SEVERITY IDENTIFICATION OF DIABETIC RETINOPATHY IN MEDICAL IMAGES

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ABSTRACT

Diabetic Retinopathy is an abnormality of eye in which the retina of patient is affected due to an increasing amount of insulin in blood. The symptoms can distort or blur the patient's vision and thus lead blindness, if necessary medical treatment is not applied on time. One of the difficulties in the illness is that the patient with diabetes mellitus requires a continuous screening for early detection. So for, numerous methods have been proposed by researchers to automate the detection process of DR in retinal images. For automatic detection of exudates we first have to differentiate intensity levels of exudate and non-exudate pixels. Matched filter is used for same. Tuning of matched filter is an important criterion which is done in this work. We proposed a simple and effective algorithm for identification and classification of hard exudates from color retinal image. Color fundus images are enhanced using brightness transform function. Morphological operator along with the Circular Hough Transform (CHT) is used for localization of optic disc. Further, Modified Matched Filter is applied to differentiate intensity level of exudate and non-exudate pixels in retinal image. Then maximum entropy method is applied to classify the exudate pixels from colour retinal image. The performance of the proposed algorithm has been tested on publicly available standard Messidor and eophtha database images with varied disease levels and non-uniform illumination.

Keywords: Diabetic Retinopathy, k-nearest neighbor, Circular Hough Transform (CHT), Dilation, Erosion, exudates, Optic disc.

I. INTRODUCTION

Diabetic retinopathy, also known as diabetic eye disease, is when damage occurs to the retina due to diabetes. It can eventually lead to blindness. It is an ocular manifestation of diabetes, a systemic disease, which affects up to 80 percent of all patients who have had diabetes for 20 years or more. Despite these intimidating statistics, research indicates that at least 90 percent of these new cases could be reduced if there were proper and vigilant treatment and monitoring of the eyes. The longer a person has diabetes, the higher his or her chances of developing diabetic retinopathy. Diabetic eye disease refers to a group of eye problems that people with diabetes may face as a complication of diabetes. All can cause severe vision loss or even blindness.

II. OBJECTIVE

- Image enhancement by using brightness transforms function for uniform illumination of image.
- Extraction of main parts of retina like optic disk and main blood vessels by using circular Hough transform and bottom hat filtering respectively.
- Tuning of Matched Filter to differentiate intensity levels for exudate pixels and non-exudate pixels.
- The exudate – non-exudate pixel classification by local mean and entropy features base combined seeded region growing method.

III. LITERATURE SURVEY

Many methods have been proposed for detecting, segmenting DR related lesions, screening DR, detecting OD and eliminating vessels in retinal images since the researches were started on automated monitoring systems in ophthalmology. Most of these methods are based on the techniques such as segmentation, edge detection, mathematical and tracking models, 2D matched filters and image thresholding methods.

Automatic model based detecting, pattern recognition, texture analysis, mathematical morphology methods and diagnosis approaches were also proposed for screening DR lesions [1] In bright lesion detection, a three-stage, bottom-up approaches is applied. After local contrast enhancement preprocessing stage, two-step improved fuzzy C-means is applied in Luv color space to segment candidate bright lesion areas. Finally, a hierarchical SVM classification structure is applied to classify bright non0 lesion areas, exudates and cotton wool spots. In haemorrhage detection, a top-down strategy is adopted. S. L. Bangare et al have proposed and mentioned the methods of Image processing and machine learning used for the medical image processing in their work like RPM method [12], Neuroendoscopy Adapter module [13] and Three dimensional Brain tumor reconstruction [14]. The haemorrhages are located in the ROI firstly by calculating the evidence value of every pixel using SVM. Then their boundaries can be accurately segmented in the post-processing stage. In [2], by using geometric structure and correlation, major blood vessels were detected and using intersection of these, OD was extracted. This is further localized using color properties. A multi-scale amplitude-modulation, [3] frequency-modulation method was also proposed for discriminating between normal and pathological retinal images. To sort out the exudates result from interference of OD, many researchers tried different techniques as explained in. entropy filtering and Otsu's binarization algorithm is applied to sort out complex region As mentioned by the S. L. Bangare et al [11]. Then they used compactness measurement and binary dilation to detect OD. Finally Naiive Bayes classifier is applied to select exudates. In [4] the next method optic disc is detected by blob measurement and finally by using AND operation, false positive like OD is removed. Maximum variances property is applied to find OD and by using region growing segmentation, exudates have been finding out. Morphological operations and Otsus algorithm are used to find optic disc and by using Fuzzy C-Means (FCM) clustering with morphological operation, exudates have been detected.

The brightness of the fundus image was changed by the nonlinear curve with brightness values of the hue saturation value (HSV) space. To emphasize exudates, gamma correction was performed on each red and green components of the image. After that, the exudates candidates were detected using histogram analysis. In [5], a supervised support vector machine (SVM) was trained based on 44 significant features of HEs to classify the candidate regions for HEs. In the next study, [6] they proposed a system to analyse the fundus images for the detection of hard exudates using image enhancement, based on Lifting Wavelet transform (LWT) and an image classifier based on Support Vector Machine (SVM). The methods adopted in [7], were the optic disk detection using circular hough transform and bit plane slicing, extraction of exudates using morphological operations were perform. The features discriminate between HEs and the retinal background were used as inputs to a multilayer perceptron (MLP) classifier to obtain a segmentation of HEs in [8]. in next approach exudates were found using there high gray level variation, and their contours were determined by means of morphological reconstruction techniques. For detection of the optic disc, morphological filtering techniques and the watershed transform were used in [9]. Possible region containing exudates were found by using grayscale morphology. And applied an active contour based methods to minimize the Chan-vese energy to extract accurate borders of the candidates. [10]

IV. PROPOSED SYSTEM

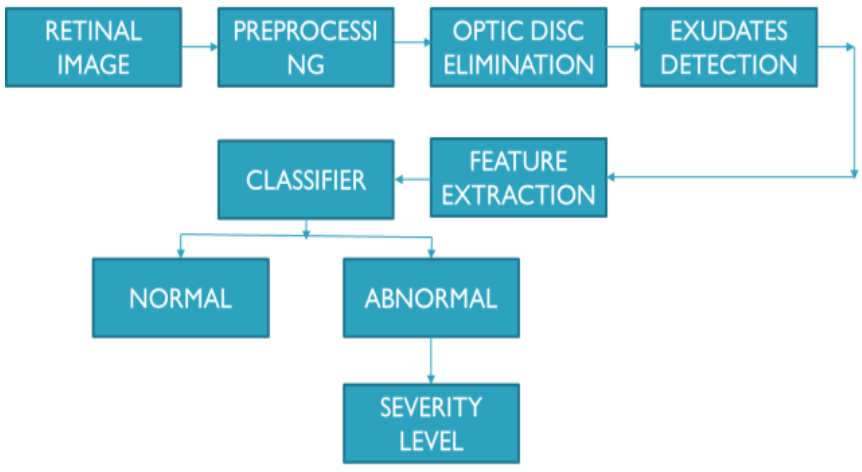

Fig.1 block diagram of proposed system

A uniform illumination over the images is ideal condition for working on the algorithm, but in practice there is a variation in images. These variations takes place due to the curved surface of the retina, variable degree of dilation of pupil, movement of the optics and the presence of other diseases like cataract. The non-uniform illumination due to reflection of light causes the rise in intensity (brightness) levels in any area, especially near the optic disk area and reduction in brightness in the region away from optic disk.

Thus the aim of pre-processing is to adjust the brightness of images to proper value and to normalize the intensity so that the images accurately classified as normal and abnormal. Optic disk is an important feature of fundus images. It is really significant to detect OD because of its similarity index in color, contrast and brightness to the exudates. In most of cases it comes along with the exudates detection results. Thus there is need to mask it out. Circular geometric structure of OD with bright intensity is used for the detection of the same. A closing operation performed on the red channel of an image using structuring element (we used disk structure of 6 pixels). Closing operation performs dilation followed by erosion. Closing operation eliminates vessels originating from OD by brighter region. The canny edge detection technique is applied on resultant image which passes on the circular edges around OD. The Circular Hough Transform (CHT) is a feature extraction technique for detecting circles. It is a specialization of Hough Transform. By applying CHT on the canny edge detected image gives the approximate center and radius of OD which are used to locate OD in fundus image.

Preprocessing overview:

Preprocessing is the first step of the algorithm which consists of enhancement of input retinal image. A uniform illumination over the images is ideal condition for working on the algorithm, but in practice there is a variation in images. These variations take place due to the following regions. (a) The curved surface of the retina. Consequently, all retinal regions cannot be illuminated uniformly; (b) Imaging requires a dilated pupil. The degree of dilation is highly variable across patients; (c) Unexpected movements of the patient's eye. The bright flash-light makes the patient move his/her eye away from the view of the camera involuntarily; (d) Presence of other diseases such as cataract which can block the light reaching the retina. These factors results in images having a large luminosity and contrast variability within and across images. The non-uniform illumination due to reflection of light causes the rise in intensity (brightness) levels in any area, especially near the optic disc area and reduction in brightness in the region.

V. CONCLUSION

An efficient algorithm for the segmentation of hard exudates has been developed. The optic disc is eliminated using morphological operation and a Circular Hough Transform. Matched filter and maximum Entropy is used for segmentation of exudate – non-exudate pixels. Proposed algorithm may give 99.6182 percent pixel level accuracy and 93.75 percent image level accuracy. It is useful in finding out severity level or stages of diabetic retinopathy.

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