LOCALIZATION OF OPTIC DISC IN RETINAL IMAGES BY USING AN EFFICIENT K-MEANS CLUSTERING ALGORITHM

[1]ARUSHI SHARMA, [2]NITA NIMABRTE, [3]SAPANA DHANVIJAY

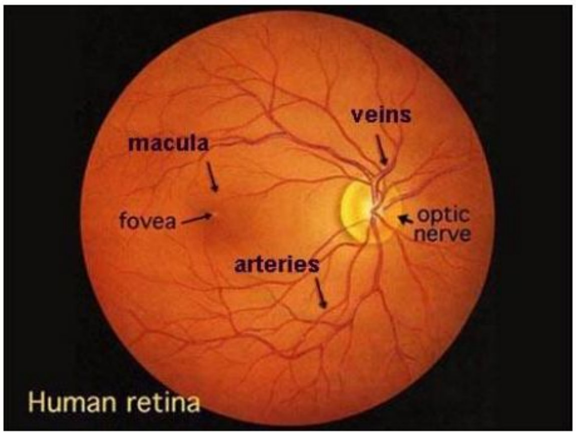
[1]Student of Mtech Communication, Yeshwantrao Chavan College of Engineering, Nagpur, India
[2]E&T Dept., Yeshwantrao Chavan College of Engineering, Nagpur, India
[3]E&C Dept., Priyadarshini Bhagwati College of Engineering, Nagpur, India
Email: arushi26sharma@gmail.com, nitangp@gmail.com, sapanadhanvijay@gmail.com

Abstract— In this paper, we proposed algorithm for localization of optic disc as it aids to detect different phases of diabetic retinopathy. The proposed algorithm gives accurate results for localization of optic disc. There are three stages defined in this paper for localization of optic disc. First stage is pre-processing in which the retinal image is enhanced. Second stage is clustering in which K-means algorithm is applied. Third stage is post-processing where morphological operations are performed. The proposed algorithm is applied on the DRIVE dataset. The results obtain when the number of clusters chosen are 16 and 20.

Keywords—Optic Disc, Adaptive Histogram Equalization, K-means algorithm, Mathematical Morphology

I. INTRODUCTION

Early detection of retinal eye disease is awful to avoid as it involves chances of vision loss. Usually, identification of retinal eye disease techniques is too expensive and very tedious for manual observation. Reliable and efficient automatic detection of normal features like optic disc, blood vessels and fovea in the retinal images are hence the significant tasks, in an automatic screening system. As a pre-requisite for the subsequent stages in many methods applied for identification of the pathological structures in retinal images, Optic disc detection is required. In macula localization the approximate distance between optic disc and the macula is used as a prior knowledge for locating the macula. To help estimate the location of the macula, as a prior knowledge, the OD serves as a landmark for other fundus features; such as the quite constant distance between the OD and the macula-center (fovea) [4]. The optic nerve head, or disc, is defined as the distal portion of the optic nerve extending from the myelinated portion of nerve. Typically, it is slightly oval with the vertical diameter being about 9% greater than the horizontal. In Optic disc, the mean vertical and horizontal optic disc diameters were 1.88 and 1.77 mm, respectively. Normal variation in cup disc ratio can be explained by the normal variation in optic disc diameter. Larger optic discs and optic nerves have more optic nerve fibers than do smaller discs and nerves. Ophthalmic pathologies especially for glaucoma are indicated by the change in the shape, color or depth of OD. Thus the OD dimensions are used to measure abnormal features due to certain retinopathies, such as glaucoma and diabetic retinopathies.



Various Models based and other approaches for detection of optic disc are described in the literature. In the Non-Model based approaches, the Optic Disc was moreover loomed as an elliptical area or they were segmented out using different thresholding techniques or morphological operations. Hummel and Pizer invented the basic form of the method independently. In this basic form involves applying to each pixel the histogram equalization mapping based on the pixel in a region surrounding that pixel. That is each pixel is mapped to an intensity value proportional to its rank in the pixel surrounding it. Nayak et al. [3] used morphological operations in the red plane of the coloured image. They further segmented out the Optic Cup in the green plane and calculated a Cup to Disc Ratio by taking the vertical lengths of both segmented areas. Using the Cup to Disc Ratio, they classified between Normal and Glaucomatous images with an overall accuracy of 90% on a set of 15 images. V. Vijaya Kumari et. al [6] used morphology operation for detection of the Optic Disc and blood vessels. Different Morphological operations of different sizes are used, but main disadvantage of this operation is that the size of structuring element suitable is for one image but not for the suitable other retinal image. Garcia et al identifies Hard Exudates using neural network (NN) methodology. Here Three NN classifiers were studied which includes multilayer perceptron (MLP), radial basis function (RBF) and support vector machine (SVM).

Vijayamadheswaran et al projected detection of Exudates with the help of Contextual Clustering and Radial basis function. In this technique all the fundus images are converted into a standard template image. The k-means algorithm is a popular method for clustering a set of data vectors. The classical version of k means uses squared Euclidean distance; however this distance measure is often inappropriate for its application to document clustering.
Complete explanations of the material used are given in Section II. Section III methods for detection of optic disc. The experimental results are given in section IV. Conclusions are given in V respectively.

II. MATERIAL

The dataset used in this paper is the DRIVE dataset it gives the relative studies on retinal vasculature segmentation. The dataset consists of a total of 40 color retinal images which is used for creating genuine clinical diagnoses, where 33 images do not show any sign of diabetic retinopathy and seven show signs of mild early diabetic retinopathy.

III. METHODS FOR DETECTION OF OPTIC DISC

This section presents proposed Optic Disc detection technique. In precise, we have divided this section in three sub sections, which deal with retinal image pre-processing, clustering and third is post processing.

A. Retinal Image Pre-Processing

Retinal images are needed to be pre-processed in case of optic disc detection. Pre-processing is again divided into two steps; the first step is to resize the input image of size 565×584 into the fixed size of 256×256. The resized image is the RGB image. Second step is to extract the green channel from the resized image, so that the image is Gray. Third step is to apply adaptive histogram equalization extracted green channel image because it normalize and enhanced the contrast in the retinal images. It increases the contrast of the grayscale image by converting the values by using contrast-limited adaptive histogram equalization (CLAHE).
CLAHE works on small regions in the image, called tiles, fairly than the entire image. Each tile's contrast is enhanced, so that the output region the histogram of roughly matches the histogram specified by the some parameter. It is more operational than classical histogram equalization as it aids in detecting small blood vessels as they are considered by low contrast level.

B. Clustering

Once the image is resized and adaptive histogram is applied, clustering algorithm is applied on image. Cluster analysis is a key technique for reducing a mountain of rare data to a pile of meaningful information. It shrinks data which creates subgroups that are more manageable than individual datum. Like factor analysis, it studies the full complement of inter-relationships between variables. Prior knowledge of membership of each cluster is required by latter in order to classify new cases whereas in case cluster analysis, no prior knowledge is required about, which elements belong to which clusters. The grouping or clusters are defined through a thorough data analysis. Subsequent multi-variate analyses are performed on the clusters as groups. Cluster analysis is a statistical method of partitioning a sample into homogeneous classes in order to produce an operational classification.

- K-Means Algorithm

K-means clustering is a vector quantization method, which is initially from signal processing, that is common for cluster analysis in data mining. The main aim of K-means clustering is to divide n observations into k clusters in which each observation fits to the cluster with the nearest mean.
The modified algorithm for k-means derived from [11] is explained as follows.
Step 1: Read the input image.
Step 2: Resized the input image into 256×256.
Step 3: Divide the input image into non overlapping blocks and convert each block to vectors thus forming a training vector set.
Step 4: Compute the centroid (codevector) of this training vector set.
Step 5: Compute Euclidean distance between all the training vectors belonging to this cluster and the vectors v1 and v2 and split the cluster into two.
Step 6: Compute the centroid (codevector) for the clusters obtained in the above step 5.
Step 7: increment i by one and repeat step 4 to step 6 for each code vector.
Step 8: Repeat the Step 4 to Step 8 till codebook of desire size is obtained.

C. Post processing

Once K-mean clustering algorithm is applied on the histogram image optic disc is detected in segmented image. After detecting optic disc in segmented we apply Mathematical Morphology (MM) on the segmented image by using disc shape structuring element. In MM images are considered as geometrical objects that are examined with other geometric object. The MM is based on set theory. Therefore, with the help of this set operation many useful operators can be defined in MM. Sets in MM represents objects in images [13]. Morphological operation can be clear by stirring a structuring element over the binary image. The Morphological operation is defined as dilation and erosion. Dilation is a method in which the binary image is stretched from its original shape that is it widens the image whereas erosion shrinks the image.

Morphological dilation applied in this proposed algorithm is disc shape structuring element because the original size of the optic disc is circular in shape.

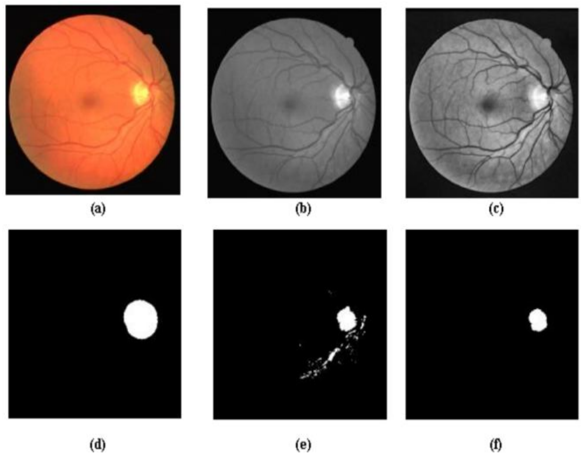


Fig.2. (a) Resized Image. (b) Green Channel Extracted Result. (c) Adaptive Histogram Equalization. (d) Mask. (e) Segmented Image. (f) Optic Disc Detected.

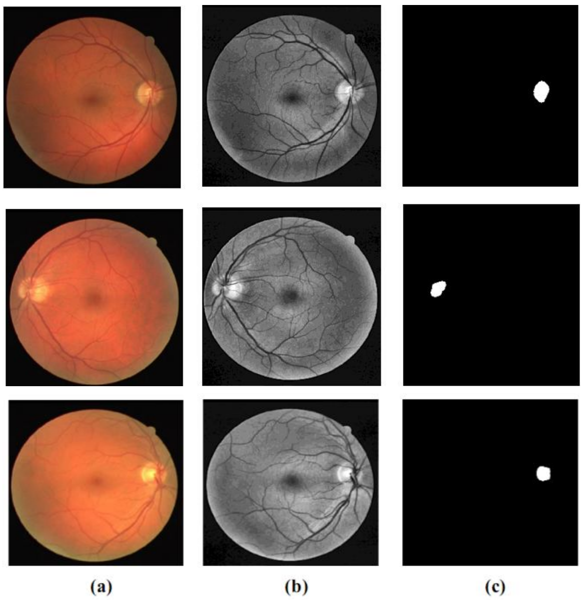


Fig.3. (a) Original resize image. (b) Adaptive histogram with green channel extracted. (c) Optic disc detected.

IV. EXPERIMENTAL RESULT

The word "The algorithms discussed above is executed using MATLAB 7.0 on Intel Core i5 processor, 2.50 GHz, 4 GB RAM. To test the enactment of the algorithms 40 retinal images that belong to different classes of size 565×584 are used. The output result is premeditated in about 6 to 8 seconds and the calculation time is changed with each new retinal image from the dataset.

The proposed algorithm developed here is tested on a set of retinal images of DRIVE dataset. The optic disc is properly located in 33 images out of 40 images. As given in figure 2(a) the image is resized to 256×256 to reduce the computing time of the algorithm, in figure 2(b) green channel is extracted as it provides finest contrast between object and background, and it also provides more contrast between optic disc and background. Figure 2(c) gives enhanced image as adaptive histogram equalization is applied on it. The mask (see in Figure 2(d)) is generated so that the exact location of optic disc can be located, which remove the background. Detected optic disc is shown in Figure 2(f).

CONCLUSION

This paper proposed algorithm for locating optic disc in retinal images by using an efficient k-means clustering algorithm. It is an effective method to detect of optic disc in retinal images. Retinal images in the DRIVE dataset are used to test the robustness of the K-mean algorithm. Reliant on the results that are obtained from the proposed algorithm it is seen that the optic disc is detected accurately. With the help of proposed algorithm in this paper workload of doctor's can be reduced.

REFERENCES

[1] S. M. Pizer, "Intensity mapping for the display of medical images, in Functional Mapping of Organ System and Other Computer Topics", Society of Nuclear Medicine, 1981.

[2] B.ter Haar Romeny, S.M.Pizer, K. J. Zuiderveld, J. B. Zimmerman, E. P. Amburn, A. Geselowitz, P. F. G. M van Waes and A. de Goffau, "Recent development in Adaptive Histogram Equalization", Exhibit at 71st Scientific Assembly and Annual Meeting of the Radiological Society of North America, November 17-22,1985.

[3] J. Nayak, R. Acharya, P. Bhat, N. Shetty and T.-C.Lim, "Automated diagnosis of glaucoma using digital fundus images", Journal of Medical Systems, 33:337–346, 2009.

[4] Aliaa Abdel-Haleim Abdel-Razik Youssif, Atef Zaki Ghalwash, And Amr Ahmed Sabry Abdel-Rahman Ghoneim, "Optic Disc Detection From Normalized Digital Fundus Images By Means Of A Vessels' Direction Matched Filter", IEEE Transactions On Medical Imaging, Vol. 27, No. 1, January 2008.

[5] Vijaya Kumari, N. Suriyanarayanan, C.Thanka Saranya, "A Feature Extraction for Early Detection of Diabetic", International Conference on Recent Trends in Information Telecommunication and Computing, pp.359 – 361, 2010.

[6] María García, Clara I. Sánchez, María I. López, Daniel Abásolo, and Roberto Hornero, "Neural Network based detection of Hard Exudates in Retinal Images", Computer Methods and Programs in Biomedicine Vol.93, Issue 1, pp. 9-19, January 2009.

[7] R. Vijayamadheswaran, Dr. M. Arthanari, Mr. M. Sivakumar, "Detection of Diabetic Retinopathy using Radial Basis Function" International journal of Innovative technology & creative Engineering, Vol.1, pp. 41-47, January 2011.

[8] R. O. Duda, P. E. Hart, and D. G. Stork, " Pattern Classification", John Wiley & Sons, 2nd edition, 2000.

[9] A. Strehl, J. Ghosh, and R. Mooney, "Impact of similarity measures on web-page clustering", In AAAI 2000 Workshop on AI for Web Search, pages 58–64, July 2000.

[10] Dr. H. B. Kekre Tanuja K. Sarode "New Clustering Algorithm for Vector Quantization using Rotation of Error

Vector", (IJCSIS) International Journal of Computer Science and Information Security, Vol. 7, No. 3, 2010.

[11] http://en.wikipedia.org/wiki/K-means_clustering.

[12] Feroui Amel, Messadi Mohammed and Bessaid Abdelhafid, "Improvement of the Hard Exudates Detection Method Used For Computer- Aided Diagnosis of Diabetic Retinopathy", I.J. Image, Graphics and Signal Processing, 2012, 4, 19-27 Published Online May 2012 in MECS (http://www.mecs-press.org/) DOI: 10.5815/ijigsp.2012.04.03.

[13]http://www.optic-disc.org/tutorials/optic_disc_basics/page12.html.

[14] Research section, digital retinal image for vessel extraction (DRIVE) database University Medical Center Utrecht, Image Sciences Institute, Utrecht, The Netherlands [Online]. Available: http://www.isi.uu.nl/Research/Databases/DRIVE.

[15] http://www.scribd.com/doc/135813800/Chapter-23-Cluster-Analysis

★★★