
This Paper presents various techniques used for locating *Optic Disc*.

Keywords: Retinal Imaging, Fundus Image, Diabetic Retinopathy, Glaucoma, Optic Disk (OD), Blind Spot, Mean Absolute Distance, Overlapping Ratio

Introduction: The fundus is the interior surface of the eye, opposite to the lens. Fundus Image (or fundography) is used to determine the interior surface of the eye for monitoring the progression of any disease. Fundus includes retina, optic disc, macula and fovea, and posterior pole as shown below.

Fundus imaging has provided considerable breakthrough in identifying larger areas of the fundus (including vascular area, optic disc and muscular region) than what can be seen at any

one time with handheld ophthalmoscopes. Likewise methods have been conceived for detection of optic disc which help in identifying and locating the structure of retinal fundus image.



Fundus

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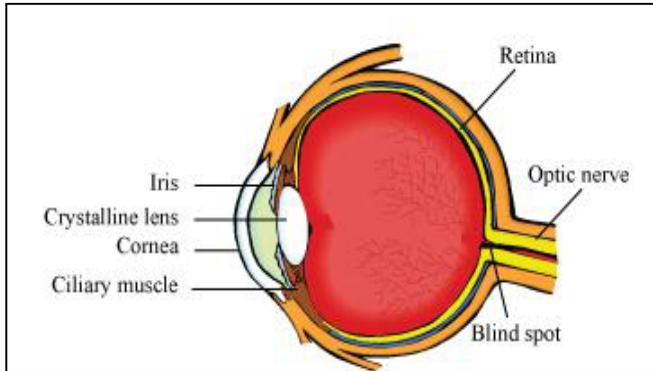
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Optic Disc

Optic Disc or Optic Nerve Head is the location where the axon exits the eye to form the optic nerve. As there are no light sensitive rods and cones present in this region, this corresponds to a *physiological blind spot*.



Physiological Blind Spot

It is also the place of enter of blood vessels and is placed 3 mm to 4 mm to the nasal side of the fovea. It is a vertical oval with average dimension of 1.76 mm horizontally, and 1.92 mm vertically.

Some Methods for Localization in Optic Disk

Subhasis Chaudhuri, S. Chatterjee & M. Goldbaum : They have proposed a new method for detection of blood vessels. These vessels usually have poor local contrast and the application of existing edge detection algorithms yield result which are satisfactory. They introduced an operator to feature extraction based on the optical and spatial properties of objects to be recognized. The concept of matched filter detection of signals is used in this detection of vessels by piecewise linear segmentation.

Ana G. Salazar-Gonzalez, Yogmin Li and Xiaohui liu : This method is an automated and unsupervised method for blood vessels segmentation using graph cut technique. The graph is constructed from pre-processed image. The results are tested on two public datasets and compared with other methods. Experimental result shows that this method outperforms on the other unsupervised methods and are better than supervised methods.

Arturo Aquino : He proposed blood vessels segmentation using circular Hough Transform to obtain circular on boundary

approximation for this purpose, a location within the OD as initial information. For this, a location methodology based on voting type algorithm is proposed. Algorithm evaluated on 1200 images of publically available messidor database the location procedure succeeded in 99% of cases taking an average computation time of 1.67 sec. with a standard deviation of 0.145. On the other hand, the segmentation algorithm rendered an average + common area overlapping between automated segmentation and true OD region of 86%.

Joao V. B. Soares & Jorge J. G. Leandro : They proposed a method of vessel segmentation using 2D gabor wavelet based on image pixel as vessel or non vessel based on the pixel's feature vector. Gabor wavelet is capable of tuning to specific frequencies thus allowing noise filtering vessel enhancement in single step.

We use Bayesian classifier with class conditional probability density functions described as Gaussian mixture that yield a fast classification. The probability distributions are estimated based on a training set of labelled pixels obtained from manual segmentation. The method performance is evaluated on publicly available DRIVE and STARE databases.

Frederic Zana and Jean Claude Klein : This paper present an algorithm based on mathematical morphological and curvature evaluation for the detection of vessel like pattern in a noisy environment. In order to differentiate vessels from analogous background pattern, a cross curvature evaluation is performed. They are separated from image as they have Gaussian profile whose curvature varies smoothly along the vessels. The detection algorithm that derives directly from this modelling is based on four steps :

- 1) Noise reduction.
- 2) Linear pattern with Gaussian profile improvement.
- 3) Cross curvature evaluation.
- 4) Linear filtering; Robustness is evaluated and its accuracy with respect to noise.

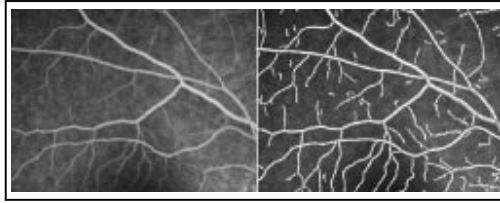


Image from an Angiography of a Normal Eye

James Lowell and Andrew Jackson :

Here optic disk localization is performed using specialized template matching and segmentation by a deformable model and local deformable model with variable edge strength dependent stiffness.

Ana Maria Mendonca : She proposed a method of segmentation of retinal blood vessels by continuing the detection of centrelines and morphological reconstruction. For this purpose, the outputs of four directional differential operators are processed in order to select connected set of candidate points to be further classified as centreline pixels using vessel derived features. The final segmentation is obtained using an interactive region growing method that integrates the contents of several binary images resulting from vessel width dependent morphological filters.

Ahmed E. Fahmy : He proposed fast localization of the optic using projection of image features. This technique require less time to localize the OD. This technique is based upon obtaining two projections of certain image features that encode the X and Y coordinates of OD. The resulting 1-D projections are then searched to determine the location of the OD.

Conclusion

Introducing simple operator for featuring detection based on the optical and spatial properties can be efficiently implemented in vision detecting machines for real time convolution operations. According to S. Chaudhuri *et al*, the automatic detection could help physicians in diagnosing ocular diseases. Likewise, Ana G. Salazar-Gonzalez *et al* the performance of their method is measured by calculating the overlapping ratio (Oratio), sensitivity and the mean absolute distance (MAD) with respect to the manually labelled images. Experimental results demonstrate that their method outperforms other methods on these datasets.

It is hoped that the automatic optic disc segmentation method can assist the ophthalmologist for the early detection of glaucoma and retinopathy diseases.

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