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Detection of Hard Exudates in Retinal Images

Snehal Rajendra Gawande , Prof. S. S. Patil

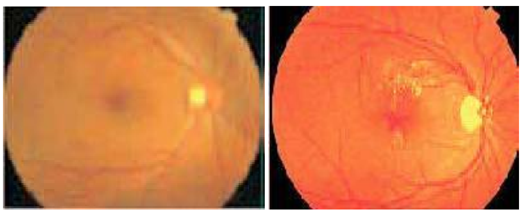
Dept. of Electronics and Telecommunication, SCOE Pune, India

ABSTRACT: Diabetic Retinopathy (DR) is the major cause of blindness in diabetic patients. Regular screening can stop or reverse the progress of this disease. Hard Exudates (HEs) are common and early medical signs of DR. Automatic detection of DR lesions in retinal images can help the diagnosis and treatment of the disease.Automatic detection of hard exudates from retinal images is medically significant. Here, various Image Processing techniques are presented that can be used for automated detection of Hard Exudates. The outcomes are evaluated by using ground truth of the test images and the use of image databases in particular digital algorithm for detection of hard Exudates. Accuracy, Sensitivity and Specificity are few of the parameters which are used for concluding the better method for digital Processing

KEYWORDS: Diabetic retinopathy, Hard Exudates, Image Processing Techniques

I. INTRODUCTION

DIABETIC retinopathy (DR) is the most common cause of blindness and vision impairments in diabetic patients [1]. Hard Exudates (HEs) are known as the specific marker of DR [2]. Automatic detection of hard exudates from retinal images is medically significant. Thus, the clinical examination of hard exudates is essential for the early detection and treatment of DR. Early detection and regular treatment of the disease can stopor reverse the progress ofthe disease and prevent blindness. The traditional detection of hard exudates is accomplished manually, which is a laborious and time-consuming work. As populations of DR expand the workload of ophthalmologist notably and the deficiency of manual checking became significantly serious, it has kept many patients apart from receiving effective treatment in time. Therefore, an automatic detection of hard exuadates is an important task in computer aided diagnosis of DR. For this reason, all diabetic patients should have their both eyes examined at least once every year even if they don't have any visual impairment. For capturing images of the retinaa fundus camera is used.The sample images are shown in the figure 1.



(a) (b)

Figure 1. (a) Sample normal image (b) Hard exudates image

II. LITERATURE SURVEY

C.JayaKumariet.al [1] presented some image processing techniques for automatic detection of the presence of hard exudates in fundus images. First preprocessing is done with the use of contrast adaptive histogram equalization then the exudates are segmented by using contextual clustering algorithm. Some of thkey features such as standard deviation, mean, intensity, edge strength and compactness of the segmented regions are extracted and given as inputs into Echo State Neural Network (ESNN) to differentiate between the normal and pathological image. A total of 50 images are used to find the exudates out of which 35 images which consists of both normal and abnormal are used to train the ESSN and the remaining 15 images are used for testing the neural network. Furthermore, it achieves 93%sensitivity and 100% specificity in terms of exudates based classification.

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Huiqi Li et.al [2] presented novel method for extraction of the main features in color retinal images. To locate the optic disk principal component analysis is employed. An approach which is the combination of region growing and edge detection is proposed here for detection ofexudates.Disk localization, disk boundary detection, and fovea localization achieve the the success rates of99%,94%, and 100%, respectively. The sensitivity and specificity of exudates detection are 100% and 71% respectively. The success ofthe proposed algorithm can be contributed for the utilization of themodel-based methods. The detection and analysis could be appliedto automatic mass screening and diagnosis of the diseases related to retina.

XiangChenet. al [3] presented a novel method for automaticdetection ofHEs in color retinal images. First combination of histogram segmentation and morphological reconstruction is used for extraction of HEs candidateregions. Next, a set of features is definedfor each candidate region which consists of 44 significant features. A supervised support vector machine(SVM) is finally trained based on these features for classification of the candidateregions for HEs. Thismethod is evaluated on the public DIARETDBI database and achievessensitivity of 94.7%and an positive predictive value of 90.0%. Experimental result shows that this method can produce efficient detection of HEs.

Clara I. Sánchez et.al [4] presented an automatic method for detection of hard exudates. The algorithm is based on mixture models fordynamicthresholding of the images for separation ofhardexudates from background. Algorithm performance is prospectively assessed using a database of 20 retinal imageswhich varies in color, brightness, and quality. The algorithmachieves a sensitivity of 90.23% and a predictive value of82.5% using a lesion-based criterion. The image-basedclassification accuracy is also measuredwhich obtains a sensitivity of 100% and a specificity of 90%.

Thomas Walter et. al [5] presented a new algorithm for exudates detection. Exudates are detected using theirhigh grey level variation, and their contours are found bythe use of morphological reconstruction techniques. The detectionof the optic disc is essential for this approach. Morphological filtering techniques and thewatershed transformation are used for Optic disc detection. The algorithm is tested on asmall image data base and compared with the performance of ahuman grader. As a result, mean sensitivity and mean predictive value of 92.8% and 92.4%are obtained. Robustness with respect tochanges of the parameters of the algorithm has been evaluated.

Xiaohui Zhang et. al [6] Here bottom-up and topdownstrategies are applied respectively based on different properties of bright lesions and dark lesions, to cope withthe main difficulties in lesions detection such as inhomogeneous illumination. A three-stage, bottom-up approach is applied in bright lesion detection. Twostep improved Fuzzy C-Means is applied in Luv colorspace to segment candidate bright lesion areasafter local contrast enhancement preprocessing stage. Finally,a hierarchical SVM classification structure is appliedfor classification of bright non-lesion areas, exudates and cottonwool spots. In detection of hemorrhages, a top-downstrategy is adopted. The hemorrhages are located inthe ROI firstly by calculating the evidence value ofevery pixel using SVM. Then their boundaries can beaccurately segmented in the post-processing stage.

Wynne Hsuet. al [7] Automated detection of retinal lesions can decreasethe workload and increase the efficiency of doctors andother eye-care personnel reading the retinal images andfacilitate the followup management of diabetic patients.Existing techniques for detection of retinal lesions are neitheradaptable nor sufficiently sensitive and specific for reallifescreening application. Here, the contribution of domain knowledge in improving the accuracyand robustness for detection of hard exudates in retinalimagesis demonstrated. This method is tested on 543 consecutive retinal images ofdiabetic patients and achieves sensitivityand specificity of 100% in the detection ofhard exudates.

DiptoneelKayalet. al [8]proposed a method which usesvarious image processing techniques with a goal to detect hard exudates. First median filtering is used for excellent noise reduction with considerably less blurring. Median filtered image is then subtracted from input image. For image segmentation thresholding is used.Image addition is then used for creating double exposure of two images into one.Proposed algorithm is evaluated on DIARETDB0, DIARETDB1 image database which contains 219 images in total.This method achieves sensitivity of 97.25% andspecificity of 96.85%.

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Dr. G. G. Rajput et. al[9] presented an efficient method for identification and classification of theexudates as hard and soft exudates. The retinal image inCIELAB color space is pre-processed for elimination of noise.Next, blood vessels network elimination is performed to facilitatedetection and optic disc elimination. Hough transform is used for optic disc is elimination. K-means clusteringtechnique is then used for the candidate exudates detection. Finally, classification of exudates is done as hard andsoft exudates based on their edge energy and threshold. Theproposed method has achieved very good results. OD has been eliminated with an accuracy of 100%.However, the method fails for the images that have only a portion of optic disk. The morphological operations for removing the blood vessel network have yielded 100% results.

NayomiGeethanjaliRanamukaet. al[10] proposed an approachbased on morphological image processing and fuzzy logic for detection of hard exudates from DR retinal images. At the initialstage, the exudates are detected using mathematical morphology that includes elimination of the optic disc. Subsequently,an adaptive fuzzy logic algorithm is implemented for extraction of hard exudates that uses values in the RGB colour space of retinal imageto form fuzzy sets and membership functions. The fuzzy output for all the pixels in every exudate is calculated for a giveninput set corresponding to red, green and blue channels of a pixel in an exudate. This fuzzy output is calculated for hardexudates according to the proportion of the area of the hard exudates. The results are compared with hand-drawn ground truthwhich achieves sensitivity of 75.43% and specificity of 99.99%.

III. CONCLUSION

Several methods are developed for detection of exudates from nonmydriatic, low-contrast, retinal digital images of retinopathypatients using various database available. The main intension isto help the ophthalmologists in the diabetic retinopathyscreening process over the large population suffering fromDiabetic Retinopathy, to detect symptoms faster and moreeasily. The proposed techniques work effectively even on apoor computing system. The results of this work can bedeveloped to produce an automated system for detection of exudates.Microaneurysm and haemorrhage detection could be added tothe system in order to increase its ability to verify the degree ofdiabetic retinopathy. It will be useful to extend this work bydeveloping a system to detect them.Future work will address an issue of improving thesensitivity by improving the results. Further classification to specify the severity of DR can be done. A complete system canbe established that can be used for detection of all the possibleabnormalities and the anatomical organs.

REFERRENCES

1. C.JayaKumari, R.Maruthi, “Detection of Hard Exudates in Color Fundus Images of the HumanRetina”, Elsevier Ltd International Conference on Communication Technology and System Design 2011
2. Huiqi Li, OpasChutatape, “Automated Feature Extraction in Color RetinalImages by a Model Based Approach” IEEE Transactions on biomedical engineering, VOL. 51, NO. 2, February 2004
3. Xiang Chen, Wei Bu;Xiangqian Wu, Baisheng Dai, Yan Teng, “A Novel Method for AutomativHard Exudates Detection in Color Retinal Images” Proceedings of the 2012 International IEEE Conference on Machine Learning and Cybernetics, Xian, 15-17 July, 2012
4. Clara I. Sánchez, Agustín Mayo, MaríaGarcía, María I. López, Roberto Hornero, “Automatic Image Processing Algorithm to Detect Hard Exudatesbased on Mixture Models” IEEEEMBS Annual International ConferenceNew York City, USA, Aug 30-Sept 3, 2006
5. Thomas Walter, Jean-Claude Klein, Pascale Massin, and Ali Erginay, “A Contribution of Image Processing to the Diagnosis of Diabetic Retinopathy—Detection of Exudates inColor Fundus Images of the Human Retina” IEEE transaction on medical imaging, VOL. 21, NO. 10, October 2002
6. Xiaohui Zhang, OpasChutatape, “Top-down and Bottom-up Strategies in Lesion Detection of BackgroundDiabetic Retinopathy” IEEE Computer Society Conference on Computer Vision and Pattern Recognition 2005
7. Wynne Hsu, P M D S Pallawala, Mong Li Lee, Kah-Guan Au Eong, “The Role of Domain Knowledge in the Detection of Retinal Hard Exudates” 0-7695-1272-0101 $10.00 Q 2001 IEEE
8. DiptoneelKayal, Sreeparna Banerjee, “A New Dynamic Thresholding Based Technique forDetection of Hard Exudates in Digital RetinalFundus Image” 2014 IEEE International Conference on Signal Processing and Integrated Networks (SPIN)
9. Dr. G. G. Rajput, Preethi N. Patil, “Detection and classification of exudates usingk-means clustering in color retinal images” 2014 Fifth IEEE International Conference on Signals and Image Processing
10. NayomiGeethanjaliRanamuka, RavindaGayan N. Meegama, “Detection of hard exudates fromdiabetic retinopathyimages using fuzzy logic” IET Image Process., 2013, Vol. 7, Iss. 2, pp. 121–130