A Review Paper on Diabetic Retinopathy

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Abstract— In this paper a review of different techniques used for detecting Diabetic retinopathy has been done. Diabetes is one of the leading diseases worldwide. Diabetic retinopathy occurs when diabetes affects human eye. If not detected in proper time, this can result in complete blindness. There are many method used to detect the symptoms of the disease as early as possible. The most recent developments and methods are discussed in this paper.

Key words: Diabetic Retinopathy, Exudates

I. A CONTRIBUTION OF IMAGE PROCESSING TO THE DIAGNOSIS OF DIABETIC RETINOPATHY—DETECTION OF EXUDATES IN COLOR FUNDUS IMAGES OF THE HUMAN RETINA

In the year 2002 Thomas Walter, Jean-Claude Klein, Pascale Massin and Ali Erginay an algorithm for detection of exudates. The presence of exudates within the macular region is a main indication of diabetic macular edema and allows its detection with a high sensitivity. Hence, detection of exudates is an important diagnostic task, in which computer techniques may play a major role. Exudates are found using their high grey level variation, and their contours are determined by means of morphological reconstruction techniques. The detection of the optic disc is indispensable for this approach. They detected the optic disc by means of morphological filtering techniques and the watershed transformation. The algorithm has been tested on a small image data base and compared with the performance of a human grader. As a result, they obtained a mean sensitivity of 92.8% and a mean predictive value of 92.4%. Robustness with respect to changes of the parameters of the algorithm has been evaluated.

II. AUTOMATIC DETECTION OF RETINA DISEASE: ROBUSTNESS TO IMAGE QUALITY AND LOCALIZATION OF ANATOMY STRUCTURE

In the year 2011 T. P. Karnowski, D. Aykac, L. Giancardo, Y. Li, T. Nichols, K.W. Tobin, E. Chaum proposed the study of robustness of an automated disease detection method with respect to the accuracy of the optic nerve location and the quality of the images obtained as judged by a quality estimation algorithm. The detection algorithm features micro aneurysm and exudates detection followed by feature extraction on the detected population to describe the overall retina image. Labelled images of retinas ground-truthed to disease states are used to train a supervised learning algorithm to identify the disease state of the retina image and exam set. Under the restrictions of high confidence optic nerve detections and good quality imagery, the system achieves a sensitivity and specificity of 94.8% and 78.7% with area-under-curve of 95.3%.

III. AUTOMATIC EXUDATE DETECTION FOR THE DIAGNOSIS OF DIABETIC RETINOPATHY

In the year 2013, Dr. Prasanna Kumar. S.C, Mrs.Deepashree Devaraj, Manisha, Proposed an automated method for the detection of exudates in retinal images with high accuracy. First, they converted the image to HSI model. After pre processing possible regions containing exudates using gray scale morphology are identified. By considering macular region, Diabetic Retinopathy is classified into mild, moderate and severe conditions. In this work, RGB image is converted to HSI image. Then intensity image is median filtered to remove the noise. Adaptive histogram equalization is applied for contrast enhancement. Then the image is thresholded to get binary image which detects the optic disc. After this step, local variation operator is applied; resultant image is thresholded and dilated to detect exudates. After the detection of hard exudates, the macula is located based on its relative position from the optic disc. The macular region is then divided into three marker regions using three circles with radii 1/3 of optic Disc Diameter (DD), 1 DD and 2 DD centered at macula. In any given image if the exudates are absent, then it is classified as normal. The presence of exudates outside the 1DD region is termed as mild. The moderate case is one with presence of exudates within the 1DD region not involving the center of the macula called foveola, i.e., outside the circle of 1/3 DD. In severe case, the exudates are present inside the 1/3 DD region obscuring the center of macula. This work has a Sensitivity and specificity of 95% and 98% respectively.

IV. AUTOMATIC CLASSIFICATION OF THE DIABETES RETINA IMAGE BASED ON IMPROVED BP NEURAL NETWORK

In the year 2014 Mingli YOU, Yafen LI proposed an automated system to analyze the retinal images for important features of diabetic retinopathy using image processing techniques and an image classifier based on BP neural network which classify the images according to the disease conditions. In the course of the study, based on the actual problem and BP neural network characteristics. They exploit an improved BP neural network classification method. BP Neural Network has a sound theoretical system, a clear algorithm flow, strong data identification and analog functions. Diabetic Retinal image used in the experiment is from DIARETDB0(Standard Diabetic Retinopathy Database Calibration level 0).Applying Canny Algorithm and Gradient Magnitude to split the Blood Vessels and Applying Threshold Algorithm to split Optic Disc and exudation In the application of artificial neural network, the BP network and its varied pattern are adopted in most of the neural network models; however, this does not mean that BP network is perfect and there are still inevitable defects in its algorithm, for example, falling into the minimum part of local part in the process of training, the convergence rate

being rather slow, the network tending to have more redundancy and the samples newly added those may affect the samples learned, or others. The researcher has put forward many improved algorithms to solve these defects. Its improved methods can be generally classified as three categories: one is to improve the speed of neural network training; the second is to improve the accuracy of training; and the third is to avoid dropping into the minimum point of local part.

V. DREAM: DIABETIC RETINOPATHY ANALYSIS USING MACHINE LEARNING

In the year 2014 Sohini Roychowdhury and Keshab K. Parhi presented a computer-aided screening system (DREAM) that analyzes fundus images with varying illumination and fields of view, and generates a severity grade for diabetic retinopathy (DR) using machine learning. Classifiers such as the Gaussian Mixture model (GMM), k-nearest neighbor (kNN), support vector machine (SVM), and AdaBoost are analyzed for classifying retinopathy lesions from nonlesions. GMM and kNN classifiers are found to be the best classifiers for bright and red lesion classification, respectively. A main contribution of this paper is the reduction in the number of features used for lesion classification by feature ranking using Adaboost where 30 top features are selected out of 78. A novel two-step hierarchical classification approach is proposed where the nonlesions or false positives are rejected in the first step. In the second step, the bright lesions are classified as hard exudates and cotton wool spots, and the red lesions are classified as hemorrhages and micro-aneurysms. This lesion classification problem deals with unbalanced datasets and SVM or combination classifiers derived from SVM using the Dempster–Shafer theory are found to incur more classification error than the GMM and kNN classifiers due to the data imbalance. The DR severity grading system is tested on 1200 images from the publicly available MESSIDOR dataset. The DREAM system achieves 100% sensitivity, 53.16% specificity, and 0.904 AUC, compared to the best reported 96% sensitivity, 51% specificity, and 0.875 AUC, for classifying images as with or without DR. The feature reduction further reduces the average computation time for DR severity per image from 59.54 to 3.46 s.This segmentation algorithm has shown to have an accuracy of 99.7% for OD segmentation on public datasets. The metrics used for analyzing the performance of the second and third stages of the detection system are defined in terms of true positives (TP), true negatives (TN), false positives (FP), and false negatives (FN).

VI. SEGMENTATION OF THE BLOOD VESSELS AND OPTIC DISK IN RETINAL IMAGES

In the year 2014 Ana Salazar-Gonzalez, Djibril Kaba, Yongmin Li, and Xiaohui Liu proposed a novel method to segment blood vessels and optic disk in the fundus retinal images. The method could be used to support nonintrusive diagnosis in modern ophthalmology since the morphology of the blood vessel and the optic disk is an important indicator for diseases like diabetic retinopathy, glaucoma, and hypertension. Their method takes as first step the extraction of the retina vascular tree using the graph cut technique. The blood vessel information is then used to estimate the location of the optic disk. The optic disk segmentation is performed using two alternative methods. The Markov random field (MRF) image reconstruction method segments the optic disk by removing vessels from the optic disk region, and the compensation factor method segments the optic disk using the prior local intensity knowledge of the vessels. The proposed method is tested on three public datasets, DIARETDB1,DRIVE, and STARE. The results and comparison with alternative methods show that the proposed method achieved exceptional performance in segmenting the blood vessel and optic disk. The morphology of the retinal blood vessel and the optic disk is an important structural indicator for assessing the presence and severity of retinal diseases such as diabetic retinopathy. In this work the optic disk segmentation starts by defining the location of the optic disk. In this process they have used the convergence feature of vessels into the optic disk to estimate its location. The disk area is then segmented using two different automated methods 1.MRF image reconstruction, 2. Compensation factor. Both methods use the convergence feature of the vessels to identify the position of the disk. The MRF method is applied to eliminate the vessel from the optic disk region. This process is known as image reconstruction and it is performed only on the vessel pixels to avoid the modification of other structures of the image. The reconstructed image is free of vessels and it is used to segment the optic disk via graph cut. In contrast to MRF method, the compensation factor approach segments the optic disk using prior local intensity knowledge of the vessels. In this work they have presented a novel approach for blood vessels and optic disk segmentation in retinal images by integrating the mechanism of flux, MRF image reconstruction, and compensation factor into the graph cut method. The process also involves contrast enhancement, adaptive histogram equalization, binary opening, and distance transform for preprocessing.

The proposed method addresses one of the main issues in medical image analysis, "the overlapping tissue segmentation." Since the blood vessels converse into the optic disk area and misguide the graph cut algorithm through a short path, breaking the optic disk boundary, to achieve good segmentation results, the MRF image reconstruction algorithm eliminates vessels in the optic disk area without any modification of the image structures before segmenting the optic disk. On the other hand, the compensation factor incorporates vessels using local intensity characteristics to perform the optic disk segmentation. Thus, this proposed method can be applied in other medical image analysis applications to overcome "the overlapping tissue segmentation."

VII. SEGMENTATION AND DETECTION OF DIABETIC RETINOPATHY EXUDATES

In the year 2014, Abderrahmane ELBALAOUI, Mehdi BOUTAOUNTE, Hassan FAOUZI, Mohamed FAKIR, Abdelkrim proposed an automated method for the detection of exudates in retinal color fundus images with high accuracy, First they converted the retinal image to HSI model. Then after preprocessing possible regions containing exudate, they segmented the image without Optic Disc (OD) using algorithm Graph cuts.Invariant moments Hu in

extraction feature vector were then classified as exudates and non-exudates using a Neural Network Classifier. They used images from database DIARETDB1.This approach was proposed to improve the precision of the diagnosis of the diabetes retinopathy before the stage of complications.In this proposed work they started in a first step with a preprocessing operation to improve image quality by eliminating defects caused by lighting and acquisition processes. In the second step they segmented the optic disc which disrupts the automatic detection of exudates. In the third step, the segmentation of graph cuts are used in order to detect exudates regions. Finally, the neural network gives better results with a feature extraction of images by descriptors and Hu moment of GIST. The final results are compared quantitatively with a manual exudates segmentation produced by an expert in ophthalmology. This work has a Specificity 95%, sensitivity 96,65% value and accuracy 95,15% .

VIII. Conclusion

From the above works one can observe that lot of advancement and improvements happened in the last few years for detecting the presence of Diabetic Retinopathy. The methods got more accurate, more reliable with faster response time. The specificity and sensitivity has increased proportionally with increase in the research work.

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